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ABSTRACT

Efficiency Gains and Structural Remedies in Merger Control*

This paper studies the role of structural remedies in merger control in a Cournot setting where (endogenous) mergers are motivated by prospective efficiency gains and must be submitted to an Antitrust Authority (AA) which might require partial divestiture for approval. Both positive and negative effects of merger remedies are identified. First, structural remedies create new merger opportunities to firms. Second, when divestitures are required, the AA over-fixes, i.e., goes beyond the recreation of the level of competition that existed prior to the transaction. Finally, by insisting in over-fixing, the AA may discourage firms to look for more efficient mergers, inducing a final outcome where consumers' surplus is lower than if divestitures couldn't be required. Overall, however, structural remedies are shown to be good: consumers' surplus ex-ante is higher with than without remedies.

JEL Classification: D43, L13, L41 and L51
Keywords: efficiency gains, endogenous mergers, failing firm defence and merger remedies

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1 Introduction

When a merger review is concluded, the Antitrust Authority (AA) has a number of options: to unconditionally approve the proposed concentration, to prohibit it, or to clear it subject to commitments. In Europe, for example, the European Commission (EC) has rarely prohibited notified transactions outright. In addition, a considerable proportion of completed mergers that faced review by the EC has involved remedial conditions (the so called *merger remedies*) for particular harms.[1]

Merger remedies can be grouped in two different categories. (*i*) *Structural remedies* modify the allocation of property rights and create new firms: they include the divestiture of an entire ongoing business, or partial divestiture. (*ii*) *Behavioral remedies* set constraints on the merged firms' property rights: they might consist of engagements by the merging parties not to abuse of certain assets available to them, or to enter into specific contractual arrangements.

It is well known that behavioral remedies might be problematic and that the EC, in the Notice adopted on December 2000 outlining its policy in relation to merger remedies,[2] clearly expressed its preference for divestitures of entire business. The Notice emphasizes that the divested assets must consist of a viable business, meaning that the business must be able to compete effectively with the merged entity. Moreover, since the viability of the divested business depends on the purchaser's suitability to run the business effectively, the EC Notice also attaches great importance to the profile of the purchaser. Hence, generally, parties involved in divestiture commitments are required to divest the relevant assets to a Commission approved purchaser that must be identified prior to the consummation of the transaction (the so called 'up-front buyer requirement').[3]

Even though there is a wide literature on the effects of mergers on consumers' and total welfare,[4] economic theory has not devoted much attention to the study of merger remedies.[5] In this paper, we study the role of structural remedies in merger control by considering a Cournot setting where mergers are motivated by prospective efficiency gains and must be submitted for approval to an AA.

To the best of our knowledge, the only paper that studies structural remedies in a Cournot framework with efficiency gains is Medvedev (2004). There exist, however, three major differences between Medvedev's

[1] For some simple summary statistics on the importance of merger remedies in the disposition of mergers by the EC, see Motta, Polo and Vasconcelos (2003).

[2] EC, 'Notice on remedies acceptable under Council Regulation no. 4064/89 and under Commission Regulation no. 447/98', *Official Journal*, 2 March 2001, C 68/3.

[3] See EC Notice, paragraph 20.

[4] A general discussion on the effects of mergers can be found in Motta (2004). For an economic analysis of the role of efficiency gains in determining the impact of mergers on welfare see Farrell and Shapiro (1990).

[5] There is, however, a strand of the literature which argues that divestitures might exacerbate pro-collusive effects of mergers if the merger-plus-divestiture industry structure turns out to be more symmetric than the status quo one (see Compte, Jenny and Rey (2002) and Vasconcelos (2005)). Another noteworthy exception is Cabral (2003). By analyzing the effects of a two firms merger in a spatially differentiated oligopoly where the industry is assumed to be at a free-entry equilibrium both before *and* after the merger takes place, he shows that asset sales and post-merger entry are 'substitutes'. By (voluntarily) selling assets (stores) to potential rival firms, merging firms may effectively 'buy them off', that is, dissuade them from opening new stores, an effect which may be detrimental to consumers.

