Strategic Merger Approvals Under Incomplete Information

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Abstract

We examine a signaling game where the merging entity privately observes the cost-reduction effect from the merger, but the competition authority does not. The latter, however, observes the firm's submission costs in the merger request, using them to infer its type. We identify pooling equilibria where all firm types, even those with small efficiencies, submit a merger request, which is approved by the regulator. This merger profile cannot be supported under complete information, thus leading to inefficiencies. We investigate under which parameter conditions inefficient mergers are less likely to arise in equilibrium, and which policies hinder them, ultimately improving information transmission from firms to the competition authority.

KEYWORDS: Mergers, Cost-reduction effects, Signaling, Submission costs.
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1 Introduction

US Merger Guidelines explicitly consider the cost-reduction effects (efficiencies) when evaluating merger requests, mentioning that this efficiency can yield lower prices passed on to consumers and, ultimately, higher welfare.[1] Although firms, when applying for a merger, argue for the existence of cost-reduction effects, merger efficiencies are difficult to observe by competition authorities (CAs). For a review of these empirical studies see, for instance, Kolaric and Schiereck (2014), and for a description of the challenges estimating post-merger efficiency effects, see Knittel and Metaxoglou (2008 and 2011), and the solutions in Jaffe and Weyl (2013).[2] As a consequence, more mergers are facing scrutiny and being blocked.[3]

In this paper, we examine how the CA can use firms' investment decisions during the submission process to infer the cost-reduction effect of the merger and avoid two undesirable outcomes due to its incomplete information: (i) blocking cost-reducing mergers, which would have improved welfare; and (ii) approving price-increasing mergers that reduce welfare.

Firms invest large amounts in their merger requests, with three main motives: (1) administrative fees, as in Besanko and Spulber (1993); (2) searching for hard evidence about the merger's efficiency to share with the CA, as in Lagerloff and Heidhues (2005); and (3) investment in public relations campaigns, advertising, and lobbying.[4] We seek to identify separating equilibria where only merging entities with substantial efficiencies submit such requests, investing enough resources to signal their type, and the CA responds approving the merger. We also search for pooling equilibria, where all types of merging entity submit requests and the CA responds approving them, leading to inefficient mergers being approved due to the CA's incomplete information. In this setting, we examine different policies to hinder inefficient mergers in equilibrium.

[1] The European Commission follows similar guidelines, see "Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings," specifically section VII, which describes the assessment of merger efficiencies.

[2] For empirical studies estimating cost-reduction effects in the US airline industry, see Kim and Singal (1993), Johnston and Ozment (2013), Gayle and Le (2013), both finding significant cost savings from the merger; Barros et al. (2013), who finds no effects; Yan et al. (2019), who find positive effects in Chinese airlines; and Gudmundsson et al. (2017) who found nil or negative cost saving effects for international airlines. Similarly, Ashenfelter et al. (2015) examines the US beer industry after the MillerCoors merger, showing that costs savings were dominated by adverse competitive effects; and so do Kwoka and Pollitt (2010) for the US electricity industry in 1994-2003 and Bloningen and Pierce (2016) for a large panel of US manufacturing industries during 1997-2007. In contrast, Ganapati (2021) shows that the mergers increased productivity in a large data set of US industries for 1972-2012, ultimately expanding output.

[3] Examples include the merger between insurance brokers Aon and Willis Towers Watson, blocked in July 2020; railway companies Kansas City Southern and Canadian National, blocked in September 2021; and the recent decision by the U.S. Department of Justice Antitrust Division opposition to block the merger of publishers Simon and Schuster with Penguin Random House in December 2022. This increased opposition comes after empirical studies finding that mergers tend to increase prices of consumer goods, Ashenfelter and Hosken (2010), and airline tickets, Kwoka and Shumilkina (2010), and can decrease labor demand by merged firms, ultimately leading to an increase in unemployment, Gugler and Yurtoglu (2003). Similarly, de Loecker et al. (2020) and Eeckhout (2021) show that the increase in market concentration can explain the reduction in labor and capital shares, and a decrease in labor market dynamism.

[4] While the third motive does not produce hard evidence, it is often used by firms seeking to merge, and may represent a large monetary outlay, given the number of consulting public relations companies offering services to firms planning to start a merger, such as TV advertising, press realeases, and training for media interviews.

Our model considers that, in the first stage, firms choose whether to submit a merger request to the CA. In the second stage, the CA responds by approving or blocking the request. In the third stage, if the merger is approved, the firms submitting the request form a single entity, thus coordinating their output decisions; whereas if the merger is blocked, every firm in the industry independently selects its output level. The merger, if approved, produces a cost-reduction effect, which the CA may not observe upon receiving a request.

As a benchmark, we first analyze equilibrium behavior under complete information. We show that only merger requests that are both profitable and welfare improving are submitted to the CA, which responds by approving them. In this setting, firms invest no resources in the merger request, as the CA observes the exact cost-reduction effect.

Under incomplete information, however, the converse of these results can be sustained, where the CA approves welfare-reducing mergers. For presentation purposes, we first consider that firms, if submitting a merger request, pay only administrative fees; we denote this case as "exogenous costs." In this setting, we identify a separating equilibrium, where only welfare-improving mergers are approved, as under complete information; and a pooling equilibrium where all types of merging entities submit a request and the CA responds approving them. As a consequence, mergers that reduce welfare are approved when the CA is uninformed while they would have been blocked under complete information, which we refer as "inefficient mergers."

We then allow for firms to invest in the submission process beyond the administrative fee, which we refer as "endogenous costs," such as public relations campaigns or consulting companies. In this context, we also identify separating and pooling equilibria. Relative to exogenous costs, we demonstrate that allowing firms to invest in the submission process facilitates information transmission and hinders inefficient mergers. This result is strengthened when the merger accounts for a large market share. While endogenous costs provide a positive effect (information transmission), they also give rise to a negative effect, as the merging entity invests more than under complete information (separating effort) to convey its type to the uninformed CA.

Comparing these positive and negative effects, we show that when the types of merging entities are moderately similar the positive effect dominates, unless administrative fees are extremely low, making endogenous costs socially preferable. Otherwise, settings with exogenous costs are preferable. Therefore, our findings suggest that allowing merging entities to invest in the submission process becomes more critical when the cost-reduction effect is relatively similar across firms, but is less relevant otherwise.

Our paper also explores other policy tools. We show that investment limits hinder information transmission when the types of merging entity are similar, but facilitate it when types are dissimilar. Intuitively, the efficient merging entity can convey its type to the CA with a lower investment (smaller separating effort), making this merger more likely to arise. In addition, we examine the role of administrative fees. When they are relatively low, endogenous costs gives rise to efficient mergers, as opposed to exogenous costs which can only sustain inefficient mergers in this context. When fees increase, efficient mergers can arise under both exogenous and endogenous settings, but they become more likely under the latter. However, when administrative fees further increase, only efficient mergers can be supported under both cost settings, implying that endogenous costs do not provide information benefits to the CA.

Related literature. The literature on mergers is extensive, covering topics such as firms' incentives to merge if their market share is sufficiently high, Salant et al. (1983); its welfare effects when the merger reduces the production costs of the merging firms, Williamson (1968), Perry and Porter (1986) and Farrell and Shapiro (1990); mergers when firms compete in prices, Deneckere and Davidson (1985) and Besanko and Spulber (1993); CAs receiving merger proposals over time, and choosing which ones to approve in a dynamic setting, Nocke and Whinston (2010); or firms choosing between alternative merger sizes and the CA responding with a tougher standard on large mergers, Nocke and Whinston (2013). For literature reviews see, for instance, Whinston (2006), Kaplow and Shapiro (2007), and Werden and Froeb (2008).[5]

Our model is, however, more related to the literature examining the role of incomplete information in mergers, either because firms are not informed about some other firm's costs, the merger's efficiency, or because the CA does not observe this efficiency.[6] Specifically, our paper considers a signalling game similar to that in Besanko and Spulber (1993) but allowing for filing fees (merger submission costs) to be endogenous, as opposed to exogenous in their setting. This helps us evaluate how equilibrium results are affected, test if information transmission is improved, and identify if the approval of socially inefficient mergers is ameliorated.

In addition, Besanko and Spulber (1993) assume an industry with two firms that compete in prices, so a full merger reduces consumer surplus with certainty but may increase or decrease social welfare. Our setting allows, instead, for a merger between a share of all firms competing in quantities, which may increase or decrease consumer surplus depending on the severity of its cost-reducing effect.

Lagerloff and Heidhues (2005) also study merger approval decisions, but assume that firms are initially uninformed about the cost-reducing effect of the merger, and must invest in producing hard evidence about this cost reduction to present to the CA.[7] As a consequence, firms and the CA are symmetrically informed in their setting, thus not allowing for signaling behaviors to occur in equilibrium. In contrast, our model allows firms to have more accurate information about the cost-reducing effect than does the CA, so their investment in expert reports and consulting companies can help the CA update its beliefs about the firm's type. In a pooling equilibrium, where both firm types invest positive amounts in the submission process, the CA is left "in the dark" about the

[5] Other recent articles analyzing welfare effects in mergers include Prat and Valletti (2021), in digital platforms, and Miller et al. (2021), in the US beer industry.

[6] For studies introducing incomplete information on the firm's side, see Saloner (1987) and Loertscher and Marx (2021), analyzing mergers where firms have private information about its production costs. They evaluate how this information asymmetry affects firms' decisions to merge and their pre-merger market outcomes (e.g., price wars).

[7] In particular, if the merging entity invests in hard evidence about the efficiency of the merger, it can produce this evidence with probability τ_i, where $i = \{H, L\}$ denotes the merger's efficiency which satisfies $\tau_H > \tau_L$. With probability $1 - \tau_i$, the merging entity does not find hard evidence, meaning that the CA does not receive any information.

merger's efficiency, which cannot occur in their model.[8] As similar signaling models, our setting considers that submission costs can help firms convey information about their efficiency, even if their investment does not produce hard evidence to present to the CA. Allowing for a share of the firm's investment to produce hard evidence does not qualitatively affect our main results, as that evidence only shifts the CA's priors, making this agency assign a larger probability to the merger's efficiency being high.

The following section describes the model. Section 3 identifies equilibrium behavior under complete information. Section 4 (5) considers a setting with exogenous (endogenous) costs under incomplete information. Section 6 examines extensions to our model: (i) more than two merging firms; (ii) the CA's using other merger evaluation guidelines; (iii) uninformed outsiders; (iv) allowing firms to submit hard evidence; and (iv) allowing for continuous responses by the CA. Section 7 discusses our main results and their policy implications.

2 Model

Consider an industry with two firms competing a la Cournot, facing an inverse demand function $p(Q) = 1 - Q$, where Q denotes aggregate output, and a marginal cost c, where $1 > c \geq 0$. As in Perry and Porter (1985), we allow for "synergies" when firms merge. Their marginal costs decrease from c to $c - x$, where parameter x denotes the cost-reduction effect of the merger (e.g., better management practices, avoid cost duplications, etc.). In contrast, if firms do not merge, their marginal cost remains at c.

The time structure of the game is the following:

1. In the first stage, firms that seek to merge choose whether to submit, as an entity, a merger approval request to the competition authority (CA), at a fixed cost $R \geq 0$.

