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Uncertain Merger Synergies, Passive Partial Ownership, and Merger Control*

Shiva Shekhar† Christian Wey‡

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Abstract

We examine the competitive effects of a passive partial ownership (PPO) when it serves as an instrument for the acquirer firm to learn the merger synergies with the target firm in advance. The realization of a synergy is uncertain ex ante, so that a direct merger exhibits a downside risk not only for the merging candidates but also for consumers. We show that minority shareholdings can reduce this downside risk as they allow for a sequential takeover where the acquirer takes an initial minority share, becomes an insider, and learns the merger synergy. We show how this feature of PPOs affects a firm's takeover strategy and the decision problem of the antitrust authority. We derive implications for a merger control approach to PPO acquisitions, where we examine a forward looking price test and a safeharbor rule.

JEL-Classification: L13, L41

Keywords: Merger Control, Passive Partial Ownership, Synergies.

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1 Introduction

Passive partial ownerships (in short: PPOs), also called non-controlling minority shareholdings,[1] create a financial interest of the acquirer firm in the target firm which makes the acquirer a softer competitor and therefore, leads to (upward) price pressure (O'Brien and Salop, 2000). PPOs are often not covered by merger regulations, which require the merging parties to notify the competition authority in advance in order to get approval.[2] Such a laissez-faire approach towards PPOs has sparked a debate whether merger regulations should be changed to better take account of anticompetitive effects of PPOs (see OECD, 2008; EC 2013). The common view on (horizontal) PPOs is that they tend to reduce competitive intensity without creating efficiencies. Put simply, the main practical question is then to determine how large the anticompetitive effects are and whether they justify the administrative costs associated with an ex ante control system as under standard merger control regulations.[3] Interestingly, an efficiency defense and a trade-off analysis in the spirit of Williamson (1968) is not considered as a relevant option in the reports on minority shareholdings recently published by competition authorities.[4] For instance, the EU Commission staff working paper (EC, 2013) states: *"Structural links mainly create a financial interest in the performance of other firms in the market, typically without much scope for rationalization or avoiding cost duplication. Therefore, synergies seem to be limited for horizontal structural links."* Similar reasoning is expressed in OFT (2010, p. 57): *"Overall, the absence of obvious sources of efficiencies suggests that minority cross-shareholdings may be more likely than full mergers to be motivated by anti-competitive objectives."*

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[1] Inter-firm ownerships are also called structural links (EC, 2013).

[2] In the EU, PPOs do not fall under the Merger Regulation, a state of affairs currently under scrutiny (see EC, 2013, 2014). The European Commission in its recent white paper on merger control (EC 2014) clearly expresses the view that PPOs should also become part of merger control.

[3] To close the enforcement gap, EC (2013) outlines different regulatory approaches towards PPOs ranging from a self-assessment approach to a notification system in line with standard merger control practice complemented by a safeharbor rule.

[4] Gilo (2000, p. 43) points out that a passive ownership may lead to efficiencies in the allocation of production among firms, whenever a less efficient firms obtains an ownership in a more efficient firm. For decreasing economies of scale, Farrell and Shapiro (1990a,b) showed that a more concentrated ownership structure must create a synergy (i.e., a more efficient technology) in order to keep the price from rising.

In this paper, we qualify this rather gloomy view on PPOs between firms competing horizontally in the same relevant market. Our main assumption is that the acquirer of the minority share is enabled to get information about the realizable synergies *before* merging their businesses. The fact that PPOs allow for better information sharing was also formulated in several policy reports but only with a focus on its anticompetitive effects. Basically, the argument is that information sharing is used to reduce competition, for instance, because it enables a better coordination of collusive conduct.[5] The possibility that the minority shareholder may get new information about the target firm which he or she can match with the information about its own business to get a better understanding of the potential synergies realizable in case of a merger, has not been examined so far. This apparent deficiency is even more surprising if one takes account of the related finance literature on PPOs (often referred to as toeholds). For instance, Povel and Sertsios (2014) argue that toeholds are an instrument to improve information about possible synergies with the target firm.[6] Thereby, it is assumed that a sequential acquisition strategy (which starts with a minority shareholding) can dominate a single-transaction acquisition strategy (direct merger), whenever there is uncertainty about the merger synergy. Referring to Folta and Miller (2002), Xu, Zhou, and Phan (2010, p. 167) emphasize the role of synergy learning through a toehold acquisition strategy: "The acquirer takes an initial equity stake, becomes an insider, gathers information on the partner and on the technology, and enjoys an information advantage over outsiders when subsequently buying out the majority partner." Using data on

[5]The Commission states in EC (2013, Annex I, p.11, para. 47): "The acquisition of a structural link may enhance transparency as it typically offers the acquiring firm a privileged view on the commercial activities of the target. According to OECD (2008), even 'passive minority shareholders may have access to information that an independent competitor would not have, such as plans to expand, to merge with or to acquire other firms, plans to enter into major new investments; plans to expand production or to enter or expand into new markets'." Interestingly, the focus is almost exclusively on strategic decisions which the acquirer becomes informed about, while the simple fact that the acquirer also becomes better informed about the targets technology and organization is not considered any further.

[6]Povel and Sertsios (2014) propose a model of competitive bidding and show that a toehold (which allows to learn the merger synergy in advance) increases the chance of winning the takeover auction. Using data on companies' financials they show that "acquirers are more likely to have owned a toehold if the target is opaque (hard to analyze)“ (Povel and Sertsios, 2014, p. 217), which they take as indirect support for their assumption of "synergy learning" through toeholds.

Chinese firms, they show that acquirers indeed use a sequential acquisition to overcome the ex ante uncertainty about the profitability of a full takeover. They describe this strategy as a real options approach to addressing uncertainty. The toehold reduces costly-to-reverse investments in tandem with the unfolding availability of new information that resolves uncertainty. An incremental approach may thus be advisable for the acquirer to gather information about the target firm before making further commitments. Similarly, Barclay and Holderness (1991) argue that a minority share makes the acquirer an "insider" in the target firm's business which allows the acquirer to gain new information about the target firm through monitoring and learning activities performed on a routine basis.[7]

We analyze the possibility of synergy learning through a PPO acquisition in a standard Cournot oligopoly setting in which the merger synergy is uncertain ex ante.[8] The acquirer firm can choose between a direct merger and a sequential takeover strategy. In the latter case, the acquirer firm first obtains a PPO in the target firm, then learns the synergy level and may propose a full takeover afterwards.[9] The sequential acquisition strategy allows to reduce the downside risk associated with a direct merger because in case no synergy is realized the ex post equilibrium profit of the merged entity is strictly smaller than the sum of the ex post profits of the PPO acquiring firm and the target firm.[10] If, however, the PPO acquiring firm learns about sufficiently large synergies, so that the merger is profitable, then the merger is also always approvable by an antitrust authority using a price test.[11] It then follows, that the sequential

[7]See also Barney (1988) for the view that the acquirer of a PPO will be better able to assess merger synergies between the two companies

[8]We assume a simple two point distribution where either no synergy is realized or a strictly positive synergy level is realized. Thus, the probability distribution of the synergy level and the strictly positive synergy level are the two primitives of our model which describe the fact that synergies are uncertain.

[9]To simplify our analysis, we assume that the synergy becomes public information when the PPO acquiring firm learns the merger synergy with the target firm. This allows us to abstract from issues of signalling, screening, and costly evidence gathering (see, Cosnita-Langlais and Tropeano, 2012, Banal-Estañol et al., 2010, and Lagerlöf and Heidhues, 2005, respectively), which is an issue because the incentives to propose a full merger are excessive from a consumer welfare perspective.

[10]We assume that a PPO acquisition and a merger is not reversed (at least in the short run) when they turn out to be unprofitable.

[11]The price test is equivalent to a consumer surplus standard when the AA knows the synergy level for sure.

acquisition strategy is always more attractive than the direct merger from the involved firms' perspective. If the maximal possible merger synergy is sufficiently large, then the lowest possible PPO level is chosen which just guarantees the flow of information about the synergy, because a higher PPO level reduces the joint profit of the involved firms when there is no synergy. If the synergy level is relatively small, then a sequential takeover strategy can be used to outplay the AA. In that case, a PPO share above the minimal level, which just ensures synergy learning, is acquired to lower the minimal admissible synergy level to pass the decision screen of the AA using a price test ("sneaky takeover").[12] Thus, there is a fundamental tradeoff when considering benchmark regulations which either allow or block any PPO proposal.

We examine four different regulatory approaches towards PPOs: "only direct merger" ($R1$), "no PPO control" ($R2$), "forward looking price test" ($R3$), and "safeharbor rule" ($R4$). Comparing the first two regimes, we make the above mentioned tradeoff explicit. A PPO is always blocked if the AA uses a price test to evaluate a PPO, because in the short run a PPO can only increase the market price. It follows that a merger can only occur directly ($R1$). The price test (which takes account of the synergy uncertainty) used to evaluate a direct merger is more restrictive than the price test criterion used to evaluate a merger when the merger leads to synergies for sure. It then follows that the "no PPO control" regime ($R2$) leads to more mergers than under $R1$, where some of those additional mergers can be price-decreasing and others price-increasing (in expected terms), where the latter is a result of the sneaky takeover incentive. We consider two more regulatory approaches towards PPOs: a "forward looking price test" ($R3$) and a "safeharbor rule" ($R4$). In the former regime, the AA evaluates a PPO proposal by taking account of the subgame perfect equilibrium following the PPO acquisition.[13] We show that such a test eliminates all sequential takeovers which aim at outplaying the AA

Both standards diverge however, when the AA faces uncertainty about the synergy.

[12]The "sneaky takeover" incentive can be derived from Farrell and Shapiro (1990b) and was made explicit in Jovanovic and Wey (2014).

[13]We say that the AA uses a "price test" whenever the AA disregards the subgame perfect outcome following a PPO proposal; i.e., it always expects the market equilibrium given the proposed PPO and does not consider a subsequent merger and the possible realization of a merger synergy. In contrast, if the AA takes account of the subgame perfect equilibrium outcome following a PPO proposal, then we refer to it as a "forward looking price test."

(i.e., all sneaky takeovers). The latter regime specifies a certain threshold value of the PPO shareholding in percentage terms below which a PPO is not restricted by the AA, while all larger shares have to be notified to the AA which then decides about them based on a standard price test (i.e., applies standard merger regulations). If the safeharbor rule is above but close to the minimal PPO level necessary to ensure synergy learning, then this rule also effectively eliminates all PPO proposals which would lead to higher prices in case of a subsequent merger (i.e., all sneaky takeovers). This follows from the insight that a PPO level above the minimal one is only chosen in the sneaky takeover instances. Finally, we evaluate our results from a consumer surplus and social welfare perspective. It is worth mentioning, that a price test applied to a direct merger is not the same as a consumers surplus test, whenever there is uncertainty about the synergy level. In those instances, the price test is more restrictive than the consumer surplus test. From this observation, we get that a regime which blocks PPO proposals ($R1$), tends to hurt consumer surplus because it blocks desirable sequential takeovers (which would be executed in $R2$). Evaluating the forward looking price test and the safeharbor rule from a consumer surplus perspective (which is also forward looking in case of a PPO acquisition), we get that the former test leads to type I errors (consumer surplus increasing PPO acquisitions are blocked) and the latter one to type II errors (consumer surplus decreasing PPO acquisitions go through uncontested). From a social welfare perspective, the stance on PPOs should be even more lenient, because any merger increases producer surplus in our model so that even the worst sneaky takeover can be socially desirable.