framework and the setting used in this paper. First, even though Medvedev also uses a cost structure inspired by the paper by Perry and Porter (1985), where the amount of fixed capital owned by a given firm determines its production costs, in his setting the antitrust agency can ask the merged entity to divest *any* subset of the acquired assets. In contrast, in this paper it is assumed that there is only a discrete number of possible divestitures which can be selected since, according to the EC Notice on merger remedies and as explained above, the divested activities (capital assets in our model) must consist of a viable business. This implies that, in equilibrium, firms may strategically opt for merger proposals in which they know the AA cannot require restructuring through divestitures. Second, in this paper merging parties are not exogenously given. The merger process is fully endogenized in the sense that we allow any coalition of firms in the industry to be possibly formed (and to be part of a merger proposal).[6] Lastly, Medvedev only considers situations where all firms in the industry are active both before *and* after the merger, while in this paper we also study the cases in which the outsiders to a merger may be pushed out of the industry if the merger is approved. This fact allows for the discussion of the use of the *failing firm defence* concept in merger control.[7]

This paper also incorporates an active AA within a merger formation game. This AA works with an enlarged toolbox for merger control since, apart from deciding to block or unconditionally approve the merger, it can also decide to partially approve the merger, i.e., to approve the merger subject to the condition that some of the acquired assets are divested. This divestiture commitment can either give rise to the emergence of a new independent competitive entity or to the strengthening of an existing competitor not involved in the merger (merger outsider). The AA is also assumed to appraise the merger on the basis of its impact on consumers' surplus.

The major motivation for having a consumers'-surplus-maximizing AA is that this assumption describes the current practice in the major antitrust jurisdictions.[8] In the US, the "substantial lessening of competition" (SLC) test has been interpreted by both the enforcement agencies (the DoJ and the FTC) and the Courts that a merger is unlawful if it is likely that it will lead to an increase in price (that is, to a decrease in consumers' surplus).[9] Since the recent changes in the Merger Regulation, the EU has moved from a dominance test to a SLC test. It is less clear whether the EC follows a consumers' surplus or a total surplus standard. However, the wording of the Merger Regulation (see Article 2.1(b)) states that an efficiency gain is in principle admitted

[6] The current paper is, therefore, also related to the literature on endogenous mergers. Some important papers in this area are Gowrisankaran (1999), Kamien and Zang (1990), Fauli-Oller (2000) and Horn and Persson (2001 a,b).

[7] The *failing firm defence* is a legal and economic concept accepted by the EU and US competition authorities. According to this concept, the AA must approve (rescue) mergers wherein an active firm in the industry is proposing to acquire a failing firm, i.e., a firm that, in the absence of a merger, would not be able to survive in the industry.

[8] As pointed out by Lyons (2002, p. 1), "most major competition authorities operate under legislation and guidelines that reject this [total surplus] standard, and no major competition authority seems to apply it consistently. Instead, they overwhelmingly focus on consumers, including industrial consumers, to the exclusion of the welfare of merging firms."

[9] The revised US Merger Guidelines explicitly defend that: 'the Agency considers whether cognizable efficiencies likely would be sufficient to reverse the merger's potential to harm consumers in the relevant market, e.g. by preventing price increases in that market.' (US Merger Guidelines, revised April 8, 1997, section 4).

to the extent that it benefits consumers, thus implying a consumers' surplus standard. An advantage of this assumption is that it allows to keep the analysis extremely simple.

Within this framework, some important merger policy implications are obtained. In particular, this paper identifies three effects (one negative and two positive) that merger remedies have in comparison with the situation where the merger policy consists of a yes/no answer by the AA to the merger proposal.

First, the possibility of approving mergers subject to the condition that some assets are divested enables the AA to take decisions at a more specific level, which in turn allows some merger proposals that in the absence of structural remedies would be blocked, to be (partially) approved by the AA when remedies are possible. In this sense, one can say that structural remedies open up new merger opportunities to firms.

Second, when the AA has the possibility to partially approve a merger proposal, it turns out that the required divestitures of assets induce a more competitive outcome (in terms of lower equilibrium prices) after the merger-plus-divestiture than prevailed before in the status quo industry structure. This model, therefore, provides a theoretical rationale for the "over-fixing" effect which was noted by Farrell (2003). The intuition is simple. Endowed with a richer toolbox available for merger control, the AA uses the opportunity of the merger notifications to reshape the industry structure by reallocating the available assets in the industry so as to maximize consumers' welfare. This implies that, as pointed out by Rey (2003, p. 130), there is a change in the nature of merger control since "introducing the possibility of remedies ... puts the merger control office in a position close to that of an industry-specific regulator".

Lastly, there is a *negative* effect of merger remedies. Even though in this setting a merger is motivated by prospective efficiency gains, the AA insistence in over-fixing may, in some circumstances, lead firms to refrain from presenting for approval large (and hence more efficient) mergers, inducing a final outcome in which consumers' surplus is lower than if the AA couldn't order partial divestiture.