2. In the second stage, the CA responds by approving or blocking the merger request. If no merger request was submitted, then the CA is not called to move. For simplicity, we consider that the CA evaluates mergers based on consumer surplus; but we later describe how our results are affected if, instead, the CA considers total welfare.

3. In the third stage, firms observe the CA's decision, and (if the merger is blocked) compete à la Cournot.

As a benchmark, we first analyze equilibrium behavior in a complete information context where the CA perfectly observes the cost-reduction effect of the merger (i.e., the realization of parameter x). Afterwards, we examine an incomplete information setting where the CA cannot observe the realization x, but may infer its realization by observing whether firms filed a merger.

[8] This result cannot occur in their extension either, where they allow for firms to fabricate false evidence to submit to the CA, as the CA does not update its beliefs about the firm's type in that setting.

3 Complete Information

Solving the game by backward induction, we find the following output in the third stage. (For compactness, superscript NM denotes "no merger," whereas M means "merger.")

Lemma 1. *In the third stage, if the merger is blocked, the equilibrium output of each firm i is* $q_i^{NM} = \frac{1-c}{3}$ *and equilibrium profits are* $\pi_i^{NM} = \left(q_i^{NM}\right)^2$. *If the merger is approved, the equilibrium output is* $q^M = \frac{1-(c-x)}{2}$ *with equilibrium profits* $\pi^M = \left(q^M\right)^2$.

The merger entity produces a positive output since $1 > c$ and $x \geq 0$. In addition, let $\theta \equiv \frac{x}{1-c}$ denote the cost-reduction effect, which is not excessive, $\theta < 1$, when $x < 1-c$, which we assume throughout the paper. Anticipating equilibrium output in the third stage, the CA compares the welfare with and without the merger, as shown in the next lemma.

Lemma 2. *In the second stage, the CA approves a merger if and only if* $\theta > \overline{\theta}$ $(\theta > \overline{\theta}_W)$ *when considering consumer surplus alone (considering total welfare, respectively), where* $\overline{\theta} \equiv \frac{1}{3}$ *and* $\overline{\theta}_W \equiv \frac{4\sqrt{6}-9}{9} \simeq 0.089$.

As described by Perry and Porter (1985), the CA faces a trade-off when approving the merger: a more concentrated industry, but also a potential cost reduction. If this cost reduction is sufficiently large, $\theta > \overline{\theta}$, then the merger enhances consumer surplus, as proposed by Pittman (2007). A similar argument applies when the CA considers both consumer and producer surplus, where the merger is approved under wider conditions; $\theta > \overline{\theta}_W$.

We next analyze the firms' decision to request a merger approval in the first stage of the game. In the absence of the CA ($R = 0$), firms merge since $\pi^M \geq 2\pi_i^{NM}$ holds for all parameter values. As we next show, when the CA is present, firms file merger approval under more restrictive parameter conditions.

Proposition 1. *In the first stage, a merger is submitted for approval if and only if* $\theta > \max\left\{\widehat{\theta}, \overline{\theta}\right\}$, *where* $\widehat{\theta} \equiv \frac{2}{1-c}\sqrt{2\left(\frac{1-c}{3}\right)^2 + R} - 1$. *Cutoffs satisfy: (i)* $\widehat{\theta} \leq 0 < \overline{\theta}$ *if* $R \leq \widetilde{R}$; *(ii)* $\overline{\theta} \geq \widehat{\theta} > 0$ *if* $\widehat{R} \geq R > \widetilde{R}$; *and (iii)* $\widehat{\theta} > \overline{\theta} > 0$ *if* $R > \widehat{R}$, *where* $\widehat{R} \equiv 2\pi_i^{NM}$, $\widetilde{R} \equiv \frac{\pi_i^{NM}}{4}$, *and* $\widehat{R} > \widetilde{R}$. *Cutoff* $\widehat{\theta}$ *is increasing in R.*

Figure 1 shows that cutoff $\widehat{\theta}$ increases in R: the merging entity finds the merger less attractive when administrative fees increase, thus requiring a larger cost-reducing effect to merge. The figure also illustrates that cutoff $\widehat{\theta}$ is negative for sufficiently low fees, $R \leq \widetilde{R}$, where the merger is profitable regardless of its cost-reducing effect. This condition on R embodies costless submissions, $R = 0$, as a special case. When fees are higher, however, cutoff $\widehat{\theta}$ becomes positive, which implies that either $\widehat{\theta} \leq \overline{\theta}$ for all $R \leq \widehat{R}$ (to the left of $\widehat{R}$ in the figure) or $\widehat{\theta} > \overline{\theta}$ otherwise, which give rises to four regions. In region I, the merger is profitable but welfare reducing (R and θ are low); in region II, the merger is both unprofitable and welfare reducing (R is relatively high and θ is low); in region III, the merger is still unprofitable but welfare improving (R and θ are relatively high); and, in region IV, the merger is profitable and welfare improving (R is low and θ is high). Anticipating these regions, firms file for a merger approval only in region IV.

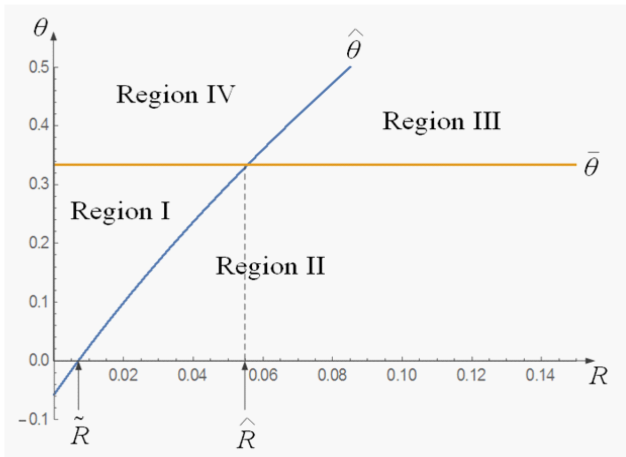

Figure 1. Equilibrium mergers and welfare.

In summary, the subgame perfect equilibrium of the game prescribes that firms file a merger approval if and only if $\theta > \max\{\widehat{\theta}, \overline{\theta}\}$; in region IV. The CA responds approving this request and, then, the merging entity produces q^M units, as reported in Lemma 1. If $\theta > \max\{\widehat{\theta}, \overline{\theta}\}$ does not hold (in regions I-III), no firm files a merger request and every firm i responds by producing the Cournot output q_i^{NM} in the last stage.

For simplicity, the remainder of the paper assumes that submission costs are relatively low, $R \leq \widehat{R}$, which implies that, if a merger is welfare improving it must also be profitable. The converse is, however, not necessarily true, meaning that a merger may be profitable but not be welfare improving.

4 Incomplete Information - Exogenous costs

Consider now that the CA does not observe the realization of the cost-savings effect, x, which implies that the CA does not observe $\theta \equiv \frac{x}{1-c}$ either. The CA, however, holds a prior probability of θ, where $\theta = \theta_H$ with probability p, and $\theta = \theta_L$ otherwise. Importantly, θ_H and θ_L satisfy $\theta_H > \overline{\theta} > \theta_L$, entailing that the CA would approve mergers if it was perfectly informed that $\theta = \theta_H$ but block them otherwise.[9]

[9] Assuming, instead, that $\overline{\theta}$ satisfies $\overline{\theta} > \theta_H$ ($\theta_L > \overline{\theta}$) would make incomplete information uninteresting, as the CA would have blocked (approved, respectively) mergers from all firm types under complete information.

In addition, let

$$\begin{aligned} E[\theta] &\equiv p\frac{x_H}{1-c} + (1-p)\frac{x_L}{1-c} \\ &= p\theta_H + (1-p)\theta_L \end{aligned}$$

denote the expected cost-reduction effect of the merger. We consider that $E[\theta] > \overline{\theta}$, which entails that $p > \frac{\overline{\theta}-\theta_L}{\theta_H-\theta_L} \equiv \widehat{p}$. Intuitively, the high type is relatively likely or, alternatively, its cost-reduction advantage as captured by $\theta_H - \theta_L$ is sufficiently large.

In this context, consider the following signaling game:

1. In the first stage, the merging entity privately observes its type, θ_H or θ_L, and decides whether to submit a merger request to the CA, paying an administrative fee $R = f$. This merger request is interpreted as an administrative form that cannot include additional technical reports describing the potential efficiency gains from the merger.

2. In the second stage, the CA does not observe the merging entity's type, but observes whether it submitted a merger approval request (M) or not (NM). Upon observing M, the CA updates its beliefs about the merging entity's type being high, $\mu(\theta_H|M)$, or low, $\mu(\theta_L|M)$, applying Bayes' rule whenever possible. Given this set of beliefs, the CA responds by approving or blocking the merger.

3. In the third stage, firms observe the CA's decision, and (if the merger is blocked) compete à la Cournot.

We study separating Perfect Bayesian Equilibria (SEs) where the θ_H-type merging entity submits a merger request, while the θ_L-type does not. This strategy profile allows the CA to concentrate its beliefs to $\mu(\theta_H|M) = 1$ and $\mu(\theta_L|M) = 0$, conveying the merging entity's cost-reduction effect to the uninformed CA. We also examine pooling equilibria (PEs) where both firm types submit a merger request and, upon observing M, the CA cannot update its beliefs, which coincide with its priors, $\mu(\theta_H|M) = p$ and $\mu(\theta_L|M) = 1 - p$. The following proposition identifies a unique SE and PE in this setting, which survive the Cho and Kreps' (1987) Intuitive Criterion.

Proposition 2. *Under exogenous submission costs:*

1. *If $\theta_L \leq \widehat{\theta}$, only a SE can be supported where only the θ_H-type merging entity submits a merger request.*

2. *Otherwise, only a PE can be sustained where every type of merging entity submits a merger request.*

Therefore, when the types of merging entities are relatively different, $\theta_L \leq \widehat{\theta}$, the θ_L-type cannot profitably mimic the request of the θ_H-type, which yields a SE. In this case, only the θ_H-type entity submits a merger request, and the merger profile coincides with that under complete information (Proposition 1). Therefore, no inefficiencies emerge due to the CA's incomplete information. However, when types are relatively similar, $\theta_L > \widehat{\theta}$, the θ_L-type mimics the merger request, which gives rise to a PE. As a result, inefficient mergers exist, as we next analyze.[10]

As shown in Proposition 1, cutoff $\widehat{\theta}$ is positive if and only if fees satisfy $R > \widetilde{R}$. Otherwise, $\widehat{\theta}$ becomes negative, and only the PE can be supported. Intuitively, when fees are sufficiently inexpensive, the low-type merging entity can profitably submit a request regardless of its difference with respect to the high-type entity. However, when fees are high enough, a SE emerges where only the high-type entity submits a merger request.

4.1 Socially inefficient mergers

We now compare our results in the PE of Proposition 2, where $\theta_L > \widehat{\theta}$, against those under complete information (Proposition 1). In the PE, both types of entity submit a merger request which are both approved by the CA. Under complete information, in contrast, only the high-type would have submitted a merger request, implying that the CA approves an inefficient merger (that of the low-type entity) under incomplete information. Intuitively, this occurs because both types of merging entity experience a relatively large cost-reduction effect (as captured by high values of θ_L), which satisfies $\theta_L < \overline{\theta}$, implying that the low-type merger is welfare reducing. Corollary 1 summarizes this region.