Our paper contributes to the IO literature dealing with PPOs and mergers in oligopolistic industries. The anticompetitive effects of PPOs and mergers are well documented within Cournot oligopoly frameworks (see Reynolds and Snapp, 1986; Bresnahan and Salop, 1986; Salant, Switzer, Reynolds, 1983).[14] Reitman (1994) shows that the joint profit of the PPO-acquiring firm and the target firm decline in the level of the PPO under Cournot competition.[15] Salant, Switzer, and Reynolds (1983) derived the 80%-market share rule for profitable mergers, basically saying that a bilateral merger is not profitable in a Cournot oligopoly when there is

[14] Another strand deals with controlling partial ownerships, where the anticompetitive effects are often larger than under non-controlling shareholdings (e.g., Foros, Kind, and Shaffer, 2011). Finally, Malueg (1992) and Gilo, Moshe, and Spiegel (2006) are works which deal with the effects of PPOs on the collusiveness of an industry.

[15] A PPO can become profitable when competition is more intense than under Cournot (Reitman, 1994).

at least one outsider.[16] Farrell and Shapiro (1990a/b) have shown (in more general settings) that sufficiently large merger synergies are a necessary prerequisite for a merger to be not price-increasing. Based on merger results presented in Farrell and Shapiro (1990b), Jovanovic and Wey (2014) show that acquiring a PPO is a way to reduce the minimal necessary synergy level which ensures that the merger is not price increasing. Gosh and Morita (2015) is the first paper which considers the relation between a PPO and synergies between horizontally related firms.[17] They focus on an alliance of two firms where one firm acquires an equity stake in its alliance partner. The acquiring firm has an incentive to share its superior (tacit knowledge) with the partner firm only when it holds a minority share in the other firm. Thus, a PPO leads to the sharing of superior knowledge which can be interpreted as an "alliance synergy "that is realized without the need to merge. Because of Cournot competition, the PPO is not maximal but rather small to just ensure information sharing. The basic message has a similar flavor to ours as it also highlights a pro-competitive argument for allowing PPOs. In contrast to their assumption of alliance synergies, we consider uncertain merger synergies, where a PPO allows for synergy learning while the synergy is only realized after a merger. By considering sequential acquisitions, we also deal with the dynamics of merger control decisions. Here, we show that a myopic decision rule, which has shown to be dynamically optimal under some conditions (Nocke and Whinston, 2010), runs the risk of being outplayed through a sequential acquisition strategy in our setting.

We proceed in Section 2 with the presentation of the set-up of the model, where we also describe the four regimes mentioned above. In Section 3, we present the equilibrium analysis of our game under the benchmark regime R1 and R2. In section 4, we analyze the two regulatory approaches towards PPOs (R3 and R4). In Section 5, we analyze the implications for consumer and social welfare. Finally, Section 6, concludes.

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[16]The 80%-rule is obtained when costs and demand are linear and all firms are symmetric.

[17]In case of shareholdings between vertically related firms, Gilo (2000) argues that efficiencies can be generated if they help to overcome frictions associated with incomplete contracts.

2 The Model

We consider three firms denoted by $i \in \{1, 2, 3\}$ supplying a homogeneous good and competing in quantities. The inverse demand is given by $P(Q) = 1 - Q$ with $Q := \sum_i q_i$, where q_i is firm i's output level. Initially, all firms have the same marginal costs which are constant and given by $c \in (0, 1)$. Firm i's profit is, therefore, given by

$$\pi_i = (P(Q) - c)q_i, \text{ for } i = 1, 2, 3, \tag{1}$$

which describes the case before a change of the ownership structure within the industry. We consider a possible two-firm merger, where firm 1 is the acquirer and firm 2 is the target firm. A merger may or may not lead to synergies s, which reduce marginal costs of the merged entity to $c - s$ with $s \in (0, c]$. Let $s = 0$ be the no synergy case, while $s > 0$ stands for cases where a synergy is realized. To rule out corner solutions, where the rival firm 3 is driven out of the market, we assume $s < 1 - c$.[18] Taken together, we assume $0 < s < \overline{s} := \min\{c, 1 - c\}$.

The acquirer has an a priori expectation about the probability that a merger synergy will be realized. Let β be the probability with which the synergy level $s > 0$ is realized and $1 - \beta$ be the counter probability that no synergy follows from a merger ($s = 0$). This distribution is common knowledge meaning that all firms and the AA have the same expectation about the possible merger synergies associated with a merger of firms 1 and 2. To rule out obvious cases, we suppose $0 < \beta < 1$, so that there is strict uncertainty with regard to the realizable merger synergy.

We denote by α the PPO firm 1 has in firm 2. The shareholding α gives firm 1 a claim of a share of α of firm 2's profit. The PPO is non-controlling so that firm 2 keeps the right to decide independently about its production output. Accordingly, we suppose that the shareholding is smaller than 1/2, because a larger shareholding is necessarily interpreted as a controlling one and would then fall under merger control.[19] We assume that the acquirer of the PPO becomes

[18] Below we show that the equilibrium quantity of firm 3 in case of a merger between firms 1 and 2 realizing a synergy s is strictly positive if $s < 1 - c$.

[19] OFT (2010, Table 1, p. 19) provides an overview of the rights of a shareholder with a percentage of voting shares below 50% of the voting shares (for instance, with regard to the right to request items be placed on the agenda of meetings). Shareholdings above 50% of the voting shares give the right to pass resolutions, so that a stake of more than 50% is generally interpreted as a controlling one.

an "insider" in the target firm which enables him or her to get information about the target firm to learn the merger synergy level.[20] This property implies that the shareholding must be larger than a certain minimal value $\underline{\alpha} \in (0, 1/2)$.[21] Thus, any shareholding $\alpha \in [\underline{\alpha}, 1/2)$ is a PPO which allows the acquiring firm 1 to perfectly learn whether or not there will be a merger synergy of $s > 0$ before the execution of the merger.

In sum, the exogenous parameters of our model are given by the vector $(c, s, \beta, \underline{\alpha})$, where the feasible set of parameter constellations, Φ, is given by

$$\Phi := \{(c, s, \beta, \underline{\alpha}) \in \{(0,1)^4 | s < \bar{s} := \min\{c, 1-c\}, \underline{\alpha} < 1/2\}.$$

We consider two takeover strategies among which firm 1 can choose. First, the direct merger strategy (D) and second, the sequential takeover via a PPO acquisition (S). In the former case, firms 1 and 2 decide whether or not to merge directly in the first stage. In the latter case, firm 1 buys first a PPO share α of firm 2's assets, which allows firm 1 to perfectly learn the merger synergy. In a next step, firm 1 can decide whether or not to merge with firm 2.

We invoke three assumptions concerning PPO acquisitions and mergers. First, firm 1 only makes a proposal to acquire a certain PPO in firm 2 or to merge with firm 2 if this increases the joint profits of the firms.[22] Second, if a direct merger turns out to be not profitable because

[20] Povel and Sertsios (2014) assume that toeholds improve the assessment of possible synergies. They argue that it can give the owner the opportunity to interact with the target or its management in ways that are not available to outsider firms: "For example, a toeholder may have the right to nominate a director on the target's board, helping her get a better sense of the target's operations and management. A toeholder may also cooperate with the target on the development of a product, or they may combine parts of their distribution networks. After cooperating for a while, the parties should find it easier to tell whether a full combination promises significant synergies, or whether the prospects are bad and a combination should not be attempted" (Povel and Sertsios 2014, p. 201).

[21] We simply assume a certain minimal PPO share above which the generation of the relevant information about the merger synergy is assured. It is reasonable, that the minimal value is above 5% (see OFT, 2010, p.19, for the rights conferred starting at the 5% threshold). However, this value can also be relatively large and the chance of information gathering may be increased with a larger share. For instance, Povel and Sertsios (2014) report that the average toehold in their sample is 27%, which is well above the 5% threshold which triggers SEC or FTC filings. With a larger share the acquirer may be better able to negotiate the right to nominate one or more directors who have direct access to the target's executives, which should increase the ability to learn the realizable merger synergy (see Povel and Sertsios, 2014, p. 217).

[22] In other words, a PPO-acquisition or a merger is treated as a cooperative joint decision of firms 1 and 2. This

of low synergies it cannot be dissolved. Third, a PPO acquisition is also not reversed even if it reduces the joint profit level of the involved firms relative to their pre-merger profits. The second assumption follows from the fact that a merged firm is often not easily disintegrated.[23] The third assumption implies a real cost of the PPO option, because in our Cournot analysis the joint profit of firms 1 and 2 is smaller with a PPO than without such a shareholding.[24]

We suppose an antitrust authority (AA) which decides about mergers and asset acquisitions. The AA uses a price test to reach a decision about an acquisition proposal.[25] It either approves a proposal (A) or rejects (R) it.[26] Thus, a merger is only allowed if the price level does not increase after the merger.[27] With regard to PPO control, we consider four regimes.

- *Regime R1 (only direct mergers):* The AA performs a short-run analysis, such that a PPO proposal is not allowed if it leads to a price increase. In our model, the AA never approves a PPO acquisition because it is, per se, always price increasing.[28] The AA is short-sighted because it does not take into account the possibility of synergy learning through PPO

is, of course, a simplifying assumption which allows us to abstract from the exact takeover process and the price the owner or owners of firm 2 will get for their assets.

[23]This coincides with empirical findings that many mergers are often not profitable (see Gugler et al. 2003).

[24]If the minority share is disposed when the acquirer learns that there are no merger synergies, then our results stay valid if the minority share must be held for a sufficiently long time to enable learning of the merger synergy. Our results also remain valid under price competition (where a PPO always increases the joint operating profit of the involved firms) if we assume additional sunk costs associated with a PPO acquisition.

[25]The price test mirrors perfectly a consumer surplus standard in a world without uncertainty. If there is uncertainty about the synergy level, then the price test is generally more restrictive than the decision rule implied by a consumer standard. We discuss this issue below.

[26]We do not consider the clearance of a merger conditional on remedies, as for instance, asset sales, which tend to increase the set of approvable mergers (Dertwinkel-Kalt and Wey, 2016).