The paper also studies the interplay between the effects of merger remedies just described. In particular, it is shown that, on balance, merger remedies (such as those contemplated by the present paper) play a positive role. Merger remedies are good since they are shown to enhance consumers' surplus from an ex-ante point of view.

The rest of the paper is organized as follows. In Section 2, the basic model is described and the equilibrium analysis of the proposed game is performed. Section 3 discusses the merger policy implications which are obtained with our simple formal setting. Finally, Section 4 offers some concluding comments.

2 The Model

We consider a model in which there are four firms which operate in a market with linear demand

$$p = 1 - Q, \tag{1}$$

where Q is the industry output.

What distinguishes firms is the amount of capital they own. The total supply of capital is assumed to be fixed to the industry (and equal to K units). Let k_i denote firm i's capital holdings, where $k_i \in \{1, 2, ..., K\}$. Hence, we normalize the smallest indivisible unit of capital assets to be one.

The cost function of a firm which owns k_i units of the industry capital and produces q_i units of output is given by:

$$C(q_i, k_i) = \frac{\alpha K}{k_i} q_i + k_i f, \tag{2}$$

where $\alpha \geq 0$, $\sum_{i=1}^{4} k_i = K$ and $f > 0$.

This cost structure was proposed by Motta and Vasconcelos (2005).[10] It assumes that each firm operates with a constant marginal cost of production, but the level of its marginal cost is a decreasing function of its capital holdings, k_i. In addition, it is assumed that there exists a plant specific fixed cost f, which has to be paid for each unit of the industry capital owned by the firm.[11]

This way of modelling the cost structure aims at capturing two distinct cost effects induced by a merger. First, a merger brings the capital of merging parties into a single larger entity and, therefore, gives rise to endogenous efficiency gains. The higher the value of α is, the stronger the efficiency gains induced by a merger are. Second, by creating a larger firm, a merger has also the effect of increasing fixed costs proportionally. This effect is captured by the parameter f in the cost function.

As is shown in Appendix A, in a Cournot-Nash equilibrium with n active firms, firm $i's$ equilibrium quantity, the market price and the individual profits are respectively given by:

$$q\left(k_i; \mathbf{k}_{-i}\right) = \frac{1 - \alpha K \left(\frac{n}{k_i} - \sum_{j \neq i} \frac{1}{k_j}\right)}{n+1}, \tag{3}$$

$$p\left(k_i, \mathbf{k}_{-i}\right) = \frac{1 + \alpha K \sum_{j=1}^{n} \frac{1}{k_j}}{n+1}, \tag{4}$$

[10] This cost function is inspired by the one proposed by Perry and Porter (1985). In their framework, firms' marginal cost is linear in output and mergers reduce variable costs.

[11] This specification is used to rule out further scale economies due to sharing of fixed costs.

$$\Pi\left(k_i; \mathbf{k}_{-i}\right) = \left(q\left(k_i, \mathbf{k}_{-i}\right)\right)^2 - k_i f, \tag{5}$$

where k_i denotes firm i's capital holdings and $\mathbf{k}_{-i}$ is a vector of dimension $(n-1)$ including the capital holdings of firm i's rival firms.

In what follows, we assume that the total quantity of capital available in the industry is equal to four units ($K = 4$) and that this available capital is equally distributed amongst the four firms in the status quo industry structure. Assume also that there are at least two potential entrants (entrepreneurs) that have the expertise and required technology to enter in this market (at no cost) but do not have any unit of capital.[12]

2.1 The Game

Before Cournot competition takes place at the market place, firms play the following three-stage game with the AA.

- In the *first stage*, one firm at the status quo industry structure is randomly selected and has the opportunity to propose a merger to the AA. This firm may propose a merger with all or a subset of its rivals. The proceeds of the merger are assumed to be shared equally by the merger partners.[13] So, amongst all feasible mergers, the firm will propose the merger that maximizes the per-firm profit of the merged entity.

- In the *second stage*, the AA decides whether to authorize or not the proposed merger. At this stage, the AA can take three different decisions: (*i*) accept the proposed merger; (*ii*) reject the proposed merger; and (*iii*) accept partially the merger, i.e., accept the merger subject to the condition that some units of the merged entity capital are divested to an incumbent rival firm or to a new firm which is attracted into the market. If the AA does not authorize the merger, then the game will have come to a final node and product market competition occurs between the four symmetric firms in the status quo industry structure.