Corollary 1. *Inefficient mergers arise in equilibrium if $\theta_H \in [\overline{\theta}, 1]$ and $\theta_L \in [\widehat{\theta}, \overline{\theta}]$, where a low-type merging entity is approved (blocked) under incomplete (complete) information.*

In addition, the region of inefficient mergers, $\left(1-\overline{\theta}\right)\left(\overline{\theta}-\widehat{\theta}\right)$, expands when cutoff $\widehat{\theta}$ decreases, which occurs when submission cost, f, decreases. That is, less expensive administrative fees make inefficient mergers more likely to occur.

The output distortion from approving the merger of a low-type entity is

$$Q^{NM} - Q^{M}(\theta_L) = \frac{(1-c)(1-3\theta_L)}{6},$$

where the CA considers the aggregate output that the low-type merging entity would produce under complete information, when the merger does not ensue, $Q^{NM} = 2q_i^{NM}$; against the aggregate output in the PE, where the merger is approved, $Q^{M}(\theta_L) = q^{M}$. As the low-type entity's cost-reduction effect increases (higher θ_L), the output distortion, as captured by $Q^{NM} - Q^{M}(\theta_L)$, decreases. Intuitively, the high- and low-type entities become more similar, reducing the output distortion of incorrectly approving a merger under incomplete information.

The output distortion is, then, weighted by the size of the region where the PE is sustained, in Corollary 1, yielding the "merger inefficiency" with exogenous costs ($MI_{exog.}$), as follows

[10] Appendix 1 investigates semiseparating equilibria where firms and the CA randomize their decisions. We show that this equilibria can be sustained only under relatively restrictive parameter conditions.

$$
\begin{aligned}
MI_{exog.} &= \left[\left(1-\overline{\theta}\right)\left(\overline{\theta}-\widehat{\theta}\right)\right] \times \left[Q^{NM} - Q^{M}(\theta_L)\right] \\
&= \frac{(1-c)\left(1-3\widehat{\theta}\right)(1-3\theta_L)}{27}
\end{aligned}
$$

since $\overline{\theta} = 1/3$. We next analyze how this inefficiency is affected by administrative fees, which increase cutoff $\widehat{\theta}$.

Corollary 2. *A marginal increase in* $\widehat{\theta}$ *produces:*

1. *A reduction of the area that supports the PE, which reduces* MI_{exog}*.*
2. *An expansion of the area that sustains the SE.*

Therefore, higher administrative fees make inefficient mergers less likely to occur, ultimately reducing $MI_{exog.}$. This increase in fees, however, expands the region where the SE can be sustained, making efficient mergers more likely to arise. Overall, an increase in administrative fees facilitates information transmission, helping the CA's decision after receiving a merger request.

5 Incomplete information - Endogenous costs

Previous sections assume that submission costs were exogenous. In several contexts, however, firms can choose how many resources to spend on preparing their merger request before submitting it to the CA, such as hiring consulting companies and experts. This cost could be interpreted more generally, also including lobbying efforts to politicians who influence the CA's opinion about the merger request, or ad campaigns on media outlets that describe the merger as beneficial for consumers.

In this section, we allow every entity $i = \{H, L\}$ to invest $R_i = f + r_i$ dollars on their submission to the CA, where $f \geq 0$ denotes the administrative fee and r_i represents any additional investment. This investment is observable by the CA, which could be explained by the CA's inspecting the expert reports included in the merger request and/or the consulting companies involved. Therefore, $R_i = 0$ means that the merging entity did not submit a merger request (not even incurring the administrative fee of submitting a form), while $R_i \geq f$ indicates that it did.[11]

Technically, the presence of endogenous submission costs changes the structure of the signaling game: from one in which the merging entity sends binary messages to the CA (submit or not a merger request) to one with a continuum of messages (investment $R_i \geq 0$).

[11] If R_i satisfies $f > R_i > 0$, the merging entity does not reach the administrative fee, which implies that the merger request is not submitted. This is strictly dominated by $R_i = 0$. As a result, the merging entity either does not submit the request, $R_i = 0$, or submits it, $R_i \geq f$, as specified above.

We next examine under which conditions a SE can be sustained where each type of merging entity invests different amounts in preparing its submission, R_H and R_L, where $R_H \neq R_L \geq 0$; and PE where both types of merging entity invest a common amount R^{PE}.

Proposition 3. *Under endogenous submission costs:*

1. *If $\theta_L \leq \widehat{\theta}$, only a SE can be supported where the high-type merging entity invests $R_H^{SE} = f$, and the low-type merging entity invests $R_L^{SE} = 0$ for all θ_L*

2. *If $\widehat{\theta} < \theta_L \leq \widehat{\theta}(R^{PE})$, only a SE can be sustained where the high-type merging entity invests $R_H^{SE} = \pi^{M,L} - 2\pi_i^{NM}$, and the low-type merging entity invests $R_L^{SE} = 0$ for all θ_L*

3. *Otherwise, SE and PE coexist. In the PE, both types of merging entity choose a common investment R^{PE}, where $f \leq R^{PE} \leq \pi^{M,L} - 2\pi_i^{NM}$.*

where cutoff $\widehat{\theta}$ satisfies $\widehat{\theta} \leq \widehat{\theta}(R^{PE})$.

The above proposition identifies three regions. First, when the types of merging entity are relatively different, $\theta_L \leq \widehat{\theta}$, only a SE can be sustained where the low-type entity does not find it profitable to mimic the investment of the high-type entity, R_H^{SE}, and does not submit a merger request. In contrast, the high-type entity invests $R_H^{SE} = f$, since $f > \pi^{M,L} - 2\pi_i^{NM} = \frac{(1-c)^2[1+9\theta_L(2+\theta_L)]}{36}$ given the small cost-reducing effect of the low-type entity.

Second, when the types of merging entity are moderately asymmetric, $\widehat{\theta} < \theta_L \leq \widehat{\theta}(R^{PE})$, only a SE arises as well, but the high-type entity invests $R_H^{SE} = \pi^{M,L} - 2\pi_i^{NM}$. In this case, the low-type entity finds the merger more attractive, and would be willing to invest up to $\pi^{M,L} - 2\pi_i^{NM}$ in the merger request, which the high-type entity must match (or marginally exceed) to convey its type to the CA. This investment is the least-costly SE that cannot be profitably mimicked by the low-type entity and still conveys its type to the CA, which responds by approving the merger.

The high-type entity's "separating effort" is given by its investment increase relative to complete information, $\frac{(1-c)^2[1+9\theta_L(2+\theta_L)]}{36} - f$, which is unambiguously increasing in θ_L. As the low-type entity enjoys a larger cost-reduction effect, this entity has more incentives to mimic (submitting a merger request), which ultimately requires a larger investment from the high-type entity to convey its type to the CA. Since this result holds for all θ_L, the SE can be supported for all admissible values of θ_L.

Finally, when the types of merging entity are relatively similar, $\theta_L > \widehat{\theta}(R^{PE})$, the low-type entity finds it profitable to submit a merger request too, and a PE and SE coexist. In this context, both types choose a common investment, R^{PE}. This investment does not convey information to the CA, which responds approving the merger. Overall, information transmission is facilitated (hindered) when the types of merging entities are relatively different (similar).[12]

[12] When R^{PE} increases, cutoff $\widehat{\theta}(R^{PE})$ increases as well. If R^{PE} increases to its upper bound, $R^{PE} = \pi^{M,L} - 2\pi_i^{NM}$, condition $\theta_L \leq \widehat{\theta}(R^{PE})$ holds for all admissible values of θ_L, implying that the PE cannot be sustained. Instead, only a SE can be supported for all θ_L.

5.1 Comparison with exogenous costs

Cutoff $\widehat{\theta}(R^{PE})$ satisfies $\widehat{\theta} \leq \widehat{\theta}(R^{PE})$ since investment R^{PE} satisfies $R^{PE} \geq f$ (see Proposition 3). This ranking helps us identify the following three regions of equilibria under exogenous and endogenous costs.

Corollary 3. *Combining Propositions 2 and 3, we obtain that:*

1. *If $\theta_L \leq \widehat{\theta}$, only a SE can be supported under both exogenous and endogenous costs.*
2. *If $\widehat{\theta} < \theta_L \leq \widehat{\theta}(R^{PE})$, only a PE (SE) can be sustained under exogenous (endogenous) costs.*
3. *If $\widehat{\theta}(R^{PE}) < \theta_L$, only a PE can be supported under exogenous costs, but SE and PE coexist under endogenous costs.*

Figure 2 summarizes the results in Corollary 3. First, region 1 indicates that when the types of the merging entity are extremely different, $\theta_L \leq \widehat{\theta}$, the same (efficient) merger profile arises under exogenous and endogenous costs, with the same investment, $R_H^{SE} = f$. Therefore, allowing for firms to invest during the submission process does not affect the equilibrium results.

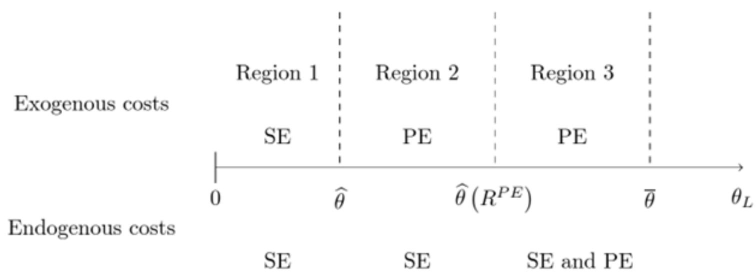

Figure 2. Equilibrium results under exogenous and endogenous costs.

In region 2, however, endogenous costs are socially preferable, as they yield a SE; whereas exogenous costs gives rise to a PE. In this case, allowing the merging entity to incur additional investments produces a positive effect, because it facilitates information transmission; but also a negative effect, as the merging entity increases its investment by $R_H^{SE} - f$. We compare both effects in the next section, but if the overall effect is positive (negative), one can argue that policies that allow (limit) investments beyond administrative fees are welfare enhancing. A similar argument applies to region 3, where only a PE can be supported under exogenous costs, but SE and PE coexist when costs are endogenous.

Figure 2 indicates also that, when R^{PE} decreases, cutoff $\widehat{\theta}(R^{PE})$ decreases as well. When R^{PE} is reduced to its lower bound, $R^{PE} = f$, cutoffs $\widehat{\theta}(R^{PE})$ and $\widehat{\theta}$ coincide, which eliminates region

2. In contrast, when R^{PE} reaches its upper bound, $R^{PE} = \pi^{M,L} - 2\pi_i^{NM}$, condition $\theta_L \leq \widehat{\theta}(R^{PE})$ holds for all values of θ_L, which implies that the PE cannot be supported and, instead, only the SE can be sustained under endogenous costs.[13]

When administrative fees are relatively low, $R < \widetilde{R}$, exogenous costs cannot support a SE (see section 4) under any parameter conditions. However, when merging entities are allowed to invest in the submission process, information transmission can be achieved: when $\theta_L \leq \widehat{\theta}(R^{PE})$ only a SE exists, and otherwise a SE and PE coexist.