[27]Our analysis focuses on unilateral effects (as opposed to coordinated effects) which arise as a result of a merger, "when competition between the products of the merging firms is eliminated, allowing the merged entity to unilaterally exercise market power, for instance, by profitably raising the price of one or both merging parties' products, thus harming consumers" (ICN, 2006, p. 11). When products are differentiated the Upward Pricing Pressure (UPP) test of Farrell and Shapiro (2010) has recently gained prominance which, incidentally, is closely related to the Price Pressure Index of O'Brien and Salop (2000).

[28]This mirrors also the main point of the literature on the anticompetitive effects of PPOs; i.e., a PPO reduces competition without creating efficiencies (see, for instance, the literature reviews in EC, 2003, and OFT, 2010).

acquisition which may lead to desirable merger proposals in the future. Thus, under $R1$, firm 1 can effectively only decide between proposing a direct merger (D) or staying independent (N).

- *Regime R2 (no PPO control)*: There is no PPO control, so that any PPO acquisition is allowed. In addition to $R1$, firm 1 can also choose a sequential takeover strategy (S) under $R2$ by acquiring a PPO in firm 2.

- *Regime R3 (forward looking price test):* The AA takes a forward-looking stance and considers the possibility of synergy learning through a PPO acquisition which may result in desirable mergers in the future. A merger is desirable from the AA's point of view if it reduces the expected price in the future below the level observed before the PPO acquisition. Thus, under $R3$, firm 2 can propose a PPO acquisition to the AA which is then evaluated by the AA according to a forward looking price test.

- *Regime R4 (safeharbor rule):* Merger regulations specify a maximal level of the minority shareholding below which a PPO can be realized without any interference by the AA. Above that threshold value, the PPO is evaluated by the AA according to a (short run) price test as under $R1$.

We analyze these regimes in a dynamic game depicted in Figure 1.

The timing of the game is as follows. In the initial stage 0, nature determines the synergy level s of a merger between firms 1 and 2 which is either $s > 0$ (with probability β) or $s = 0$ (with probability $1 - \beta$). In the first stage, firm 1 decides about its takeover strategy (direct merger, D, or sequential takeover, S), while having the option to stay independent (N). When firm 1 makes this decision, it is uncertain about the precise level of the merger synergy (information sets are indicated by bold dashed lines in Figure 1). If firm 1 stays independent, then firms compete independently (case I) and the game ends.[29] If a direct merger (D) is proposed, then in the second stage the AA decides about it by either approving (A) the merger or rejecting (R) it.[30] If the merger is approved, then firms 1 and 2 merge and compete with the remaining firm

[29] In Figure 1, terminal nodes are indicated by boxes labeled by I, M, or P, which stand for the Cournot games played when all firms remain independent, firms 1 and 2 merge, or firm 1 acquires a PPO in firm 2, respectively.

[30] Note that we can suppress the acceptance decision of firm 2, because we assumed that firm 1's decision to

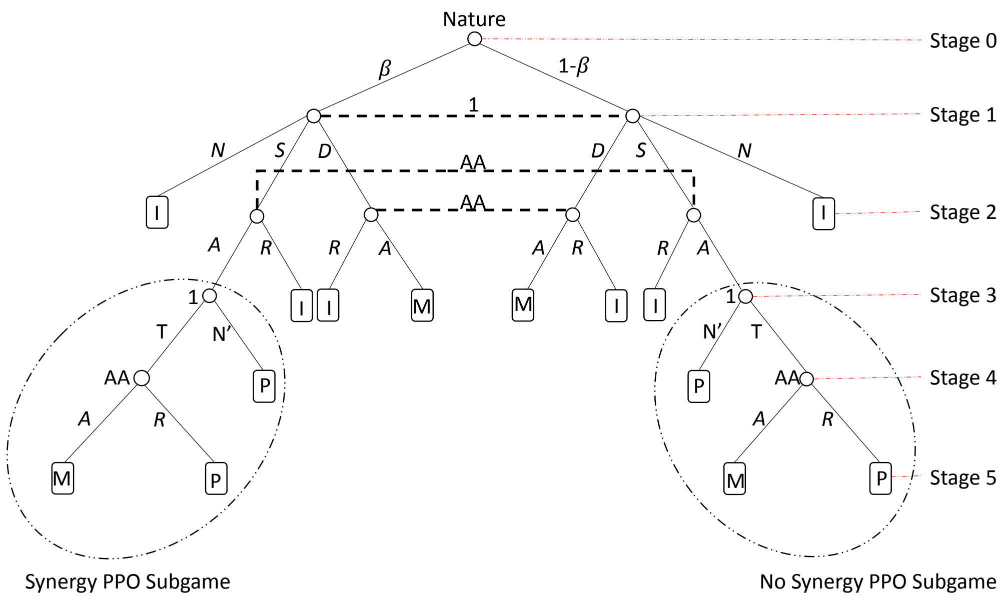

Figure 1: The game tree

3 in Cournot fashion (Case M) after which the game ends. If the merger is rejected, then all three firms compete independently (case I) and the game ends. If firm 1 chooses S, it acquires a PPO of α in firm 2. In this case, the game proceeds differently under $R1$-$R4$. Under $R2$ and $R4$ (given the safeharbor rule applies), the PPO is implemented without any merger control and the synergy level of the merger becomes public information. Under regimes $R1$, $R3$, and $R4$ (if the safeharbor rule is surpassed), the AA decides in stage 2 about the PPO acquisition either on a short-run or a forward looking basis. If the PPO is not approved, then all three firms remain independent and they compete in quantities (case I) and the game ends. If the PPO can be implemented, then the true value of the merger synergy s becomes public information. In the third stage, firm 1 (now holding a PPO in firm 2) proposes a complete takeover (T) or not (N'). If it does not propose a takeover, then the three firms compete in Cournot-fashion (case P) and the game ends. If a merger is proposed, then the AA decides about it in the fourth stage. If the merger is approved, then the merged firm and the remaining competitor set their quantities (case M) and the game ends. If the merger is blocked, then the three firms compete

acquire a PPO in firm 2 or to merger with firm 2 is a cooperative decision of both firms. Accordingly, such a decision is only made if it is joint profit maximizing.

in quantities (case P) and the game ends.

Figures 1 presents the game trees under regimes $R1$, $R3$ and $R4$, respectively. We get the game tree for regime $R2$ and $R4$ (given the safeharbor rule applies) by neglecting the decision node of the AA in stage 2, which is reached when firm 1 chooses a sequential takeover strategy (S). That is, under $R2$ and $R4$ (given the safeharbor rule applies), the decision node of firm 1 in stage 3 is directly reached when firm 1 chooses S in stage 1. Under all regimes, the game tree always ends with a Cournot competition stage with I indicating the independent firms case, M denoting the merger case and P standing for the partial ownership case. Notice, that the AA is uncertain about the possible synergy level in stage 2 while it has complete information about the synergy level when it decides later in stage 4 about a merger. A PPO acquisition, therefore, informs not only the firms but also the AA about the merger synergy level. Thus, all uncertainty is removed after the PPO acquisition, which allows us to abstract from the difficult question how information about the merger synergy is credibly transmitted to the AA. Consequently, all stages following an approved PPO acquisition constitute a subgame which are encircled by the dash-dotted lines in Figure 1. The subgame reached when there are synergies ($s > 0$) is labeled as the "synergy PPO subgame" and the other one (reached when there are no synergies) as the "no synergy PPO subgame." We solve for the subgame perfect Bayesian Nash equilibrium by working backwards.

3 Equilibrium Analysis

3.1 Equilibrium Outcomes of the Terminal Cournot Games

The games played under $R1$-$R4$ always end with a proper subgame of Cournot competition for ownership structures I, P, or M.[31] We refer to these three Cournot competition games as cases I, P, and M, respectively. The derivation of the equilibrium outcomes of those subgames is relegated to the Appendix. Table 1 summarizes the values we need for the following analysis.

[31] Case I can be reached when firm 1 neither proposes a direct merger or a PPO in stage 1 or the merger proposal is rejected by the AA in stage 2. In those instances the synergy level remains uncertain but this does not affect the analysis of the then resulting terminal Cournot game I.

Cases \ Eq. Values	Price	Joint Profit Firms 1+2	Profit Firm 3
Case I	$p^I = \frac{1+3c}{4}$	$2\pi^I = 2\left(\frac{1-c}{4}\right)^2$	$\pi^I = \left(\frac{1-c}{4}\right)^2$
Case P	$p^P = \frac{1+(3-\alpha)c}{4-\alpha}$	$\pi_1^P + \pi_2^P = \left(\frac{1-c}{4-\alpha}\right)^2 (2-\alpha)$	$\pi_3^P = \left(\frac{1-c}{4-\alpha}\right)^2$
Case M	$p^M = \frac{1+2c-s}{3}$	$\pi_1^M = \frac{(1-c+2s)^2}{9}$	$\pi_3^M = \frac{(1-c-s)^2}{9}$

Table 1. *Equilibrium values of cases I, P, and M*

In case of a merger, firm 1 takes over firm 2, so that the joint profit is given by π_1^M. In case P, firm 1 acquires a minority share in firm 2 and the joint profit is then given by $\pi_1^P + \pi_2^P$. When all firms are independent, then the joint pre-merger profit of firms 1 and 2 is given by two times the independent firm profit π^I, which is the same for all firms. It is noteworthy, that the price in case P is always larger than the pre-merger price; i.e., $p^P > p^I$ for any $\alpha > 0$. Similarly, the joint profit of firms 1 and 2 in case P is always smaller than the sum of both firms' pre-merger profits in case I. Moreover, the joint profit $\pi_1^P + \pi_2^P$ in case P is decreasing in α; i.e., a larger minority reduces the joint profit. This result mirrors the classical merger paradox result of Salant, Switzer, and Reynolds (1983). In fact, if we allow for a minority share close to unity, then $\lim_{\alpha\to 1}(\pi_1^P + \pi_2^P) = \pi_1^M(s = 0)$ holds, so that the full merger profit is realized when the synergy is absent. Of course, such a merger is never profitable because Salant, Switzer, and Reynolds' 80%-rule is not fulfilled on our model. Put another way, a merger can only be profitable if a synergy is realized. The larger the synergy level, the higher the joint profit of the merging firm, π_1^M. Of course, a PPO, per se, can never be profitable, but only if it opens the window for a merger with sufficiently high synergies.

3.2 PPO Subgames

As indicated in Figure 1 (see the encircled parts with dashed-dotted lines in Figure 1), we obtain two proper PPO subgames depending on whether or not a synergy exists. In the following we solve for the subgame perfect Nash equilibrium outcomes of these two subgames.

No Synergy PPO Subgame. If firm 1 acquires a partial ownership in firm 2 and learns that there are no merger synergies ($s = 0$), then the market equilibrium is given by case M if the merger is allowed and the market equilibrium is given by case P if the merger is not approved. Setting $s = 0$ in case M and comparing the price levels in both cases (see Table 1), it is easily checked that the price in the full merger case is always larger than in the partial ownership case. Thus a merger proposal is always blocked in this subgame and the outcome is case P.