- In the *third* stage, if in the previous stages of the game a merger was proposed and approved by the AA and if the outsider(s) to this merger would be pushed out of the industry as a result of the merger,

[12] There are several industries that are characterized by fixed capacity and difficult entry. Cases in point are the cement industry (availability of raw materials and environmental regulations make new production sites unlikely) and the mineral water industry (in most countries, mineral water must be bottled at the source, and existing sources are known and already exploited). These industries are probably characterized by a low degree of efficiency gains (i.e., by a low value of α). Other industries which might fit the assumption of fixed capital are those where entry is regulated by law and subject to licenses or authorization (e.g., radio, television, telecommunication services). In many countries, the use of the spectrum for a particular purpose is given (or auctioned off) by the government. Firms can only expand by buying licenses from competitors through mergers. Very often, scale and scope economies arise when more licenses are owned by the same operator, i.e. potential efficiency gains from a merger are large (α is high).

[13] This seems a natural assumption since the four firms in the status quo industry structure are all symmetric in terms of capacity.

then the remaining active firm can make a take-it-or-leave-it offer to acquire the assets of the exiting outsider firm(s) through a *rescue merger*. This rescue merger will always be cleared by the AA under the *failing firm defence* concept.[14]

Two notes regarding the case in which the merger is partially approved by the AA are in order at this point. First, notice that in Europe the AA has a decisive role in the identification of the purchaser of the divested assets.[15] Hence, in what follows, it is assumed that when a modified version of the merger proposal is approved, the remedy chosen by the AA specifies the number of units of capital to be divested and also the purchaser of those units.[16] Second, there is only a discrete number of possible divestitures which can be selected. This is for two reasons. On the one hand, there is an upper bound to the units of capital that can be divested. The randomly selected firm (at stage 1) cannot be asked at stage 2 to divest all the units it proposed to acquire; only a subset of those units can be divested. On the other hand, it is assumed that a firm can only be asked to divest multiples of the smallest indivisible unit of this asset, which we normalized to be one. The idea here is that of divesting a plant or a group of plants.

2.1.1 The capital indivisibility assumption

The fact that capital is lumpy is a crucial assumption of the model. If the level of divestiture shrinks, the ability of the AA to implement the socially optimal industry structure is improved. In the limit, if capital were perfectly divisible and the AA could require a divestiture of any subset of the acquired assets, then the AA would be able to use its power to ask for restructuring so as to implement the socially optimal industry structure (and firms would probably submit directly a merger proposal leading to this socially optimal industry structure).[17] So, by assuming that a firm can only divest multiples of the smallest indivisible unit of capital (one plant),[18] one creates a non-trivial game of strategic interaction between the firms and the AA, where remedies cannot be used with full flexibility and, thus, firms can strategically embark on mergers in which the AA cannot ask for partial divestiture of the acquired assets.

On the top of that, and perhaps more important, the rationale for this assumption comes directly from the EC Notice on remedies. Firstly, the Notice emphasizes that the divested activities (capital assets in our

[14] According to this concept, a transaction can be regarded as a rescue merger if the competitive market structure would deteriorate in a similar fashion even if the merger did not take place (i.e. because the undertaking would exit the market). Approving a rescue merger is a way of keeping the assets of the exiting firms in productive use.

[15] As stressed in the EC Notice (paragraph 49), "in order to ensure the effectiveness of the commitment, the sale to a proposed purchaser is subject to prior approval by the Commission. The purchaser is normally required to be a viable existing or potential competitor, independent and unconnected to the parties, possessing the financial resources, proven expertise and having the incentive to maintain and develop the divested business as an active competitive force in competition with the parties."

[16] This is similar to the assumption in Medvedev (2004) that the AA has veto power over the choice of the purchaser of the divested units of capital.

[17] Put another way, in the limit case where capital is perfectly divisible, there is no 'real' strategic game between the firms and the AA.

[18] One can also interpret $k_i = 1$ as the minimum size of a viable line of business.

model) must consist of a viable business, meaning that the business must be able to compete effectively with the merged entity.[19] As stressed in the Notice (paragraph 46), "in a typical divestiture commitment, the business to be divested normally consists of a combination of tangible and intangible assets, which could take the form of a pre-existing company or group of companies". Secondly, even if the acquirer of the divested assets is a firm already active in the industry, the EC does not look favorably at a "mix-and-match" approach where the divestiture package consists only of certain assets which could only operate in a stand-alone basis if combined with other assets already belonging to the purchaser of the divested assets (see EC Notice, paragraph 18). This approach is also in the light of the 1999 FTC Divestiture Study[20], which reveals that the likelihood of successful entry is much higher when an entire ongoing business is divested, whereas entry is significantly more problematic in case of divestiture of selected assets.