5.1.1 Equilibrium refinements

In our context, the Cho and Kreps' (1987) Intuitive Criterion seeks to identify types of merging entities that can benefit by deviating towards no merger if the CA responded in the most positive way (approving the merger), while other types cannot benefit from such a deviation. The CA, however, is not called to move when the firm deviates to no merger, entailing that such a deviation yields, with certainty, $2\pi_i^{NM}$ to both types. Therefore, the CA does not hold off-the-equilibrium beliefs (upon observing no merger requests), which the Intuitive Criterion cannot help to further restrict.[14]

In settings where the responder's action is binary (approve or block the merger), the Banks and Sobel's (1987) Divinity Criterion yields the same results as the Intuitive Criterion, which applies both to the case of exogenous and endogenous submission costs.

5.2 Socially inefficient mergers

Approving a merger in the PE yields the same output distortion as in section 4.1, $Q^{NM} - Q^M(\theta_L) = \frac{(1-c)(1-3\theta_L)}{6}$. However, the regions where PEs can be sustained shrink relative to those under exogenous submission costs. In particular, the merger inefficiency with endogenous costs is

$$MI_{endog.} = \left[1 - \overline{\theta}\right]\left[\overline{\theta} - \widehat{\theta}(R^{PE})\right] \times \left[Q^{NM} - Q^M(\theta_L)\right]$$

where the first and last term in square brackets coincide with those in $MI_{exog.}$. The second term, however, is smaller in $MI_{endog.}$ than in $MI_{exog.}$ since cutoff $\widehat{\theta}(R^{PE})$ satisfies $\widehat{\theta}(R^{PE}) > \widehat{\theta}$. Therefore, $MI_{endog.} < MI_{exog.}$, which implies that the merger inefficiency decreases when firms are allowed to invest during the submission process.

For instance, when R^{PE} reaches its upper bound, $R^{PE} = \pi^{M,L} - 2\pi_i^{NM} = \frac{(1-c)^2[1+9\theta_L(2+\theta_L)]}{36}$, cutoff $\widehat{\theta}(R^{PE})$ simplifies to $\widehat{\theta}(R^{PE}) = \theta_L$; in turn, $MI_{endog.}$ becomes $MI_{endog.} = \frac{(1-c)(1-3\theta_L)^2}{27}$. Comparing it against $MI_{exog.}$, we obtain that

[13] The argument for this result is analogous to that of cutoff $\widehat{\theta}\left(R_H^{SE}\right)$ in the SE (see proof of Proposition 3).

[14] A similar argument applies under endogeneous costs, where both types of merging entity can improve their equilibrium payoffs by deviating from investing R^{PE} to R' where $0 \leq R' < R^{PE}$, saving $R^{PE} - R' > 0$ in submission costs. Therefore, we cannot find a type of merging entity for which a deviation to R' is equilibrium dominated.

$$MI_{exog.} - MI_{endog.} = \frac{(1-c)(1-3\theta_L)\left(\theta_L - \widehat{\theta}\right)}{9}$$

where $1 > c$ by assumption, the second term in the numerator is positive since $\theta_L < \overline{\theta} = 1/3$ by definition, and the last term is also positive since $\theta_L > \widehat{\theta}$ holds in regions 2 and 3; then $MI_{exog.} > MI_{endog.}$. However, when R^{PE} coincides with its lower bound, $R^{PE} = f$, cutoff $\widehat{\theta}(R^{PE}) = \widehat{\theta}$, which yields that $MI_{endog.} = MI_{exog.}$.

As was discussed in Section 5.1, in region 2, the positive effect of allowing firms to invest in the submission process is measured by $MI_{exog.}$, as the PE (SE) arises under exogenous (endogenous) costs. The negative effect, however, is captured by the investment increase $\left(\pi^{M,L} - 2\pi_i^{NM}\right) - f$. Comparing these effects, we find that the positive effect dominates if $MI_{exog.} > \left(\pi^{M,L} - 2\pi_i^{NM}\right) - f$, which occurs when the administrative fees are relatively high; this implies that the investment increase is small, relative to the output distortion of inefficient mergers.

6 Extensions

6.1 Allowing for more merging firms

In this section, we extend our above analysis to an industry with $n \geq 2$ firms and a merging entity of k firms, where $n \geq k \geq 2$. Appendix 2 identifies the SE and PE in this setting, which yields similar results to those in Corollary 3, but with cutoffs and investment levels becoming a function of k and n, as follows,

$$\begin{aligned}
\overline{\theta}(k,n) &\equiv \frac{k-1}{n+1}, \\
\widehat{\theta}(k,n) &\equiv \frac{n-k+2}{(1-c)(n-k+1)}\sqrt{k\left(\frac{1-c}{n+1}\right)^2 + R} - \frac{1}{n-k+1},
\end{aligned}$$

where $\widehat{\theta}(k,n) > 0$ if and only if $R > \widetilde{R}(k,n) \equiv \pi^{M,L} - k\pi_i^{NM}$, where

$$\pi^{M,L}(k,n) - k\pi_i^{NM}(n) = \left(\frac{1-c+(n-k+1)x_L}{n-k+2}\right)^2 - k\left(\frac{1-c}{n+1}\right)^2.$$

As expected, when $n = k = 2$, the cutoffs collapse to $\overline{\theta}(2,2) = \frac{1}{3}$, $\widehat{\theta}(2,2) = \frac{2}{1-c}\sqrt{2\left(\frac{1-c}{3}\right)^2 + R} - 1$, and $\widetilde{R}(2,2) = \frac{(1-c)^2}{36}$; as in the previous sections.

When the submission is costless, $R = 0$, cutoff $\widehat{\theta}(k,n)$ simplifies to $\widehat{\theta}(k,n) = \frac{\sqrt{k}(n-k+2)-(n+1)}{(n+1)(n-k+1)}$. Therefore, under complete information, firms merge if $\theta \geq \widehat{\theta}(k,n)$. In addition, if the merger generates no cost-reduction effects, $\theta = 0$, this inequality entails $0 \geq \widehat{\theta}(k,n)$ which, when we solve for k, yields $k \geq \frac{2n+3-\sqrt{4n+5}}{2} \equiv \widehat{k}$, with a market share of $\frac{\widehat{k}}{n} \simeq 0.8$. Therefore, our results embody Salant et al.'s (1984) "80-percent rule" when $\theta = R = 0$. Furthermore, the cutoff $\widehat{\theta}(k,n)$ is concave in k; as in Perry and Porter (1985). In particular, $\widehat{\theta}(k,n)$ is positive for $k = 2$, increases in k (at a low rate), then decreases in k, and becomes negative for all $k > \widehat{k}$, where the merger is profitable for all cost-reduction effects.

Figure 3 shows how regions 1-3 are affected by an increase in the number of firms, n, fixing the merging entity at $k = 2$. For illustration purposes, the figure considers $c = 1/2$, $f = 1/100$, and $n = 8$.[15] The vertical axis, where $n = k = 2$, represents the results in Figure 2, where cutoffs satisfy $\overline{\theta}(2, n) > \widehat{\theta}(R^{PE}) > \widehat{\theta}(2, n)$, entailing that regions 1-3 can be sustained.[16] When n increases, cutoff $\overline{\theta}(k, n)$ is unambiguously decreasing in n, while cutoffs $\widehat{\theta}(k, n)$ and $\widehat{\theta}(R^{PE})$ are increasing in n. Hence, as the merger accounts for a smaller share of the industry, regions 1 and 2 expand, but region 3 shrinks. When $n < 5$, all three regions can be supported in equilibrium; when $n = 5$, only regions 1 and 2 can be sustained; and for all $n \geq 6$ only region 1 can be supported since θ_L must satisfy $\theta_L \leq \overline{\theta}(k, n)$.

Our results suggest that, when the merger represents a relatively large share of the industry (low n), regions 2 and 3 are likely to arise. As was discussed in the previous sections, a SE can be sustained in this region when firms are allowed to invest in the submission process, which could not be supported under exogenous costs. When the merger's market share is significant, letting firms invest in the submission process can improve information transmission to the CA, which ultimately prevents inefficient mergers. However, when the merger accounts for a small market share (high n), our findings indicate that only region 1 can be supported. In this region, a SE arises under both exogenous and endogenous costs, and the high-type entity invests f under both contexts as well, which implies that endogenous costs do not provide information advantages over exogenous costs in this setting.

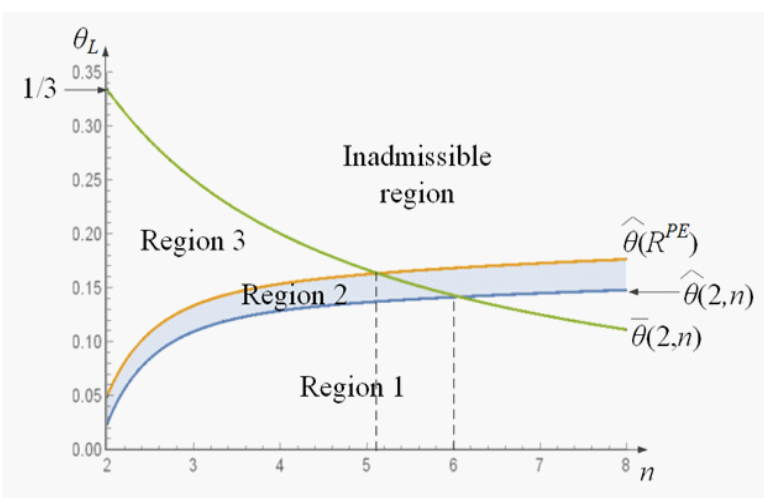

Figure 3. Equilibrium results as a function of n.

[15] Administrative fees, f, below 1/144 would yield a negative cutoff $\widehat{\theta}(2, 2)$, in the vertical axis, thus not supporting region 1. Other parameter values produce similar results and can be provided by the authors upon request.

[16] For simplicity, Figure 3 considers that $R^{PE} = f + \frac{\pi^{M,L} - k\pi_i^{NM}}{4}$.

6.2 Allowing for other merger evaluation guidelines

Total welfare guidelines. Under complete information, the CA approves a merger if θ satisfies $\theta > \overline{\theta}$ when considering consumer surplus, but $\theta > \overline{\theta}_W$ when considering total welfare (see Lemma 2), where $\overline{\theta} > \overline{\theta}_W$. Under incomplete information, the condition for the CA's decision to be relevant ($\theta_H > \overline{\theta} > \theta_L$, as defined in section 4) becomes $\theta_H > \overline{\theta}_W > \theta_L$, which produces a more dissimilar set of types. Our equilibrium results would hold in this setting as well, since Propositions 2 and 3 identify the firm's equilibrium behavior, which does not directly depend on the CA's payoff. (Graphically, cutoffs $\widehat{\theta}$ and $\widehat{\theta}(R^{PE})$ are unaffected.) However, region 3 now shrinks since its upper bound shifts leftward from $\overline{\theta} = 1/3$ to $\overline{\theta}_W = 0.089$; but regions 1-3 can still be supported. Hence, the information benefit of allowing firms to invest during the submission process apply in this context too.