Lemma 1. *Consider the no-synergy PPO subgame. The AA always rejects a merger proposal in this subgame and the equilibrium outcome is always case P.*

We turn next to the analysis of the PPO subgame when a synergy $s > 0$ is realized.

Synergy PPO Subgame. In this subgame, firm 1 has learnt that a synergy s, with $0 < s < \overline{s}$, will be realized with a direct merger.[32] We assume that this information becomes public information, so that the AA knows that the market outcome in case of a merger is given by case M. If no merger occurs, then the market outcome is given by case P. Comparing the price levels in both cases we get that the merger is approvable, with $p^M \leq p^P$, if

$$s \geq s_1 := \frac{(1-c)(1-\alpha)}{4-\alpha}. \tag{2}$$

We assumed that $\alpha \in [\underline{\alpha}, 1/2)$ with $0 < \underline{\alpha} < 1/2$. Note that $\partial s_1/\partial\alpha < 0$, so that a higher PPO level reduces the minimal synergy level that induces approval by the AA. Note also that $s_1(\alpha = 0) = (1-c)/4$ and $s_1(\alpha = 1/2) = (1-c)/7$. Thus, for all $s \leq (1-c)/7$ no feasible PPO exists to fulfill (2) and any merger proposal is rejected. Conversely, if $s \geq (1-c)/4$, then a merger proposal is accepted even with the lowest possible PPO level $\underline{\alpha}$. The feasible intermediate range is given by $(1-c)/7 < s < \min\{c, (1-c)/4\}$, where we considered the additional constraint $s < \overline{s}$. In that range, all PPO levels which fulfill (2) are approvable. We obtain the minimal approvable PPO level, α_1, from rearranging (2) which yields the condition

$$\alpha \geq \alpha_1 := \frac{1-c-4s}{1-c-s}. \tag{3}$$

Thus, for all $\alpha \in [\alpha^*, 1/2)$, with $\alpha^* := \max\{\underline{\alpha}, \alpha_1\}$ the AA allows the merger, while for lower PPO levels, with $\alpha < \alpha_1$, the approvability condition of the AA is violated inducing the AA to reject the proposal. We summarize the AA's merger decision in the following lemma.

Lemma 2. *Consider the synergy PPO subgame. The AA's merger decision depends on the parameter values as follows. If $c \leq 1/8$, then there exists no synergy level s such that a PPO*

---

[32] We assume that $\alpha \geq \underline{\alpha}$ holds always if the PPO subgame is reached. Otherwise, there would be no learning of the merger synergy level which would make this stage irrelevant. The decision problem of the merging firms and the AA would then be same as in stage 1 and stage 2, respectively, of the game under $R1$.

could induce an approval and the equilibrium outcome is case P. If $1/8 < c < 1$, then the following cases have to be distinguished.

i) If $s \leq (1-c)/7$, then there exists no PPO to induce approvability and the outcome is case P.

ii) If $(1-c)/7 < s < \min\{c, (1-c)/4\}$, then for sufficiently large PPO levels $\alpha \in [\max\{\underline{\alpha}, \alpha_1\}, 1/2)$, the AA approves the merger and the outcome is case M. If the PPO level falls short of the critical value α_1, then the merger is rejected and the outcome is case P.

iii) If $s \geq (1-c)/4$, then any $\alpha \geq \underline{\alpha}$ induces an approval and the outcome is always case M.

If $c \leq 1/8$, then the synergy level is effectively constrained by the condition $s < c$, which implies $s < (1-c)/7$, so that no α exists to meet the approvability constraint (2). Parts i)-iii) of Lemma 2 are those cases, where feasible PPO levels exist to meet the approvability constraint (2). For that to happen, the synergy level must be sufficiently large. If the synergy level surpasses the value of $(1-c)/4$, then the merger is approved even at the minimal PPO level $\underline{\alpha}$, which could be close to zero. Part ii) mirrors sneaky takeovers (see Jovanovic and Wey, 2014). In the considered region, a merger is never approvable when $\alpha \to 0$; i.e., the pre-merger price level remains virtually the same in case P. A merger is now only approvable with a strictly positive PPO which can very well be larger than $\underline{\alpha}$ in order to meet the approvability condition (2). Intuitively, a higher level of the PPO increases the price level in case P which improves the chance that the merger becomes approvable in stage 4, because the merger is then evaluated relative to the price level in case P.

We turn now to the profitability condition for a merger proposal in stage 3 (firm 1 chooses T). The merger is jointly profitable if the joint profit of firms 1 and 2 in case of P is smaller than the merged firm's profit; i.e., $\pi_1^P + \pi_2^P \leq \pi_1^M$ (see Table 1). Comparison of both profit levels gives that the merger is profitable if

$$s \geq s_2 := \frac{(1-c)(\alpha + 3\sqrt{2-\alpha} - 4)}{2(4-\alpha)}$$

and unprofitable otherwise.[33] Note that $\partial s_2/\partial\alpha < 0$. Moreover, $s_1 > s_2$ holds always for any $s < \overline{s}$ such that any approvable merger fulfills the profitability condition in the synergy PPO

[33] Note that the second term in brackets in the numerator is strictly positive for all admissible values of α. Clearly, the denominator is also always positive, so that s_2 is always positive.

subgame.[34] We can therefore conclude, that case M is the equilibrium outcome in the synergy PPO subgame if (2) holds, while case P is the equilibrium outcome otherwise.

We next get to stages 1 and 2, where we distinguish between the regulatory regimes $R1$ and $R2$ (in the next section below, we turn to $R3$ and $R4$).

3.3 Only Direct Merger ($R1$)

Under $R1$, the AA never accepts a PPO acquisition, because it is always price increasing in the short run. Put another way, the AA disregards the possible learning of merger synergies which may lead to a merger in the future. A direct merger is evaluated under a price test taking properly care of the uncertainty of a merger synergy.[35] For that purpose, the AA relies on the a priori probability distribution of the synergy level, with which the expected price after a merger, Ep^M, can be calculated as

$$Ep^M := \beta p^M(s) + (1-\beta)p^M(s=0) = \beta\left(\frac{1+2c-s}{3}\right) + (1-\beta)\left(\frac{1+2c}{3}\right). \tag{4}$$

If the expected price is not larger than the price before the merger, p^I, then the AA accepts the merger, while it blocks it otherwise. Comparing both prices, we get that $Ep^M \leq p^I$ if

$$s \geq s_3 := \frac{1-c}{4\beta} \tag{5}$$

holds. If $\beta \to 1$, then $s_3 = (1-c)/4$ which is equal to s_1, when evaluated at $\alpha = 0$.[36] If there is almost perfect certainty about the synergy level, then the decision rule of the AA is the same in

[34] The ordering $s_1 > s_2$ follows from noticing that the difference $s_1 - s_2$ is strictly increasing in α; i.e., $\partial(s_1 - s_2)/\partial\alpha = \left(2\sqrt{2-\alpha} - 1\right) / \left(2\sqrt{2-\alpha}\right) > 0$ for all admissible values of α. Evaluating the difference, $s_1 - s_2$, at the lowest possible value of α, we get $3\left(2-\sqrt{2}\right)(1-c)/8 > 0$. Thus, private merger incentives are excessively large from a consumer welfare perspective. If we abandon our assumption that the AA knows the synergy level for sure, then we may expect too many mergers to take place in the synergy PPO subgame.

[35] Merger regulations in the US and EU require to take merger efficiencies into account (e.g., Farrell and Shapiro, 2001).

[36] Of course, for any $\alpha > 0$, the AA's decision rule s_3 used in the second stage of the game is always more restrictive than the AA's price test criterion s_1 used in the synergy PPO subgame in the fourth stage of the game. Formally, $s_3 > s_1$ follows from noticing that the difference $s_3 - s_1 = (1-c)\left[4 - \alpha - 4\beta(1-\alpha)\right]/(4\beta(4-\alpha))$ is positive because the term in rectangular brackets is positive. This follows from noticing that this term decreases in β. Setting $\beta = 1$, this term becomes $3\alpha > 0$.

the second stage as in the fourth stage with the only difference that firm 1 does not hold a PPO in firm 2. Note that (5) can only be fulfilled for $c \geq 1/5$, because of $s < \overline{s} := \min\{c, 1-c\}$. We can solve condition (5) for β and obtain the condition

$$\beta \geq \widetilde{\beta} := \frac{1-c}{4s}. \tag{6}$$

Clearly, the critical probability $\widetilde{\beta}$ above which a direct merger should be approved, decreases in s. Using $s < \overline{s} := \min\{c, 1-c\}$, we get that approvable mergers only exist, if β is not smaller than 1/4, which follows from evaluating $\widetilde{\beta}$ at $s = 1-c$, which ensures that in case M the outsider firm stays active in the market.[37]. With conditions (5) and (6) at hand, we can summarize the AA's merger control decision under uncertainty in the second stage as follows.

Lemma 3. *The AA's merger control decision in stage 2 (for a direct merger proposal) depends on the parameters as follows. If $c \leq 1/5$, then a direct merger is always rejected. If $1/5 < c < 1$, then for synergy levels $s \in [s_3, \overline{s})$ (or, equivalently, values of β with $\beta \geq \max\{\widetilde{\beta}, 1/4\}$) the direct merger is approvable. Otherwise, a merger proposal is rejected. Moreover, $\partial s_3/\partial\beta < 0$ for $\beta > 1/4$.*

Lemma 3 describes the parameter restrictions which have to be met in order to induce the AA to approve the direct merger proposal in the second stage. Quite intuitively, the synergy level s must be large enough according to (5) for this to happen. If the marginal cost in the pre-merger situation is already low ($c < 1/5$), then the scope for synergies is also restricted from above, which implies that an approvable merger never exists. When the pre-merger marginal costs are larger, $c \geq 1/5$, then a merger is approvable if the synergy level is large enough according to (5). This is more likely to happen, if the probability of a synergy is large enough.

We next consider the profitability of a direct merger. Again, this assessment is based on the a priori distribution of the synergy level. A merger is profitable in expected terms if $E\pi_1^M - 2\pi^I \geq 0$,

[37]This is an assumption to avoid case distinctions depending on whether firm 3 is active or not in case of a merger with synergies. If we drop this assumption, then a synergy larger than s_3 would induce exit of firm 3 which would increase the price, so that β and s are not monotonically negatively related anymore (i.e., it could be that a higher s must go hand in hand with a higher β to make the merger approvable). By constraining the maximal synergy level, we rule out predatory merger effects so that, ceteris paribus, a higher synergy level and higher synergy probability will never make the merger approval less likely (see Farrell and Shapiro, 2001, and Cabral, 2003, where the latter work considers entry deterring effects of merger synergies).

where

$$
\begin{aligned}
E\pi_1^M &= \beta\pi_1^M(s) + (1-\beta)\pi_1^M(s=0) \\
&= \beta\frac{(1-c+2s)^2}{9} + (1-\beta)\frac{(1-c)^2}{9}
\end{aligned} \tag{7}
$$

Using the profit levels stated in Table 1 and solving for the synergy level, we get the profitability condition

$$
s \geq s_4 := \frac{(1-c)}{8\beta}\left(-4\beta + \sqrt{2}\sqrt{\beta\,(8\beta+1)}\right).
$$

Clearly, s_4 is always positive. Comparing s_3 and s_4, we get that $s_3 > s_4$ holds always, so that any approvable merger is also profitable. The reverse does not hold, so that all mergers with maximal synergy $s_4 \leq s \leq s_3$ are profitable but not approvable. For the purpose of deriving the equilibrium of our game under the considered regimes, it suffices to state the following lemma.

Lemma 4. *An approvable direct merger is always profitable for the merging parties when compared with the pre-merger equilibrium profits (i.e., $E\pi_1^M \geq 2\pi^I$).*

Taking Lemmas 3 and 4 together, we can state the equilibrium outcome under $R1$ as follows.

Proposition 1. *The game has a unique equilibrium outcome under regime $R1$. If $s \in [s_3, \overline{s})$ (or, equivalently, $\beta \geq \max\{\widetilde{\beta}, 1/4\}$), then case M is the equilibrium outcome, while case I is the equilibrium outcome if $\beta < 1/4$ and/or $s < s_3$. Moreover, $s \geq s_3$ implies $c > 1/5$.*

We next turn to regime $R2$ which expands the action set of firm 1 in the first stage of the game by allowing for a PPO acquisition which is assumed to be never challenged by the AA.

3.4 No PPO Control ($R2$)

If there is no control of PPO acquisitions ($R2$), then firm 1 can always decide to acquire a PPO in the target firm to learn the merger synergy level in advance. The expected joint profit of firms 1 and 2 from a PPO acquisition (denoted by $E\pi^P$) depends on the possible synergy level s and is given by

$$
E\pi^P = \begin{cases} \beta\pi_1^M + (1-\beta)(\pi_1^P + \pi_2^P), & \text{if merger is approved in stage 4} \\ \pi_1^P + \pi_2^P, & \text{if merger is rejected in stage 4.} \end{cases}
$$

Clearly, if the merger is not approved in the synergy PPO subgame, then a PPO can never be profitable in our model of Cournot competition. Thus, to derive the equilibrium under regime $R2$, we notice that a PPO can only be chosen if this induces the AA to approve the merger proposal in stage 4 of the game. That is, the approvability conditions as specified in Lemma 2 must hold. This follows from the fact that the sum of firm 1 and 2's profits in case I, $2\pi^I = 2((1-c)/4)^2$, is always larger than the joint profit of the firms in case P, $\pi_1^P + \pi_2^P = ((1-c)/(4-\alpha))^2(2-\alpha)$, because $\alpha > 0$. If, however, the merger is approved in the synergy PPO subgame, then a PPO can be optimal. Using the profit levels stated in Table 1, the expected joint profit if the merger is approved in the synergy PPO subgame, is given by

$$E\pi^P = \beta\frac{(1-c+2s)^2}{9} + (1-\beta)\left(\frac{1-c}{4-\alpha}\right)^2(2-\alpha). \tag{8}$$

Clearly, the joint profit in case of P decreases in the size of the PPO, so that the expected profit $E\pi^P$ from a PPO acquisition must also decrease in α, as the profit in case of a merger does not depend on the chosen PPO level. Note that this implies that the optimal PPO will always be equal to the minimal approvable level.[38] From Lemma 2 we know that a merger will only be approved after a PPO acquisition if the PPO share fulfills

$$\alpha \geq \alpha^* := \max\{\underline{\alpha}, \alpha_1\}.$$

This constraint must be binding. If $\alpha_1 > \underline{\alpha}$, then $\partial\alpha^*/\partial s < 0$, so that a lower synergy level increases the minimal necessary PPO. With that, we have characterized the optimal α chosen in the first stage of the game if the PPO route is optimal for firm 1. Comparing next the expected profits of a sequential takeover strategy (S) with the expected profits of a direct merger (D) in stage 1, it is straightforward to see that the PPO route is always more profitable from firm 1 and firm 2's joint perspective. This follows from comparing the expected profits with a PPO proposal (8) and the expected profits from a direct merger proposal (7). If a large enough synergy $s > 0$ is realized (which occurs with probability β), then both profit levels are the same, because a full merger with synergies is realized in both scenarios. If, however, no synergy is realized ($s = 0$), then the joint profit is strictly larger under the PPO-strategy than under a direct merger strategy; i.e., $\pi_1^P + \pi_2^P > \pi_1^M(s=0)$ or $((1-c)/(4-\alpha))^2(2-\alpha) > (1-c)^2/9$ for all $\alpha \in [\underline{\alpha}, 1/2)$. Thus, comparing the sequential and the direct merger choices in stage 1 of the game, the former strategy is more attractive because the PPO allows to learn the synergy level perfectly while keeping the committed resources of firm 1 in firm 2 at a relatively low level. Put

[38] We note that this result is specific to our Cournot framework.

another way, the downside risk of realizing no synergy is reduced with a PPO which enables the acquirer firm to learn the merger synergy in advance. We summarize these results in the following lemma.

Lemma 5. *If a PPO is chosen under R2, then it is always at the minimal level which ensures synergy learning and approval of a merger proposal in the "synergy PPO subgame;" i.e.,* $\alpha^* := \max\{\underline{\alpha}, \alpha_1\}$ *holds. A sequential takeover strategy (S) is always more profitable than a direct merger (D).*

We now turn to the question when is the PPO strategy better than the outcome under case I, which is reached if firm 1 abstains from proposing either a PPO or a direct merger in stage 1 of the game. Comparing the expected joint profits of firms 1 and 2, $E\pi^P$ (see (8)), with the joint profit in case I, $2\pi^I$, we first notice that the probability of a synergy, β, must be sufficiently large to make the PPO option more attractive. This follows from noticing that firm 1 and 2's joint profit decreases with a PPO, $\alpha > 0$, whenever the no-synergy PPO subgame is realized. At the other extreme, if it is almost sure that an approvable synergy will be realized (according to Lemma 2), then the expected profit $E\pi^P$ from the sequential takeover strategy must be larger than the joint profit in case I. If the merger is approvable in stage 4, then the profitability constraint is always satisfied as we showed above. As $E\pi^P$ increases linearly in β, there exists a unique threshold value $\beta^* \in (0,1)$ such that for all $\beta \geq \beta^*$ the sequential takeover strategy yields highest expected profits. We can characterize this critical value as follows. Note first that the condition $E\pi^P \geq 2\pi^I$ can be written as

$$\beta\pi_1^M + (1-\beta)(\pi_1^P + \pi_2^P) \geq 2\pi^I,$$

which yields the following condition

$$\beta \geq \beta^*(\alpha) := \frac{2\pi^I - (\pi_1^P + \pi_2^P)}{\pi_1^M - (\pi_1^P + \pi_2^P)}, \tag{9}$$

where $\beta^* \in (0,1)$ follows from $\pi_1^M > 2\pi^I > (\pi_1^P + \pi_2^P) > 0$. It is easily checked that $\partial\beta^*/\partial s < 0$ and $\partial\beta^*/\partial\alpha > 0$, where the former derivative says that a higher synergy level makes it, *ceteris paribus*, more likely that the sequential takeover strategy is optimal, while for α an inverse relationship holds. If a sequential takeover strategy is chosen, then $\alpha = \alpha^*$. According to Lemma 2, if $s \geq (1-c)/4$, then $\alpha^* = \underline{\alpha}$ induces an approval. Substituting $\underline{\alpha}$ into the joint profit levels $\pi_1^P + \pi_2^P$, we get

$$\beta^*(\underline{\alpha}) = \frac{2\left((1-c)/4\right)^2 - \frac{(2-\underline{\alpha})(1-c)^2}{(4-\underline{\alpha})^2}}{\frac{(1-c+2s)^2}{9} - \frac{(2-\underline{\alpha})(1-c)^2}{(4-\underline{\alpha})^2}}. \tag{10}$$

As long as $\underline{\alpha} > \alpha_1$, this critical value remains valid also for lower synergies with $(1-c)/7 < s < \min\{c, (1-c)/4\}$ (see part ii) of Lemma 2). If, however, in that region $\underline{\alpha} \leq \alpha_1$, then we have to evaluate β^* at $\alpha^* = \alpha_1$, which gives

$$\beta^*(\alpha_1) = \frac{(1-c-4s)^2}{24s\,(1-c+2s)}. \tag{11}$$

Note that $\partial\beta^*(\alpha_1)/\partial s < 0$. It is easily checked that $0 < \beta^*(\alpha_1) < 1$ for the considered parameter values. Thus, for all $(1-c)/7 < s < \min\{c, (1-c)/4\}$, there always exist large enough synergy probabilities, β, such that (11) holds. We summarize as follows.

Proposition 2. *Consider regime R2. The following cases have to be distinguished.*

i) If $s \leq (1-c)/7$, then the outcome is case I.

ii) If $(1-c)/7 < s < \min\{c, (1-c)/4\}$, then a PPO $\alpha = \alpha^* := \max\{\underline{\alpha}, \alpha_1\}$ is chosen if $\beta \geq \beta^*(\alpha^*)$ holds. Otherwise, case I is the outcome.

iii) If $s \geq (1-c)/4$, then the minimal PPO $\underline{\alpha}$ is chosen if $\beta \geq \beta^*(\underline{\alpha})$ holds. Otherwise, case I is the outcome.

Moreover, $s > (1-c)/7$ implies $c > 1/8$.

Part ii) of Proposition 2 follows directly from Lemma 5 and the profitability condition (9).