The above results are, nonetheless, affected when we allow for $n \geq 2$ firms and a merger between $k = 2$, as in the previous section. In this context, it is easy to show that cutoff $\overline{\theta}_W$ becomes $\overline{\theta}_W(2, n) = \frac{n[2+n-\sqrt{4+n(8+n)}]+1}{1+3n-2n^3}$. Figure 4 depicts this cutoff, which originates at $\overline{\theta}_W(2, 2) = 0.089$ when $n = 2$, but otherwise decreases in n, being positive for all values of n. Cutoffs $\widehat{\theta}(2, n)$ and $\widehat{\theta}(R^{PE})$ coincide with those in Figure 3 since firm behavior is unchanged. The figure illustrates that, as the merger accounts for a smaller share of the industry (higher n), region 3 shrinks, eventually disappearing, and further increases in n also shrink region 2. When $n > 3$, only region 1 can be sustained in equilibrium, where allowing for firms to invest strategically in their submission process does not provide information benefits to the CA. Therefore, our equilibrium results suggest that, in this context, preventing merging entities from submitting expert reports in their merger requests, along with other submission-related investments, could improve outcomes.

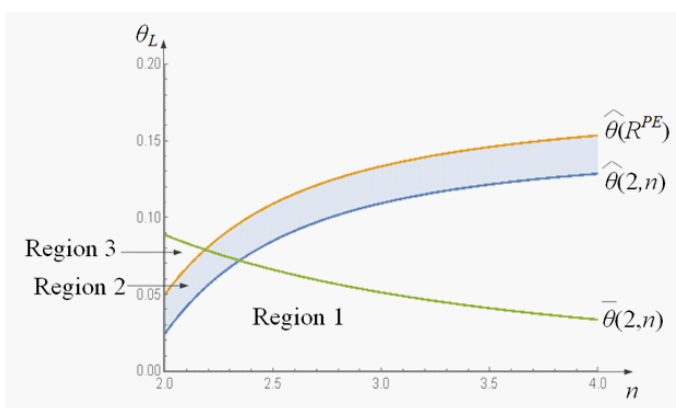

Figure 4. Equilibrium behavior as a function of n
when the CA considers total welfare.

HHI guidelines. Alternatively, the CA could consider the Herfindahl-Hirschman Index (HHI) if the merger is approved, or the change in HHI before and after the merger. Pre-merger, firms are symmetric, evenly sharing the market, so that $HHI_{pre} = n\left(\frac{100}{n}\right)^2 = \frac{10{,}000}{n}$. Post-merger, however, this index becomes

$$\begin{aligned} HHI_{post} &= \left(\frac{q^M}{q^M + (n-k)q_O^M}100\right)^2 + (n-k)\left(\frac{q_O^M}{q^M + (n-k)q_O^M}100\right)^2 \\ &= \frac{10,000\left[1-c-(n-k+1)x\right]^2 + (n-k)(1-c-x)^2}{\left[(1-c)(n-k+1)+x\right]^2} \end{aligned}$$

where $q^M = \frac{1-c+(n-k+1)x}{n-k+2}$ and $q_O^M = \frac{1-c-x}{n-k+2}$ denote the equilibrium output of the merging entity and each of the $n-k$ outsiders, respectively (see Appendix 2). Comparing HHI_{pre} and HHI_{post}, we find that $HHI_{post} > HHI_{pre}$ holds under all parameter values, thus increasing market concentration. To see this point, note that, when the merger does not yield cost-reducing effects, $x = 0$, HHI_{post} collapses to $HHI_{post} = \frac{10{,}000}{n-k+1}$, which exceeds $HHI_{pre} = \frac{10{,}000}{n}$ since $k \geq 2$ by definition. When $x > 0$, HHI_{pre} is unaffected, but HHI_{post} increases since $\frac{\partial HHI_{post}}{\partial x} = \frac{20{,}000(1-c)(n-k)(n-k+2)^2 x}{[(1-c)(n-k+1)+x]^3}$ is unambiguously positive given that $n \geq k \geq 2$ by assumption. Intuitively, as the cost-reducing effect becomes more significant, the merging entity enjoys a larger cost advantage relative to the $n-k$ outsiders, and captures a larger market share, which ultimately leads to a greater market concentration.

Figure 5 depicts HHI_{post}, evaluated at the same parameter values as in the previous figures ($c = 1/2$ and $k = 2$). As a reference, the figure also includes the case in which $x = 0$, showing that an increase in the cost-reduction effect produces an upward pivoting effect on HHI_{post}. As was discussed above, this result entails that the market becomes more concentrated when the merging entity enjoys a more significant cost-reduction effect (higher x).[17]

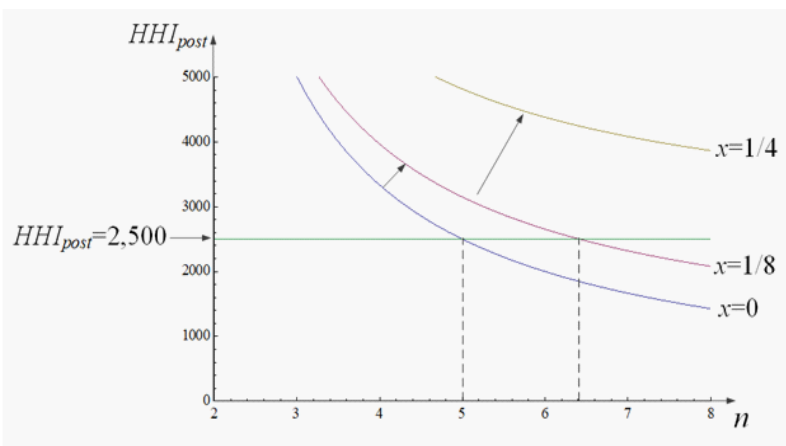

Figure 5. HHI_{post} at different values of x.

[17] Alternatively, cutoff $\overline{\theta}(k,n)$ can be expressed as a function of HHI_{pre}, as follows $\overline{\theta}(k,n) = \frac{n(k-1)}{n+1}HHI_{pre}$. Therefore, an increase in the number of merging firms, k, produces an increase in ratio $\frac{n(k-1)}{n+1}$ while keeping HHI_{pre} unaffected, which shifts the upper bound of θ, $\overline{\theta}(2,n)$, on figure 3.

The former Horizontal Merger Guidelines by the US Department of Justice identified mergers with $HHI_{post} > 2,500$ (horizontal line in the figure) as "presumed to be likely to enhance market power."[18] Therefore, our findings suggest that, if the CA considers this criterion exclusively, it will be more likely to challenge merger requests with large cost-reduction effects. In contrast, the CA would approve mergers when θ is sufficiently low, $\theta < \overline{\theta}_{HHI}$, blocking them otherwise, where

$$\overline{\theta}_{HHI} \equiv \frac{(n-k-3)(1+c) + 2(1-c)(n+k-2)\left[(n-k)(n-k-3)\right]^{1/2}}{(1-c)\left[3+4k^2+4n(3+n)-4k(3+2n)\right]}.$$

Hence, for the CA's incomplete information to be relevant, $\overline{\theta}_{HHI}$ must satisfy $\theta_H < \overline{\theta}_{HHI} < \theta_L$, which implies that the CA approves (blocks) the merger when its cost-reduction effect is relatively low (high, respectively); as opposed to section 6.1. These results would, then, be consistent with those in Froeb and Werden (1998) and Nocke and Whinston (2022).

6.3 Allowing for uninformed outsiders

We now examine the setting where the $n-k$ outsiders cannot observe the realization of the cost-reduction effect, x, which can be x_H with probability p or x_L with probability $1-p$, where $p \in [0,1]$. When no merger occurs, profits coincide with π_i^{NM}, as identified in Lemma 1. When a merger ensues, however, every outsider chooses its output q_i to solve the following expected profit-maximization problem

$$\max_{q_i \geq 0} \; p\left[(1-q_H-q_i-Q_{-i})q_i - cq_i\right] + (1-p)\left[(1-q_L-q_i-Q_{-i})q_i - cq_i\right]$$

where q_H (q_L) denotes the merging entity's output when its type is high (low, respectively); and Q_{-i} represents the aggregate output of all other outsiders (except for firm i).

The merging entity, however, observes the realization of x. Solving this problem, yields a Bayesian Nash equilibrium output, (q_H, q_L, q_i), as is shown in Appendix 3, where

$$q_j^M = \frac{(1-c)\left[2+(n-k)E[\theta]\right] + (n-k+2)x_j}{2(n-k+2)} \text{ for the merging entity, and}$$

$$q_i^M = \frac{(1-c)\left[1+E[\theta]\right]}{n-k+2} \text{ and each outsider,}$$

where $j = \{H, L\}$ denotes the type of the merging entity; and $E[\theta] \equiv p\theta_H + (1-p)\theta_L$ represents the expected cost-reduction effect. The outsiders' equilibrium profit does not affect our results with regard to regions 1-3, but the merging entity's profit does change, becoming

$$\pi^{M,L}(p) = \left(\frac{(1-c)\left[2+(n-k)E[\theta]\right] + (n-k+2)x_L}{2(n-k+2)}\right)^2$$

[18] These guidelines also described that $\Delta \equiv HHI_{post} - HHI_{pre} > 200$ is likely to increase market power. A figure that depicts Δ at the same parameter values produces similar results.

which collapses to that in the previous section when the merging entity's type is low with certainty, $p = 0$, $\pi^{M,L}(0) = \left(\frac{1-c+(n-k+1)x_L}{n-k+2}\right)^2$.

Appendix 3 shows that the profit gain $\pi^{M,L}(p) - k\pi_i^{NM}$ is positive for all parameter values and, in addition, increases in p. Intuitively, when the merging entity's type is low, an increase in p implies that outsiders become more poorly informed. In this setting, the low-type merging entity anticipates a softer output competition in the last stage of the game (as outsiders produce fewer units), which makes the merger more attractive; as in Shapiro (1986) or Amir et al. (2009).

Therefore, condition $\pi^{M,L}(p) - R \geq k\pi_i^{NM}$ yields cutoff $\widehat{\theta}(p)$. Cutoffs $\widehat{\theta}(p)$ and $\widehat{\theta}(p, R^{PE})$ are both highly nonlinear in p. Figure 6 depicts them with the same parameter values as Figure 3 to illustrate how regions 1-3 are affected by the outsiders' incomplete information about the cost-reduction effect.

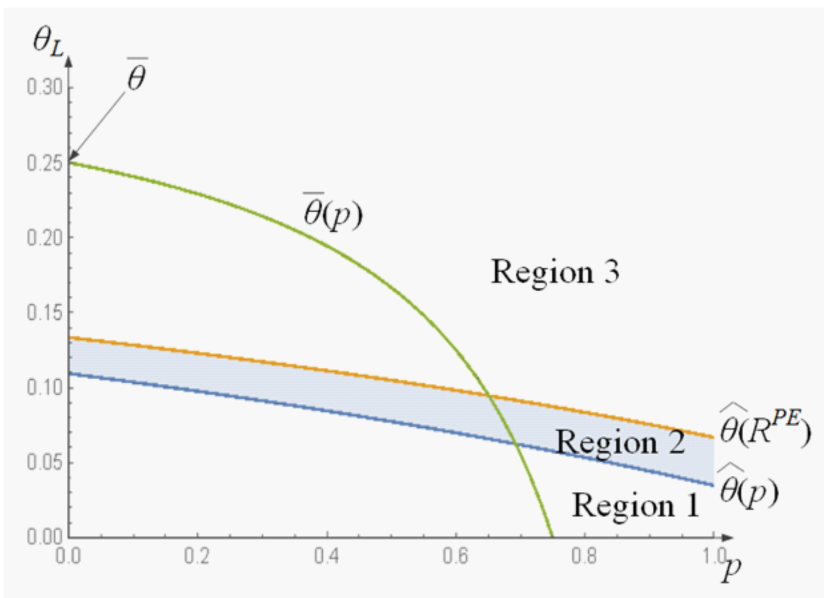

Figure 6. Equilibrium results as a function of p.