3.5 Comparison of Regimes $R1$ and $R2$

Comparing Propositions 1 and 2 shows that a merger outcome is supported for a strictly larger set of parameters under $R2$ than under $R1$. In particular, if a direct merger is the outcome under $R2$, then the minimal PPO level $\underline{\alpha}$ is chosen under $R2$. Comparing $\widetilde{\beta}$ (approvable direct merger, see (6)) and $\beta^*(\alpha)$ (profitable PPO-acquisition, see (9)), we note that $\widetilde{\beta} > \beta^*(\alpha)$ holds always which follows from noticing that $\widetilde{\beta} \geq 1/4$ must hold for an approvable direct merger to exist (see Proposition 1). Note that $\beta^*(\alpha)$ is maximal at $\alpha = 1/2$. Comparing the respective values, we get

$$1/4 - \beta^*(1/2) = \frac{19c^2 + 392cs - 38c - 392s^2 - 392s + 19}{40c^2 + 1568cs - 80c - 1568s^2 - 1568s + 40} > 0,$$

where the numerator is strictly positive if $s > (1-c)\left(3\sqrt{26}-14\right)/28$ and the denominator is strictly positive if $s > (1-c)\left(3\sqrt{2}\sqrt{3}-7\right)/14$. Both conditions hold in the considered parameter regions of Proposition 1 and 2. This ordering is quite intuitive. We showed above that any approvable direct merger is also profitable. At the same time, a sequential takeover is always more profitable than a direct merger in expected terms (Lemma 5) and it induces acceptance of a subsequent merger proposal by the AA (Proposition 2). Thus, if case M is the equilibrium outcome under $R1$, then a minimal PPO $\underline{\alpha}$ is acquired in equilibrium under $R2$. The following proposition summarizes the comparison of regimes $R1$ and $R2$ for the entire range of considered parameter constellations.

Proposition 3. *The set of parameters under which a merger is the equilibrium outcome under $R2$ is strictly larger than under $R1$, where the former one is a strict subset of the latter one. The following cases emerge.*

i) If $s \leq (1-c)/7$, then the outcome is case I under $R1$ and $R2$.

ii) If $(1-c)/7 < s < \min\{c, (1-c)/4\}$, then case I is the outcome under $R1$, while under $R2$ a PPO $\alpha = \alpha^* := \max\{\underline{\alpha}, \alpha_1\}$ is chosen if $\beta \geq \beta^*(\alpha^*)$ holds. Otherwise, case I is the outcome.

iii) If $(1-c)/4 \leq s \leq s_3$, then case I is the outcome under $R1$ and also under $R2$, if $\beta < \widetilde{\beta}(\underline{\alpha})$. If $\beta \geq \widetilde{\beta}(\underline{\alpha})$, then the minimal PPO $\underline{\alpha}$ is chosen under $R2$.

iv) If $s_3 < s \leq \overline{s}$ (or, equivalently, $\beta \geq \max\{\widetilde{\beta}, 1/4\}$), case M is the equilibrium outcome under $R1$, while the minimal PPO $\underline{\alpha}$ is chosen under $R2$. In addition, the minimal PPO $\underline{\alpha}$ is also chosen under $R2$, whenever $\beta \geq \widetilde{\beta}(\underline{\alpha})$ holds, while otherwise case I follows under $R2$.

Note that $\lim_{\beta \to 1} s_3 = \lim_{\underline{\alpha} \to 0} s_1 = (1-c)/4$. Thus, a direct merger can never occur for $s < (1-c)/4$, while in that area a sequential takeover strategy is possible under $R2$. Thus, if for $\underline{\alpha} \to 0$, a PPO level of α_1 is chosen in equilibrium (i.e., sneaky takeover), then a direct merger is never approvable under $R1$, because it would be price increasing in expected terms. Overall, Proposition 3 makes the tradeoff associated with a laissez-faire approach towards PPOs ($R2$) explicit. As it increases the set of parameters which support a merger outcome beyond the one under $R1$, it invites both price increasing and price decreasing mergers, which would be blocked when a price test is used to evaluate PPOs.

4 Regulating PPO Acquisitions

4.1 Forward Looking Price Test ($R3$)

Under a forward looking price test ($R3$), the AA accepts a PPO proposal only when the expected market price is lower than the price realized in the absence of a PPO. In contrast to $R1$, the AA takes a longer run perspective to assess the expected price resulting from a PPO acquisition by acknowledging that the PPO acquisition is the first step of a sequential takeover strategy. The AA thus calculates the expected (equilibrium) market price under the sequential takeover strategy, Ep^P, and compares it with the price which is realized when the PPO acquisition is rejected, p^I. As we showed above (Proposition 3), a sequential takeover strategy is only chosen if the maximal synergy level is sufficiently large, so that a merger proposal will be accepted in equilibrium in stage 4. The expected (equilibrium) price from a PPO strategy is, therefore, given by

$$Ep^P = \beta p^M + (1-\beta)p^P = \beta\frac{1+2c-s}{3} + (1-\beta)\left(\frac{1+(3-\alpha)c}{4-\alpha}\right).$$

A forward looking PPO control allows the PPO acquisition if $Ep^P \leq p^I$, which gives the condition

$$s \geq s_5 := \frac{(1-c)(3\alpha + 4(1-\alpha)\beta)}{4(4-\alpha)\beta}. \tag{12}$$

Note that $\partial s_5/\partial\beta = -(3(1-c)\alpha)/(4\beta^2(4-\alpha)) < 0$ and that $\lim_{\beta\to 1} s_5 = (1-c)/4$, so that a PPO is never approved when $s < (1-c)/4$. Thus, the entire parameter range under which a sneaky takeover occurs under regime $R2$ is eliminated by a forward looking price test (see part ii) of Proposition 2). If, however, $s > (1-c)/4$, then the PPO acquisition is approvable if the probability of a synergy is large enough. Solving (12) for β, we get

$$\beta \geq \beta^{**} := \frac{3\alpha(1-c)}{4(\alpha(1-c-s) - (1-c-4s))}. \tag{13}$$

Note that $0 < \beta^{**} < 1$ holds in the considered parameter area and that $\partial\beta^{**}/\partial\alpha > 0$ and $\partial\beta^{**}/\partial s < 0$. The former derivative implies that firm 1 will always choose the minimal PPO level $\alpha = \underline{\alpha}$ because a higher level reduces the expected joint profits of firms 1 and 2 and decreases the chance of approvability. We can summarize the equilibrium outcome as follows.

Proposition 4. *Suppose a PPO is evaluated by the AA according to a forward looking price test. The following cases then emerge.*

i) If $s \leq \min\{c, (1-c)/4\}$*, then the outcome is case* I*.*

ii) If $s > (1-c)/4$*, then a PPO with* $\alpha = \underline{\alpha}$ *is chosen if* $\beta \geq \beta^{**}(\underline{\alpha})$ *holds. Moreover,* $\partial\beta^{**}/\partial\alpha > 0$ *and* $\partial\beta^{**}/\partial s < 0$*. Otherwise, case* I *is the outcome.*

It is obvious that the forward looking regime is more restrictive than $R2$. First, the entire area where a sneaky takeover is chosen under $R2$ disappears. Second, even in the area where a PPO would be ex ante price reducing (part ii) of Proposition 4), the forward looking price test is more restrictive than under $R2$. This can be seen from comparing directly the critical values s_1 and s_5, for which we get that $s_5 > s_1$. Or, in terms of the probability of a synergy, $\beta^{**} > \beta^{*}$ holds always. The reason is that the critical value β^{**} takes account of the downside risk that there will be no synergy in which case the expected price is always larger than in case I. In contrast, the critical value β^{*} follows from firm 1 and 2's profitability constraint which is less restrictive. Comparing $R3$ with $R1$, we get that the AA can improve its decision by taking a longer run perspective in case of PPO proposals. A (short run) price test only considers the price increasing effect of the PPO, so that any PPO would be blocked under $R1$, leading to the result that only direct mergers can happen. As the analysis of $R3$ reveals, allowing only direct mergers which pass the price test leads to too few merger proposals when compared with the outcomes of the forward looking price test. Comparing the critical values s_5 and s_3, we get that $s_3 > s_5$ holds always which follows directly from the fact, that a sequential takeover strategy reduces the downside risk of allowing the merger not only from the firms' but also from the AA's perspective.

4.2 Safeharbor Rule ($R4$)

Another policy alternative to the forward-looking price test is to put a constraint on the maximal minority share holding, such that any PPO proposal below that value can be implemented without notifying the AA ($R4$). Denote that value by $\overline{\alpha}$ to which we refer as the safeharbor rule (assume also $\overline{\alpha} < 1/2$). If the PPO share surpasses the safeharbor rule, then the PPO acquisition has to be notified and the AA decides about it on the basis of standard merger control regulations (i.e., it uses a short run price test as in $R1$).

We can distinguish basically two cases which depend on how restrictive the safeharbor rule $\overline{\alpha}$ is when compared with $\underline{\alpha}$ (above which synergy learning is assured) and α_1 (above which a merger proposal is accepted by the AA in the synergy PPO subgame). If $\overline{\alpha} < \underline{\alpha}$, then the safeharbor constraint is too restrictive to induce a sequential takeover strategy. In this case, a PPO acquisition (for the purpose of synergy learning with $\alpha \geq \underline{\alpha}$) would trigger a merger analysis based on merger control practice as in $R1$. Accordingly, the possibility of a sequential takeover strategy is not taken into account, so that a PPO acquisition is always blocked by the AA. It follows that the only acquisition strategy remaining is the direct merger, so that the equilibrium outcome is the same as under $R1$.

The second case is $\underline{\alpha} < \overline{\alpha} < 1/2$, so that all $\alpha \in [\underline{\alpha}, \overline{\alpha}]$ enable the acquirer to learn the value of the merger synergy by means of a sequential acquisition strategy. Such a regulatory constraint implies two important features. First, it reduces the scope for sneaky takeovers if $\overline{\alpha} < \alpha_1$ which is desirable from a forward looking price test perspective. Second, it never restricts mergers in the range where the post merger price is smaller than before the mergers (i.e., in the area $s > (1-c)/4$). The former follows from condition (3) which constraints the PPO from below (only PPOs above α_1 are approvable in the fourth stage of our game). The latter statement follows from noticing that in the respective area firm 1 will always choose the minimal PPO level, $\underline{\alpha}$, which just ensures learning of the synergy level. A higher PPO level always reduces the expected joint profits of the acquirer and the target, and is thus never optimal making the safeharbor constraint always nonbinding. We summarize that reasoning as follows.

Proposition 5. *Suppose that PPOs are regulated according to a safeharbor rule $\overline{\alpha}$, so that a PPO has only to be notified in advance if $\alpha > \overline{\alpha}$, in which case the AA decides on the basis of a (short run) price test. The following cases then emerge.*

i) If $\overline{\alpha} < \underline{\alpha}$, then the outcome is the same as under $R1$ (only direct merger).

ii) If $\overline{\alpha} > \underline{\alpha}$ and if $\underline{\alpha}$ is the equilibrium outcome under $R2$, then the outcome is the same as under $R2$ (no PPO control).

iii) If $\overline{\alpha} > \underline{\alpha}$ and if $\alpha_1 > \underline{\alpha}$ is the equilibrium outcome under $R2$, then two cases have to be considered: a) If $\overline{\alpha} > \alpha_1$, the outcome is the same as under $R2$ (no PPO control). b) If $\overline{\alpha} < \alpha_1$, then the safebarbor rule effectively blocks all equilibrium PPO proposals under $R2$ which are in the interval $(\overline{\alpha}, \alpha_1|_{s=(1-c)/7})$, while all PPO proposals $\alpha_1 \leq \overline{\alpha}$ are allowed (i.e., the same outcome as in $R2$ follows).