Figure 6 also includes the initial condition for the CA to approve a merger under incomplete information, $p > \widehat{p} \equiv \frac{\overline{\theta}-\theta_L}{\theta_H-\theta_L}$ or, after solving for θ_L, $\theta_L > \overline{\theta}(p) \equiv \frac{\overline{\theta}-p\theta_H}{1-p}$. When the merging entity's type is low with certainty, $p = 0$, this condition simplifies to $\theta_L > \overline{\theta} = \overline{\theta}(0)$, which cannot hold since $\theta_L < \overline{\theta}$ by definition. In this case, the CA perfectly observes the merging entity's type; this implies that the latter does not need to reveal or conceal its type, and it behaves as under complete information.[19]

However, when p increases, cutoff $\overline{\theta}(p)$ unambiguously decreases: as the CA believes that the merger's type is high (higher p), it is willing to approve mergers for lower values of θ_L. In turn,

[19]Evaluating the cutoffs of figure 6 at $p = 0$, we obtain the same results as in figure 3 evaluated at $n = 3$, where recall that $\widehat{\theta}(0) = 0.11$, $\widehat{\theta}(0, R^{PE}) = 0.13$, and $\overline{\theta}(0) = 0.25$; as depicted in the vertical axis of figure 6.

this gives rise to admissible parameter values where the SE, PE, or both, can be sustained. In particular, region 3 can be supported for relatively low values of p; regions 2 and 3 for intermediate values of p; and all regions for sufficiently high values of p. Importantly, cutoffs $\widehat{\theta}(p)$ and $\widehat{\theta}(p, R^{PE})$ decrease in p, shrinking regions 1 and 2 while expanding region 3. Our findings, then, suggest that, as the CA and outsiders assign a higher probability to the merger's cost-reduction effect being high (higher p), the PE is more likely to arise under exogenous costs (regions 2 and 3), while the SE and PE coexist under endogenous costs.

In summary, the benefit of allowing firms to invest in the submission process becomes more significant when $p > 0$, i.e., when the outsiders cannot say with certainty that the merger is of a low type.[20]

6.4 Allowing for hard evidence

Previous sections considered that a higher investment in the firm's submission, R_i, does not provide verifiable information (hard evidence) that the CA can use to modify its prior probability, p. If, instead, the firm's investment provides hard evidence, we could consider that $R_i = f + r_i + h_i$, where f and r_i were defined in Section 5, and h_i is the investment in hard evidence.

At the beginning of the game, the CA's priors would then be a function of the hard evidence provided by the firm, $p(h_i)$, where $p' > 0$ and $p'' < 0$. This is equivalent to adding a new stage before the game starts, where the firm chooses h_i, which produces prior $p(h_i)$. As a consequence, the presence of hard evidence would change only the CA's prior to $p(h_i)$ and, from that point, the game that we analyzed in previous sections ensues.

6.5 Allowing for continuous responses by the CA

In previous sections, the CA's available responses are binary (approve or block the merger). In richer settings, however, the CA could exert different effort levels in its challenge to a merger. This yields a profit of

$$\alpha\left(k\pi_i^{NM}\right) + (1-\alpha)\pi_I^M,$$

where $\alpha \in [0, 1]$ represents the challenge effort that the CA chooses. When $\alpha = 1$ the merger is challenged so effectively that it is blocked, which entails a profit of $k\pi_i^{NM}$ for the merging entity; whereas when $\alpha = 0$, the CA does not challenge the merger at all, being approved, and the merging entity earns π_I^M. For all other values of α, the merging entity earns a linear combination of these two profits, reflecting that it must adjust its production process following the CA's recommendations, or spend additional resources on appeals, which reduces its profits below π_I^M. As a consequence, the CA's strategy becomes a continuum $\alpha \in [0, 1]$ rather than discrete (approve or block). More intense challenging efforts are costly for the CA, however, as it needs to hire a larger team of lawyers

[20] This result is analogous to those in the literature of signaling to multiple audiences, as Gertner et al (1988). In our setting, information transmission improves because the merging entity's interests towards both audiences are aligned: information transmission increases the chances of the merger being approved by the CA and also softens output competition against outsiders in the last stage of the game.

and experts, at a total cost $\frac{1}{2}\lambda\alpha^2$, where $\lambda > 0$ represents a higher cost of challenging the merger request.

In this setting, the SE of Proposition 3 is unaffected. Indeed, upon observing a submission cost that originates from the high-type merging entity, the CA finds that approving the merger is welfare-improving ($\alpha = 0$) since $\theta_H > \overline{\theta} > \theta_L$. Similarly, Appendix 4 shows that the PE is unchanged. Intuitively, this occurs because, in the main model, blocking a merger was costless, and yet the CA had no incentives to block in the PE. In the current setting with a continuous strategy space, the CA actually faces a higher cost from challenging the merger than under a binary strategy space ($\lambda \geq 0$, whereas this cost was zero in the main model), implying that the CA has *less* incentives to challenge in the current setting.

7 Discussion

Endogenous submission costs. Allowing for firms to invest strategically during the preparation of the merger request (endogenous costs), hinders the emergence of the PE, which makes inefficient mergers less likely to be approved than when firms can invest only in an administrative fee (exogenous costs). These investments include, for instance, hiring experts, consulting companies, and even lobbying. The SE, instead, arises under wider parameter conditions when firms are allowed to invest than is true otherwise, which is welfare-improving given that only efficient mergers are approved by the CA in this equilibrium.

Therefore, allowing firms to invest beyond the administrative fee provides a positive effect, since investment facilitates information transmission. However, it also brings a negative effect because the merging entity incurs a separating effort: the firm invests more than under complete information. As a consequence, endogenous costs are not unambiguously preferable under all parameter conditions. In particular, when the types of merging entity are very similar and a PE arises under both cost settings, we observe an inefficient merger, but a more intense investment under endogenous costs, which makes the setting with exogenous cost preferable. However, when the types of merging entity are moderately similar, the positive effect dominates unless administrative fees are extremely low, which makes endogenous costs preferable.

Investment limits. Our above results help to inform policy proposals that would limit firms' ability to invest in their merger requests. In our setting, these policies would introduce a maximum investment $\overline{R}$ that firms cannot exceed. This maximum investment could be implemented, for instance, by requiring firms to submit bills for all reports and consulting companies that are hired while preparing the merger request documentation.

From our previous findings, if $\overline{R} < R^{PE}$, region 3 of figure 2 expands since its lower bound is now $\widehat{\theta}(\overline{R})$, where $\widehat{\theta}(\overline{R}) < \widehat{\theta}(R^{PE})$. Intuitively, the investment limit helps firms coordinate into a lower investment level, but does not facilitate information transmission. In contrast, regions 1 and 2 are unaffected, but the investment of the high-type entity in region 2, R_H^{SE}, decreases to $\overline{R}$, which helps reduce this merging entity's separating effort, $R_H^{SE} - f$ (see section 5), improving efficiency.[21] Overall, when the types of merging entity are relatively similar (high θ_L), investment limits hinder information transmission. However, when types are dissimilar (low θ_L), information transmission is facilitated, since the high-type merging entity can convey its type to the CA with a lower investment (smaller separating effort), which makes it more likely to arise.

Administrative fees. Our results also highlight the role of administrative fees f in facilitating each type of equilibria. When f is relatively low, cutoff $\widehat{\theta}$ becomes negative (see figure 2), which hinders the emergence of SE under exogenous costs. In this context, allowing firms to invest in the submission process helps SE to exist, where the CA approves efficient mergers. When f is intermediate, the SE arises under both exogenous and endogenous costs. Both cost settings, then, yield identical results when the types of merging entity are relatively different (region 1) but endogenous costs are still socially preferable when types are relatively similar (regions 2 and 3). Finally, when f is relatively high, only a SE can be sustained under both settings, entailing that endogenous costs do not provide information benefits to the CA. Extremely high fees, however, could deter even high-type entities from submitting a merger request, and would thus be welfare reducing.

In addition, our findings help inform the debate on whether filing fees should increase in the merger deal. We demonstrate that the profit difference $\pi_i^{M,L} - k\pi_i^{NM}$ and n move in opposite directions.[22] This implies that, as the merger accounts for a larger industry share, $\pi_i^{M,L} - k\pi_i^{NM}$ increases; this does not affect region 1 but does expand (shrink) region 2 (3). Therefore, allowing for firms to invest in the submission process provides more information benefits in this class of mergers; otherwise an inefficient merger is likely to exist under exogenous costs. Nonetheless, the separating effort of the high-type merging entity in the SE is larger in this context, $\left(\pi_i^{M,L} - k\pi_i^{NM}\right) - f$. To ameliorate this wasteful investment, regulators often set filing fees that increase in the profit gain from the merger, or the deal size as a proxy; as in the US, where filing fees became more rapidly increasing in the merger deal after the Filing Fee Modernization Act of 2021.[23]

Mergers between several firms. When the merger represents a relatively large share of the industry (low n), a SE can be sustained when the types of merging entity are relatively similar and firms can invest in the submission process, which produces an efficient merger. In this case, letting firms invest in the submission process can improve information transmission to the CA, and avoid the inefficient mergers that arise under exogenous costs. However, when the merger accounts for a small market share (high n), a SE arises under both exogenous and endogenous costs, and the high-type entity submits only the administrative fee f under both contexts. In this setting, endogenous costs do not provide information advantages over exogenous costs.

[21] If, instead, $\overline{R}$ satisfies $\overline{R} \geq R_H^{SE}$ ($\overline{R} \geq R^{PE}$), the investment limit becomes not binding, and the high-type merging entity (both types) behaves as in the SE (PE), thus investing R_H^{SE} (R^{PE}) without exceeding $\overline{R}$.

[22] Specifically, section 6.1 shows that cutoff $\widehat{\theta}(k, n)$ is increasing in n. This is equivalent to the profit difference $\pi_i^{M,L} - k\pi_i^{NM}$ decreasing in n, for a given merger size k.

[23] As a reference, filing fees in merger deals between US\$1 and \$2 billion increased from \$280,000 to \$415,000; those between \$2 and \$5 billion increased from \$280,000 to \$800,000; while those above \$5 billion increased from \$280,000 to \$830,000. In contrast, deals between \$92 and \$161.5 million saw a reduction in filing fees from \$45,000 to \$30,000; and those between \$184 to \$500 million also decreased their fees from \$125,000 to \$105,000. For more details on this act, see https://www.ftc.gov/enforcement/premerger-notification-program/filing-fee-information.

In summary, allowing firms to invest in the submission process is particularly beneficial when the merger represents a large market share. This result is emphasized when the CA uses total welfare as a guideline to approve mergers.

Uninformed outsiders. Finally, we explore how our findings are affected when outsiders are uninformed about the merging entity's cost-reduction effect. We show that, as outsiders become more uninformed, they produce fewer units, which softens output competition, and makes the merger more attractive. As a consequence, the PE is more likely to arise under exogenous costs (regions 2 and 3), but the merging entity's investment decision can still give rise to the SE under endogenous costs. Therefore, the information benefit of allowing firms to invest in the submission process becomes more significant when outsiders are incompletely informed about the merger's cost-reduction effect than otherwise.

Declarations of interest: none.

8 Appendix

8.1 Notation table

θ	Cost-reduction effect of the merger.
$\overline{\theta}$	Cutoff for a merger to increase consumer surplus.
$\overline{\theta}_W$	Cutoff for a merger to be welfare enhancing.
$\widehat{\theta}$	Cutoff for a merger to be profit enhancing.
f	Administrative fee
R_H^{SE}	Investment of the high-type merging entity in a separating equilibrium.
R_L^{SE}	Investment of the low-type merging entity in a separating equilibrium.
R^{PE}	Investment of every type of merging entity in a pooling equilibrium.
$\widehat{\theta}(R^{PE})$	Cutoff for a merger to be sustained in the pooling equilibrium.
$\widetilde{R}$	Fees below which mergers are profitable regardless of θ.
$\widehat{R}$	Fees below which mergers satisfy $\overline{\theta} > \widehat{\theta}$.

8.2 *Proof of Lemma 1*

In a case of no mergers, every firm solves,

$$\max_{q_i \geq 0} \quad (1 - q_i - q_j)q_i - cq_i$$

Differentiating with respect to q_i, we find firm i's best response function $q(q_j) = \frac{1-c}{2} - \frac{1}{2}q_j$ In a symmetric equilibrium, $q_i = q_j = q$. Therefore, the equilibrium output in this setting is

$$q_i^{NM} = \frac{1-c}{3}$$

and equilibrium profits become $\pi_i^{NM} = \left(\frac{1-c}{3}\right)^2 = \left(q_i^{NM}\right)^2$.

Now consider a merger is approved, then, firms solve

$$\max_{q\geq 0} \quad (1-q)q - (c-x)q$$

Differentiating with respect to q, yields $q^M = \frac{1-(c-x)}{2}$, entailing merger profits

$$\pi^M = \left(\frac{1-(c-x)}{2}\right)^2 = \left(q^M\right)^2.$$

8.3 *Proof of Lemma 2*

In this setting, an increase in consumer surplus is equivalent to an increase in output. In particular, $q^M \geq 2q_i^{NM}$ holds if and only if

$$\frac{1-c+x}{2} \geq 2\frac{1-c}{3}.$$

Rearranging, and solving for x yields $x \geq \frac{1-c}{3}$ or, alternatively, $\theta \equiv \frac{x}{1-c} \geq \frac{1}{3} \equiv \overline{\theta}$. If the CA considers, instead, total welfare, it approves the merger if and only if

$$\begin{aligned} & \frac{1}{2}\left(\frac{1-c+x}{2}\right)^2 + \left(\frac{1-c+x}{2}\right)^2 \\ \geq \quad & \frac{1}{2}\left(\frac{2(1-c)}{3}\right)^2 + 2\left(\frac{1-c+x}{3}\right)^2 \end{aligned}$$

where the left (right) side represents the sum of consumer and producer surplus when the merger is approved (blocked, respectively). Rearranging, and solving for x yields $x \geq \frac{1-c}{3}$ or, alternatively,

$$\theta \equiv \frac{x}{1-c} \geq \frac{4\sqrt{6}-9}{9} \simeq 0.089 \equiv \overline{\theta}_W$$

8.4 *Proof of Proposition 1*

A merger is profitable if $\pi^M - R \geq 2\pi_i^{NM}$, which holds if

$$\left(\frac{1-(c-x)}{2}\right)^2 - R \geq 2\left(\frac{1-c}{3}\right)^2$$

and rearranging, we find

$$\theta \equiv \frac{x}{1-c} \geq \frac{2}{1-c}\sqrt{2\left(\frac{1-c}{3}\right)^2 + R} - 1 \equiv \widehat{\theta}$$

In the absence of submission costs, $R = 0$, this cutoff simplifies to $\theta \geq \frac{2\sqrt{2}}{3} - 1 \simeq -0.06$, which is always satisfied. In addition, $\widehat{\theta} > \overline{\theta}$ holds if and only if

$$\frac{2}{1-c}\sqrt{2\left(\frac{1-c}{3}\right)^2 + R} - 1 > \frac{1}{3}$$

or, rearranging, and solving for R, $R > 2\left(\frac{1-c}{3}\right)^2 \equiv \widehat{R}$. Therefore, $\widehat{\theta} > \overline{\theta}$ holds when $R > \widehat{R}$; otherwise, $\widehat{\theta} \leq \overline{\theta}$ holds. Finally, it is easy to check that cutoff $\widehat{\theta}$ increases in R, as it enters positively, and in c since

$$\frac{\partial\widehat{\theta}}{\partial c} = \frac{6R}{(1-c)^2\sqrt{2\left(1-c\right)^2 + 9R}} > 0.$$

8.5 *Proof of Proposition 2*

SE where only the high-type submits a merger request. *Updated beliefs.* In this separating strategy profile, the CA updates its beliefs according to Bayes' rule, obtaining $\mu\left(\theta_H|M\right) = 1$ and $\mu\left(\theta_L|M\right) = 0$.

Receiver's response. Given the above beliefs, the CA is convinced of facing a high-type firm, and responds approving a merger upon observing one since $\theta_H > \overline{\theta}$ by definition.

Sender's messages. Anticipating these beliefs, the θ_H-type entity submits a merger approval, as prescribed in this separating strategy profile, if and only if $\pi^{M,H} - f \geq 2\pi_i^{NM}$, since it anticipates that the request will be approved by the CA. As shown in Proposition 1, this inequality entails that

$$\theta_H \equiv \frac{x_H}{1-c} \geq \frac{2}{1-c}\sqrt{2\left(\frac{1-c}{3}\right)^2 + f} - 1 \equiv \widehat{\theta}.$$

This condition, however, holds by definition since $\theta_H > \overline{\theta}$ and $\overline{\theta} > \widehat{\theta}$, implying that $\theta_H > \widehat{\theta}$ as well. In contrast, the θ_L-type entity does not submit a merger request, as required in this separating strategy profile, if and only if $\pi^{M,L} - f \leq 2\pi_i^{NM}$. Rearranging this inequality, yields $\theta_L \leq \widehat{\theta}$.

PE where both firm types submit a merger request. *Updated beliefs.* In this pooling strategy profile, the CA cannot update its beliefs according to Bayes' rule, keeping its prior probabilities unaffected, $\mu\left(\theta_H|M\right) = p$ and $\mu\left(\theta_L|M\right) = 1-p$.

Receiver's response. Given the above beliefs, the CA responds approving a merger upon observing a request if and only if

$$p\frac{1-c+x_H}{2} + (1-p)\frac{1-c+x_L}{2} \geq 2\frac{1-c}{3}.$$

Rearranging, yields $px_H + (1-p)x_L \geq \frac{1-c}{3}$ or, alternatively,

$$\frac{px_H + (1-p)x_L}{1-c} \geq \frac{1}{3} \equiv \overline{\theta}$$

which we can also express as

$$E[\theta] \equiv p\frac{x_H}{1-c} + (1-p)\frac{x_L}{1-c} = p\theta_H + (1-p)\theta_L \geq \overline{\theta}.$$

or, after solving for p, we obtain $p > \frac{\overline{\theta}-\theta_L}{\theta_H-\theta_L} \equiv \widehat{p}$, which holds by assumption.

Sender's messages. The θ_H-type entity submits a merger approval, as prescribed in this pooling strategy profile, if and only if $\pi^{M,H} - f \geq 2\pi_i^{NM}$, since it anticipates that the request will be approved by the CA. This inequality entails $\theta_H \geq \widehat{\theta}$. Similarly, the θ_L-type entity submits a merger approval, as required in this pooling strategy profile, if and only if $\pi^{M,L} - R \geq 2\pi_i^{NM}$, which yields $\theta_L \geq \widehat{\theta}$.

PE where both firm types do not submit a merger request. *Updated beliefs.* In this pooling strategy profile, the CA's information set is not reached since no merger approval request is submitted. Then, the CA holds off-the-equilibrium beliefs $\mu(\theta_H|M) = \mu$ and $\mu(\theta_L|M) = 1-\mu$.

Receiver's response. Given the above beliefs, the CA responds approving a merger upon observing one (which can only happen off-the-equilibrium path) if and only if $\mu\theta_H + (1-\mu)\theta_L > \overline{\theta}$ or, alternatively, $\mu > \frac{\overline{\theta}-\theta_L}{\theta_H-\theta_L} \equiv \widehat{p}$. We next separately analyze the case in which $\mu > \widehat{p}$ (and the CA responds approving merger, if one is submitted off the equilibrium) and that in which $\mu \leq \widehat{p}$ (and the CA blocks the merger).

Sender's messages. If $\mu > \widehat{p}$, the θ_H-type entity, does not submit a merger approval, as prescribed in this pooling strategy profile, if and only if $\pi^{M,H} - f < 2\pi_i^{NM}$, since it anticipates that a deviation towards sending a request will be approved by the CA (given its off-the-equilibrium beliefs). This inequality entails $\theta_H < \widehat{\theta}$. Similarly, the θ_L-type entity, does not submit a merger approval, as required in this pooling strategy profile, if and only if $\pi^{M,L} - f < 2\pi_i^{NM}$. This inequality yields $\theta_L < \widehat{\theta}$. However, condition $\theta_i < \widehat{\theta}$ for all types $i = \{H, L\}$ is not compatible with the initial condition that $\theta_H > \overline{\theta} > \theta_L$, implying that this pooling strategy profile cannot be sustained as a PE.

If, instead, $\mu \leq \widehat{p}$ holds, both entity types anticipate that the CA will respond blocking merger approval requests (off-the-equilibrium path). In this context, the θ_H-type entity does not submit a request, as prescribed in this pooling strategy profile, if and only if $\pi^{NM} - f < 2\pi_i^{NM}$, which simplifies to $-f < \pi_i^{NM}$, which holds by definition. A similar argument applies to the θ_L-type entity. As in the previous case, since condition $\theta_i < \widehat{\theta}$ for all $i = \{H, L\}$ is not compatible with the initial assumption $\theta_H > \overline{\theta} > \theta_L$, this pooling strategy profile cannot be sustained as a PE.

In summary, the pooling strategy profile where no merging entity types submits a merger request cannot be sustained as a PE.