Part iii) of Proposition 5 shows that a safebarbor rule can deter PPO proposals which aim at outplaying the AA using a price test (i.e., whenever $\alpha_1 > \underline{\alpha}$ is the equilibrium outcome in $R2$). Clearly, if the safeharbor rule is set equal to the minimal PPO shareholding which ensures synergy learning (i.e., $\overline{\alpha} = \underline{\alpha}$), then all those proposals are effectively eliminated because all of them would fall under standard merger control. By reference to a (short run) price test all the notified proposals are rejected. Of course, to allow for synergy learning in the first place, the safeharbor rule must not fall short of $\underline{\alpha}$ (see part ii) of Proposition 5), because otherwise it would deter any sequential acquisition strategy for the purpose of synergy learning.

5 Welfare Implications

We examine the welfare implications of our analysis. Our focus is on consumer surplus, CS, but we also shortly refer to social welfare (which is the sum of consumer surplus and producer surplus, PS). Table 2 states consumer and producer surplus for the cases I, P, and M.

Cases \ Eq. Values	Consumer Surplus	Producer Surplus
Case I	$CS^I = \frac{9(1-c)^2}{32}$	$PS^I = 3\left(\frac{1-c}{4}\right)^2$
Case P	$CS^P = \frac{((3-\alpha)(1-c))^2}{2(4-\alpha)^2}$	$PS^P = \frac{(3-\alpha)(1-c)^2}{(4-\alpha)^2}$
Case M	$CS^M = \frac{(2(1-c)+s)^2}{18}$	$PS^M = \frac{(1-c+2s)^2+(1-c-s)^2}{9}$

Table 2. *Consumer and producer surplus in cases I, P, and M*

The expected values of consumer surplus, producer surplus, and social welfare if a merger (strategy D) is proposed by firm 1 and approved by the AA in stages 1 and 2, respectively, are given by

$$E\Omega^D := \beta\Omega^M + (1-\beta)\Omega^M(s=0), \text{ with } \Omega \in \{CS, PS, SW\}.$$

If a PPO-strategy is chosen by firm 1 (strategy S) and approved by the AA in the first and second stage of the game, respectively, then the expected values of consumer surplus, producer surplus, and social welfare are given by

$$E\Omega^S := \beta\Omega^M + (1-\beta)\Omega^P, \text{ with } \Omega \in \{CS, PS, SW\}.$$

We first note that the price test is different than the consumer surplus test when there is uncertainty about the synergy. Take a direct merger proposal in stage 1. Under a consumer surplus test, the AA accepts the merger if $ECS^D \geq CS^I$, which gives the condition

$$s \geq s_D := \frac{1-c}{\beta}\left(-2\beta + \frac{1}{4}\sqrt{\beta\left(64\beta+17\right)}\right).$$

Comparing s_D with the critical synergy level s_3 under regime $R1$, we get

$$s_3 - s_D = \frac{1-c}{4\beta}\left(8\beta - \sqrt{\beta\left(64\beta+17\right)} + 1\right) > 0.$$

Thus any merger which is approved under a price test is also approvable under a consumer surplus test, but not otherwise around.

Proposition 6. *Any direct merger which is approvable under the price test is also approvable under a consumer surplus test. As a merger is always strictly profitable under a price test, a consumer surplus test would allow more mergers to be completed than the price test. The price test, therefore, blocks profitable mergers which are consumer surplus increasing.*

Proposition 6 already implies that allowing for PPO-induced mergers can be desirable from a consumer surplus point of view because the price test in stage 2 of our game is too restrictive and blocks consumer surplus increasing direct mergers. However, sneaky takeovers are possible under regime $R2$ which may reduce expected consumer surplus. Comparing the expected consumer surplus in case of a sequential takeover with the consumer surplus in case I, we get

$$ECS^S < CS^I \text{ for all } (1-c)/7 < s < \min\{c, (1-c)/4\}.$$

Thus, with no PPO control at all ($R2$), there are too many sequential mergers from a consumer surplus perspective. The forward looking price test deters all sneaky takeovers, which is a desirable feature from a consumer surplus perspective.[39] A comparison of the forward looking price test with the consumer surplus rule occurs only for synergy levels which induce price decreasing mergers (i.e., $s > (1-c)/4$ holds). The expected consumer surplus does not fall with a sequential merger strategy if

$$ECS^S = \beta CS^M + (1-\beta)CS^P \geq CS^I.$$

from which we obtain the condition

$$\beta > \beta_S := \frac{CS^I - CS^P}{CS^M - CS^P}. \tag{14}$$

[39] We show in the Appendix that a sneaky takeover strategy always lowers expected consumer surplus compared to the pre-merger level.

Note that $\beta_S \in (0,1)$, because of $CS^M > CS^I > CS^P > 0$. Comparing β_S with the β^{**} (see 13), we get

$$\beta^{**} > \beta_S$$

holds always in the considered parameter range (see Appendix for the proof). Again, the forward looking price test applied to PPO acquisitions is more restrictive than a test based on expected consumer surplus (which is also forward looking in terms of foreseeing the subgame perfect equilibrium outcome of a sequential takeover strategy).

Comparing the safeharbor rule with the expected consumer surplus change, the safeharbor rule should be set at the lowest possible level which just ensures synergy learning; i.e., $\overline{\alpha} = \underline{\alpha}$ should hold from a consumer surplus perspective to deter all sneaky takeovers. But even fixing the safeharbor rule optimally at $\overline{\alpha} = \underline{\alpha}$ invites too many PPO acquisitions, because from Proposition 2 we know that the takeover incentive is then driven by firm 1 and 2's profitability condition; in particular, $\beta \geq \beta^*$ must hold according to (10). In the Appendix, we show that $\beta^*(\underline{\alpha}) < \beta_S$ for $s > 0$, so that the profitability condition implies too large takeover incentives for the firms from a consumer surplus perspective. Or, put differently, consumer-decreasing sequential takeovers under a safeharbor rule are possible even if $\overline{\alpha} = \underline{\alpha}$, so that all sneaky takeovers cannot occur.

Proposition 7. *The forward looking price test eliminates all sneaky takeovers which are also consumer surplus reducing, which is also true under a safeharbor rule with $\overline{\alpha} = \underline{\alpha}$. If $\underline{\alpha}$ is the equilibrium outcome in R2, then the forward looking price test is more restrictive than a (forward looking) consumer surplus test, so that profitable sequential acquisitions are blocked under the forward looking price test which are consumer surplus increasing. If, again, $\underline{\alpha}$ is the equilibrium outcome in R2, then a safeharbor rule $\overline{\alpha} \geq \underline{\alpha}$ is less restrictive than a (forward looking) consumer surplus test, so that some sequential acquisitions are taking place under the safeharbor rule which are consumer surplus decreasing.*

Finally, under a social welfare standard firms' profit changes would also have to be taken into account. It is easily checked that any concentration increases the sum of firms' profits (with and without synergies). It is, therefore, obvious that the price test (as well as a consumer welfare standard) is more restrictive than a social welfare test. Thus, from a social welfare perspective allowing for the opportunity of sequential mergers is even more advisable. In particular, a sneaky takeover can be social welfare increasing in expected terms. The expected social welfare under a sequential merger is higher than the pre-merger social welfare level if

$$ESW^S = \beta SW^M + (1-\beta)SW^P \geq SW^I. \tag{15}$$

Substituting the respective values from Table 2 into (15), setting $\alpha = \alpha_1$, and evaluating at the lowest (approvable) synergy level possible ($s = (1-c)/7$; see part ii) of Proposition 2), we get

$$\beta\, SW^M\big|_{s=(1-c)/7} + (1-\beta)\, SW^P\big|_{\alpha=\alpha_1, s=(1-c)/7} - SW^I = \frac{3}{1568}\,(32\beta - 5)\,(1-c)^2\,,$$

which is larger than zero for $\beta \geq 5/32$. Thus, even the worst possible sneaky takeover can be socially desirable.

6 Conclusion

We presented a model which takes account of uncertainty about merger synergies. Uncertainty about the synergy level creates a downside risk for both the merging parties and consumers. If no synergy is realized after the merger, then the merging firms and consumers are worse off than before the merger. Acquiring a PPO can be an effective way to reduce this downside risk if it allows the acquiring firm to learn the merger synergy in advance. A PPO reduces the resources which have to be committed and thus also the losses if it turns out that no merger synergies will be realized. Thus, taking the synergy learning property of PPO acquisitions into account, they appear in a better light when compared with the views expressed in recent competition policy reports (OECD, 2008; OFT, 2010; EC, 2013, 2014). However, there is still a tradeoff involved with PPOs as they can be used strategically to reduce the competitive intensity so as to induce the AA to approve a merger proposal which would not be approvable in the absence of a PPO acquisition. This can happen because a lower competitive intensity lowers the minimal synergy level necessary to lower the market price after a merger (sneaky takeover). We have proposed two regulatory approaches to counter those sneaky takeovers to better filter out the pro-competitive PPO acquisitions. First, we examined a forward looking price test which requires evaluating a PPO acquisition by taking account of the possibility of synergy learning and the potential of realizing possible merger synergies in the future. A forward looking price test applied to PPO proposals deters all sneaky takeovers but is still too restrictive from a consumer welfare perspective.

Another problem with the forward looking price test is that it appears to be both informationally demanding and costly in terms of the administrative burden because it involves a detailed market analysis as in a merger control case. We have also investigated a simple safeharbor rule to deal with PPOs which was also proposed in some of the above mentioned competition policy reports. If that rule is adjusted properly just above the minimal necessary PPO level which ensures synergy learning, then virtually all sneaky takeovers are eliminated. However, even if the safeharbor rule is set optimally in this way, it has the drawback that it allows for too many PPO acquisitions from a consumer surplus perspective. Thus, neither the forward looking price test nor the safeharbor rule can perfectly monitor PPO acquisitions from a consumer welfare perspective, where the former one implies type I and the latter one implies type II errors.

An advantage of both regulatory approaches $R3$ and $R4$ (given the safeharbor rule is optimally set at $\overline{\alpha} = \underline{\alpha}$) when compared with the benchmark regimes $R1$ and $R2$ is that they ensure that any merger (resulting always from a sequential takeover strategy) must be price reducing both from an ex ante and an ex post perspective. This is neither the case under $R1$ nor under $R2$. In the former case, any approvable merger cannot increase the expected price, but the price can be higher ex post if no synergy is realized. In the latter case, because of sneaky takeovers, the price can increase both from an ex ante and ex post perspective. In contrast, under regimes $R3$ and $R4$ (with $\overline{\alpha} = \underline{\alpha}$) only sequential takeovers occur and the price cannot increase in expected terms, while the deterrence of sneaky takeovers ensures that the price is also always lower ex post.