Applying the Cho and Kreps' Intuitive Criterion. We need to consider only the PE where both firm types submit a merger request. In this case, if any firm i deviates towards not submitting a merger request (off-the-equilibrium path), the CA is not called on to move, which implies that this player does not hold off-the-equilibrium beliefs. As a consequence, we cannot further restrict the set of types that could have sent such an off-the-equilibrium message, which ultimately implies that we cannot restrict the CA's beliefs either. As a consequence, this pooling PE survives the Intuitive Criterion.

8.6 *Proof of Corollary 1*

Cost-reduction effects θ_H and θ_L, satisfy $1 > \theta_H > \overline{\theta} > \theta_L > 0$. If cutoffs $\widehat{\theta}$ and $\overline{\theta}$ satisfy $\widehat{\theta} \leq \overline{\theta}$, then, we obtain that $1 > \theta_H > \overline{\theta}$, while θ_L satisfies $\overline{\theta} > \theta_L > \widehat{\theta}$, which entails that the PE of Proposition 3 can be supported in the region $(1-\overline{\theta})(\overline{\theta}-\widehat{\theta})$.

If, instead, cutoffs $\widehat{\theta}$ and $\overline{\theta}$ satisfy $\widehat{\theta} > \overline{\theta}$, then, the PE of Proposition 3 cannot be sustained.

8.7 *Proof of Corollary 2*

The region where a PE can be sustained is given by $PE = \left(1-\overline{\theta}\right)\left(\overline{\theta}-\widehat{\theta}\right)$. Differentiating with respect to $\widehat{\theta}$, yields $\frac{\partial PE}{\partial \widehat{\theta}} = -\left(1-\widehat{\theta}\right)$, which is negative since cutoff $\widehat{\theta}$ satisfies $\widehat{\theta} < 1$ by definition. Therefore, PE unambiguously shrinks as cutoff $\widehat{\theta}$ increases.

The region where the SE can be supported is $SE = \left(1-\overline{\theta}\right)\widehat{\theta}$. This region satisfies $\frac{\partial SE}{\partial \widehat{\theta}} = 1-\overline{\theta}$, which is positive given that $\overline{\theta} < 1$ by definition.

8.8 *Proof of Proposition 3*

SE where $R_H \neq R_L$. *Updated beliefs.* In this separating strategy profile, the CA updates its beliefs according to Bayes' rule, obtaining $\mu(\theta_H|R_H) = 1$ and $\mu(\theta_H|R_L) = 0$. For simplicity, we consider that, upon observing an off-the-equilibrium message $R \neq R_H \neq R_L$, the CA's off-the-equilibrium beliefs satisfy $\mu(\theta_H|R) = 0$.

Receiver's response. Given the above beliefs, the CA is convinced that it faces a high-type firm upon observing R_H, and responds by approving a merger since $\theta_H > \overline{\theta}$ by definition. In contrast, upon observing R_L, the CA is convinced that it faces a low-type firm, and it thus blocks the merger since $\theta_L < \overline{\theta}$ by assumption. A similar argument applies upon observing any other $R \neq R_H$, leading to a merger blocking decision.

Sender's messages. Anticipating these responses, the θ_H-type entity invests R_H, as prescribed in this separating strategy profile, if $\pi^{M,H} - R_H \geq 2\pi_i^{NM}$, where the right-hand side assumes that the high-type deviates to zero (no merger request). This inequality simplifies to $\pi^{M,H} - 2\pi_i^{NM} \geq R_H$ or, solving for θ_H, we know from Proposition 2 that this inequality yields $\theta_H > \widehat{\theta}(R_H)$, where cutoff $\widehat{\theta}(\cdot)$ is evaluated at $R = R_H$. Alternatively, the high-type firm could deviate to R_L, but doing so would yield even a lower payoff on the right-hand side of the above inequality, $\pi^{M,H} - R_H \geq 2\pi_i^{NM} - R_L$, which implies that $\theta_H > \widehat{\theta}(R_H)$ is a sufficient condition for $\pi^{M,H} - R_H \geq 2\pi_i^{NM} - R_L$. Condition $\theta_H > \widehat{\theta}(R_H)$, however, holds by definition since $\theta_H > \overline{\theta}$ and $\overline{\theta} > \widehat{\theta}(R)$ for all admissible values of R, including $\widehat{\theta}(R_H)$, which implies that $\theta_H > \widehat{\theta}(R_H)$ as well.

In contrast, the θ_L-type entity chooses R_L, instead of deviating to R_H, if and only if $2\pi_i^{NM} - R_L \geq \pi^{M,L} - R_H$, as the CA blocks the merger upon observing R_L but approves it upon observing R_H. Among all of the values of R_L that lead to the CA's blocking of a merger, the most profitable is, of course, $R_L = 0$ (minimizing submission costs), so the above inequality becomes $2\pi_i^{NM} \geq \pi^{M,L} - R_H$. Solving for θ_L, yields $\theta_L \leq \widehat{\theta}(R_H)$ which, solving for R_H, is equivalent to $R_H \geq \pi^{M,L} - 2\pi_i^{NM}$. Combining the inequalities we found from the high- and low-type firms, we obtain that a SE can be sustained if $\theta_H > \widehat{\theta}(R_H) > \theta_L$, where the high-type firm invests $R_H \geq \pi^{M,L} - 2\pi_i^{NM}$.

Among all these SEs, however, only the least-costly SE, where $R_H^{SE} = \pi^{M,L} - 2\pi_i^{NM}$, survives Cho and Kreps' Intuitive Criterion. However, cutoff $\widehat{\theta}(R_H^{SE})$ evaluated at $R_H^{SE} = \pi^{M,L} - 2\pi_i^{NM}$ simplifies to θ_L, which implies that inequality $\theta_L \leq \widehat{\theta}(R_H^{SE})$ holds for all parameter values. (The above argument assumes that f satisfies $f < \pi^{M,L} - 2\pi_i^{NM}$. Otherwise, the only SE entails $R_H = f$.)

PE where both firm types invest a positive amount. *Updated beliefs.* In this pooling strategy profile, the CA cannot update its beliefs according to Bayes' rule. Therefore, upon observing R, where $R \geq f$, its beliefs are $\mu(\theta_H|R) = p$ and $\mu(\theta_L|R) = 1 - p$, whereas upon receiving any off-the-equilibrium message $R' \neq R$, where $R' \geq f$, its off-the-equilibrium beliefs are $\mu(\theta_H|R') = 0$.

Receiver's response. Given the above beliefs, upon observing R, in equilibrium, the CA responds by approving a merger upon observing a request if and only if

$$p\frac{1-c+x_H}{2} + (1-p)\frac{1-c+x_L}{2} \geq k\frac{1}{3}.$$

Rearranging, yields $px_H + (1-p)x_L \geq \frac{1-c}{3}$ or, alternatively,

$$E[\theta] \equiv p\frac{x_H}{1-c} + (1-p)\frac{x_L}{1-c} = p\theta_H + (1-p)\theta_L \geq \overline{\theta}.$$

or, after solving for p, we obtain $p > \frac{\overline{\theta}-\theta_L}{\theta_H-\theta_L} \equiv \widehat{p}$, which holds by assumption. In contrast, upon observing the off-the-equilibrium message R', the CA responds blocking the merger since $\mu(\theta_H|R') = 0$ and $\theta_L < \overline{\theta}$ by assumption.

Sender's messages. Anticipating these responses, the θ_H-type entity invests R, as prescribed in this pooling strategy profile, if $\pi^M - R \geq 2\pi_i^{NM}$, where the right-hand side assumes that the high-type deviates to zero investment (no merger request) because any deviation to $R' \neq R$ guarantees that a merger will be blocked and $R' = 0$ minimizes the firm's submission cost. This inequality simplifies to $\pi^{M,H} - 2\pi_i^{NM} \geq R_H$ or, solving for θ_H, we know from Proposition 2 that this inequality yields $\theta_H > \widehat{\theta}(R)$.

Similarly, the θ_L-type entity chooses R, instead of deviating to any other $R' \neq R$, which guarantees that a merger will be blocked, if and only if $\pi^{M,L} - R \geq 2\pi_i^{NM}$. (The right-hand side of this inequality follows a similar argument as for the high-type firm.). This inequality simplifies to $\pi^{M,L} - 2\pi_i^{NM} \geq R$ or, solving for θ_L, we know from Proposition 2 that this inequality yields $\theta_L > \widehat{\theta}(R)$.

Combining the inequalities we found from the high- and low-type firms, we obtain that a PE can be sustained if $\theta_H > \widehat{\theta}(R)$ and $\theta_L > \widehat{\theta}(R)$, but since $\theta_H > \theta_L$ by definition, a sufficient condition for both inequalities to hold is $\theta_L > \widehat{\theta}(R)$, which is equivalent to $\pi^{M,L} - 2\pi_i^{NM} \geq R$.

Applying the Cho and Kreps' Intuitive Criterion does not have a bite in this case. Specifically, both firm types have incentives to deviate from R to R', where $R > R' \geq f$, if the merger request is still approved. As a consequence, the CA cannot update its off-the-equilibrium beliefs.

PE where both firm types invest zero. *Updated beliefs.* In this pooling strategy profile, where $R = 0$ for both firm types, the CA's information set is not reached since no merger approval request is submitted. Then, the CA holds off-the-equilibrium beliefs $\mu(\theta_H|M) = \mu$ and $\mu(\theta_L|M) = 1 - \mu$.

Receiver's response. Given the above beliefs, the CA responds by approving a merger upon observing one (which can happen only off the equilibrium path) if and only if $\mu\theta_H + (1-\mu)\theta_L > \overline{\theta}$ or, alternatively, $\mu > \frac{\overline{\theta}-\theta_L}{\theta_H-\theta_L} \equiv \widehat{p}$. We next separately analyze the case in which $\mu > \widehat{p}$ (and the CA responds by approving merger, if one is submitted off the equilibrium) and that in which $\mu \leq \widehat{p}$ (and the CA blocks the merger).

Sender's messages. If $\mu > \widehat{p}$, the θ_H-type entity does not invest $R = 0$, as prescribed in this pooling strategy profile, if and only if $\pi^M - R' < 2\pi_i^{NM}$, where $R' \geq f$, since it anticipates that a deviation towards sending a request will be approved by the CA (given its off-the-equilibrium beliefs). This inequality entails $\theta_H < \widehat{\theta}(R')$. Similarly, the θ_L-type entity, does not invest, as required in this pooling strategy profile, if and only if $\pi^M - R' < 2\pi_i^{NM}$, which yields $\theta_L < \widehat{\theta}(R')$. However, condition $\theta_i < \widehat{\theta}(R')$ for all $i = \{H, L\}$ is not compatible with the initial assumption $\theta_H > \overline{\theta} > \theta_L$, since $\widehat{\theta}(R) < \overline{\theta}$ for all R, which implies that this pooling strategy profile cannot be sustained as a PBE.

Summary. Cutoff $\widehat{\theta}(R^{PE})$ lies below $\widehat{\theta}(R_H^{SE})$ since R^{PE} satisfies $f \leq R^{PE} \leq R_H^{SE}$, thus giving rise to three regions: (i) if $\theta_L \leq \widehat{\theta}(R^{PE})$, only a SE can be sustained; (ii) if $\widehat{\theta}(R^{PE}) < \theta_L \leq \widehat{\theta}(R_H^{SE})$, both a SE and PE coexist; and (iii) otherwise, only a PE can be supported.

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