We finally, discuss some extensions and robustness checks of our model. Increasing the competitive intensity by considering more than one outsider firm should reinforce our results because a direct merger then becomes less attractive which increases the incentive for synergy learning through a PPO acquisition. Another extension is to allow for a non-linear demand, where we expect that our results remain qualitatively valid as long as standard regularity conditions are fulfilled (e.g., log-concave demand function). Considering other distribution functions of the merger synergy should also not change our basic insight on the downside risk of a direct merger from both the firms' and the consumers' perspective.

Appendix

In this Appendix, we derive the equilibrium values stated in Tables 1 and 2. We also prove the ordering of the critical synergy levels introduced in the analysis of our model. We also prove claims made in Section 5 in association with Propositions 6 and 7.

Derivation of the equilibrium values stated in Table 1. *Case I.* When all firms are independent, firm i's profit is given by (1). Independent profit maximization gives the symmetric Cournot quantities $q^I = (1-c)/4$ for the firms. We then get the equilibrium price level $p^I = (1+3c)/4$ and the equilibrium profits $\pi^I = ((1-c)/4)^2$.

Case P. Suppose firm 1 acquires a PPO of α in firm 2. Then the profit of firm 1 is given by $\pi_1^I = (1-Q-c)(q_1+\alpha q_2)$, and the profit of firm 2 by $\pi_2^I = (1-\alpha)(1-Q-c)q_2$. Firm 3's profit is the same as before. The first-order conditions of firms 2 and 3 do not change when compared with the case of independent firms, but the first-order condition of firm 1 is now different. Solving all three first-order conditions, we get the following equilibrium quantities $q_1^P = [(1-\alpha)(1-c)]/(4-\alpha)$ and $q_2^P = q_3^P = (1-c)/(4-\alpha) =: q^P$. The equilibrium price is $p^P = [1+(3-\alpha)c]/(4-\alpha)$ and firms' equilibrium profits are given by $\pi_1^P = \left(q^P\right)^2$, $\pi_2^P = (1-\alpha)\left(q^P\right)^2$, and $\pi_3^P = \left(q^P\right)^2$. Note also that the joint profit of firms 1 and 2 is given by $\pi_1^P + \pi_2^P = \left(q^P\right)^2(2-\alpha) = ((1-c)/(4-\alpha))^2(2-\alpha)$. We notice, that the joint profit of firms 1 and 2 is lower with a PPO when compared with the sum of their profits before the merger. Moreover, a larger PPO reduces the joint profit $\partial(\pi_1^P + \pi_2^P)/\partial\alpha = [\alpha(1-c)^2]/[(\alpha-4)^3] < 0$.

Case M. In case of a takeover of firm 2 by firm 1 synergies s (which can be zero) are realized and the profit of firm 1 is given by $\pi_1 = (1-Q-(c-s))q_1$, while the outsider firm's profit function remains the same as in the independent firms case. Calculating the duopoly equilibrium we get the equilibrium quantities $q_1^M = (1-c+2s)/3$ and $q_3^M = (1-c-s)/3$. Note that we assumed $s < 1-c$, so that $q_3^M > 0$ holds always. The equilibrium price is then given by $p^M = (1+2c-s)/3$, while the merged firm realizes equilibrium profits $\pi_1^M = (1-c+2s)^2/9$ and the outsider firm gets $\pi_3^M = (1-c-s)^2/9$.

Derivation of the equilibrium values stated in Table 2. We use the equilibrium values stated in Table 1 to derive the values of consumer and producer surplus as well as social welfare under the three cases I, P, and M.

Case I. From Table 1, we get

$$PS = \sum_i \pi_i^I = 3\pi^I = 3\left(\frac{1-c}{4}\right)^2.$$

Consumer surplus is given by $CS^I = (1-p^I)^2/2$ (p^I is stated in Table 1) and we get

$$CS^I = \frac{9(1-c)^2}{32},$$

so that social welfare $SW = \sum_i \pi_i^I + CS^I$ becomes

$$SW^I = \frac{15(1-c)^2}{32}.$$

Case P. We get for producer surplus

$$PS^P = \sum_i \pi_i^P = \frac{(3-\alpha)(1-c)^2}{(4-\alpha)^2}.$$

Consumer surplus is given by $CS^P = (1-p^P)^2/2$ and we get

$$CS^P = \frac{((3-\alpha)(1-c))^2}{2(4-\alpha)^2},$$

so that social welfare $SW^P = PS^P + CS^P$ becomes

$$SW^P = \frac{(1-c)^2\left(15-8\alpha+\alpha^2\right)}{2\left(4-\alpha\right)^2}.$$

Case M. Producer surplus is

$$PS^M = \pi_1^M + \pi_3^M = \frac{(1-c+2s)^2 + (1-c-s)^2}{9}.$$

Consumer surplus is given by $CS^M = (1-p^M)^2/2$ and we get

$$CS^M = \frac{(2(1-c)+s)^2}{18},$$

so that social welfare $SW^M = PS^M + CS^M$ becomes

$$SW^M = \frac{(1-c+2s)^2 + (1-c-s)^2}{9} + \frac{(2(1-c)+s)^2}{18}.$$

Expected consumer surplus under a sequential merger (Prop. 6 and 7). In part i), we first show that expected (equilibrium) consumer surplus under a sequential takeover ECS^S is always smaller than CS^I if a sneaky takeover occurs (see part ii) of Proposition 2). In part ii), we show that the forward looking price test is more restrictive than a consumer surplus test in case of sequential takeovers. Finally, in part iii) we show that an evaluation of a PPO based on a (forward looking) consumer surplus test is more restrictive than the profitability condition for a sequential takeover strategy under $R2$ evaluated at $\alpha = \underline{\alpha}$ (i.e., when the price in case of a merger is lower than the pre-merger market price).

Part i) We show that expected consumer surplus in case of a sneaky takeover is always lower than consumer surplus in case I. From Proposition 2 part ii) we know that the lowest possible PPO level in case of a sneaky takeover is given by $\alpha = \alpha_1$. We then get

$$CS^I - ECS^S(\alpha = \alpha_1) = \frac{17(1-c)^2 - 16s(4(1-c)+s)}{288}.$$

This difference is decreasing in s. Evaluating it at the maximal possible values of $s < \min\{c, (1-c)/4\}$, we get that $CS^I - ECS^S(\alpha = \alpha_1) > 0$ is always true.

Part ii) We show that $\beta^{**} > \beta_S$ holds always for $s > (1-c)/4$. We substitute the values of CS^I, CS^P, and CS^M from Table 2 into (14) and comparing that value with (13) we get

$$\begin{aligned} \beta^{**} - \beta_S &= -\frac{3}{16}\frac{(1-c)(4-\alpha)\alpha(1-c-4s)}{\tau}, \text{ with} \qquad (16) \\ \tau &:= -5c^2\alpha^2 + 22c^2\alpha - 17c^2 - 4cs\alpha^2 + 32cs\alpha - 64cs + 10c\alpha^2 - 44c\alpha \\ &\quad +34c + s^2\alpha^2 - 8s^2\alpha + 16s^2 + 4s\alpha^2 - 32s\alpha + 64s - 5\alpha^2 + 22\alpha - 17. \end{aligned}$$

The numerator of the second fraction on the right-hand side of (16) is always negative because $(1-c-4s) < 0$ for $s > (1-c)/4$. The difference ,$(\beta^{**} - \beta_S)$, is therefore, positive if $\tau > 0$. We get $\partial\tau/\partial s = 2(4-\alpha)^2(2(1-c)+s) > 0$. Evaluating τ at the lowest possible value $s = (1-c)/4$, we get $\tau(s = (1-c)/4)) = -\frac{9}{16}\alpha(7\alpha - 24)(1-c)^2 > 0$ for all α. Thus, $\beta^{**} > \beta_S$ holds.

Part iii) We show that $\beta^*(\underline{\alpha}) < \beta_S$ holds always. This inequality holds if the numerator of $\beta^*(\underline{\alpha})$ is smaller than the numerator of β_S and if the denominator of $\beta^*(\underline{\alpha})$ is larger than the denominator of β_S. The former comparison gives the difference

$$2\pi^I - (\pi_1^P + \pi_2^P) - \left[CS^I - CS^P\right] = \frac{1}{32}\frac{\alpha(11\alpha - 24)(1-c)^2}{(\alpha-4)^2} < 0,$$

which is obviously strictly negative for $\alpha < 24/11$. The latter comparison gives the difference

$$\pi_1^M - (\pi_1^P + \pi_2^P) - \left[CS^M - CS^P\right] = \frac{\lambda}{18(\alpha-4)^2}, \qquad (17)$$

with

$$\begin{aligned} \lambda &:= 7c^2\alpha^2 - 20c^2\alpha + 13c^2 - 4cs\alpha^2 + 32cs\alpha - 64cs - 14c\alpha^2 \\ &\quad +40c\alpha - 26c + 7s^2\alpha^2 - 56s^2\alpha + 112s^2 + 4s\alpha^2 - 32s\alpha + 64s + 7\alpha^2 - 20\alpha + 13. \end{aligned}$$

Differentiating λ successively with respect to α, we get

$$\begin{aligned}\frac{\partial \lambda}{\partial \alpha} &= 40c - 32s + 14\alpha - 28c\alpha + 8s\alpha + 14c^2\alpha + 14s^2\alpha \qquad (18)\\ &\quad +32cs - 20c^2 - 56s^2 - 8cs\alpha - 20,\\ \frac{\partial^2 \lambda}{\partial \alpha^2} &= 14c^2 - 8cs - 28c + 14s^2 + 8s + 14. \qquad (19)\end{aligned}$$

Inspecting the right-hand side of (19), we see that this expression is decreasing in c. Evaluating accordingly at the largest possible value of c, we get $\frac{\partial^2 \lambda}{\partial \alpha^2}\Big|_{c=1} = 14s^2 > 0$ for $s > 0$, so that $\frac{\partial^2 \lambda}{\partial \alpha^2} > 0$ holds always for $s > 0$. Evaluating next the right-hand side of (18) at $\alpha = 1$, we get

$$\frac{\partial \lambda}{\partial \alpha}\Big|_{\alpha=1} = 40c - 32s + 14 - 28c + 8s + 14c^2 + 14s^2 + 32cs - 20c^2 - 56s^2 - 8cs - 20,$$

which is increasing in c. We then get $\frac{\partial \lambda}{\partial \alpha}\Big|_{\alpha=1,c=1} = -42s^2$, so that $\frac{\partial \lambda}{\partial \alpha} < 0$ holds always if $s > 0$. Evaluating finally λ at $\alpha = 1$, we get

$$\lambda(\alpha = 1) = 9s(4(1-c) + 7s) > 0,$$

so that (17) is strictly positive if $s > 0$. Taking together, we have shown that $\beta^*(\underline{\alpha}) < \beta_S$ holds always for $s > 0$.

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