2.2 Equilibrium Analysis

In what follows, we seek the symmetric[21] subgame perfect Nash equilibria (henceforth, SPNE) in pure strategies of the proposed three-stage game, following the usual backward induction procedure.

Assumption 1 Let us assume that

$$\alpha < \frac{1}{4} \equiv \overline{\alpha}; \quad f < \left(\frac{1-4\alpha}{5}\right)^2 \equiv \overline{f}. \tag{6}$$

These two conditions are imposed to exclude the trivial case in which production is not viable at the status quo market structure.[22]

Analysis of the third stage If the game arrives at the *third* stage, then the merged entity resulting from the previously approved merger proposal can propose a rescue merger with the exiting outsider firm(s).

If the previously approved merger proposal involves *two firms* and the outsiders to this merger are constrained to exit the industry, then the merged entity will be interested in proposing a rescue merger if

$$\Pi(4) = \left(\frac{1-\alpha}{2}\right)^2 - 4f \geq \Pi(2) = \left(\frac{1-2\alpha}{2}\right)^2 - 2f, \tag{7}$$

[19] See EC Notice, paragraph 14.

[20] Federal Trade Comm'n, *A Study of the Commission's Divestiture Process* (1999).

[21] Firms endowed with the same amount of capital are assumed to have the same output and profit in equilibrium.

[22] If $\alpha \geq 1/4$, then $dC(q_i,1)/dq_i = 4\alpha \geq 1$, which in turn implies that the equilibrium quantity in the status quo industry structure is $q(1;1,1,1) = 0$. Likewise, four firms would not co-exist if $f > \overline{f}$ since $\Pi(1;1,1,1) = ((1-4\alpha)/5)^2 - f$ (see eq. (5)).

which in turn implies that fixed costs should be sufficiently low:

$$f \leq \frac{\alpha\,(2-3\alpha)}{8} \equiv f_2^r. \tag{8}$$

If instead the previously approved merger proposal involves *three firms* and the outsider to this merger is pushed out of the industry as a result of this merger, then the merged entity will propose a rescue merger with the single outsider (exiting) firm if

$$\Pi\,(4) = \left(\frac{1-\alpha}{2}\right)^2 - 4f \geq \Pi(3) = \left(\frac{3-4\alpha}{6}\right)^2 - 3f, \tag{9}$$

which turns out to be satisfied if

$$f \leq \frac{\alpha\,(6-7\alpha)}{36} \equiv f_1^r. \tag{10}$$

Note that in both cases just described, the AA would always have to approve the rescue merger under the *failing firm defence* concept. If a rescue merger is proposed, then a previous merger was approved and the outsider(s) to this merger would not be able to survive in the industry. In that case, the AA clearly prefers to have a monopolist with the entirety of industry capital units than a monopolist operating with only a subset of those units of capital (after the failing firm(s) have exited the industry).[23]

Analysis of the second stage At the *second* stage, the AA can be faced with three different merger proposals: a merger between two firms, a merger between three firms or a merger leading to complete monopolization of the industry. We analyze each of these three scenarios in turn.

Scenario 1: Merger Involving 2 Firms

If a merger between two firms is proposed, then the AA has to decide whether or not to allow this merger. Notice, however, that, when faced with this merger proposal, the AA cannot ask for a divestiture as a condition to clear the transaction. The randomly selected firm at stage 1 is only buying 1 unit of capital and we have assumed that the acquiring firm cannot be asked to divest all the units that it bought. Hence, merger control in this scenario amounts to a yes/no decision by the AA.

As explained in Motta and Vasconcelos (2005), after a merger between two of the four firms in the status quo market structure, the induced post-merger market structure might be either $\{2,1,1\}$ or simply a

[23] From (4), very simple algebra shows that, for any $\alpha > 0$, $p(4) < p(3) < p(2)$.

monopoly market structure of the type $\{2\}$.[24] If after the merger the two outsiders are able to make positive profits, the induced market structure is $\{2,1,1\}$. In that case, from eqs. (3) and (5), one has that the equilibrium levels of profits of the merged entity and of each of the merger outsiders are respectively given by:

$$\Pi(2;1,1) = \left(\frac{1+2\alpha}{4}\right)^2 - 2f, \tag{11}$$

$$\Pi(1;2,1) = \left(\frac{1-6\alpha}{4}\right)^2 - f. \tag{12}$$

Two different reasons can, however, imply that, in the absence of a subsequent rescue merger, the two merger outsiders would be unable to make positive profits and would therefore exit the industry after the merger. First, if $\alpha \geq 1/6$, the merger gives rise to very high synergies and the two (smaller) outsider firms would be constrained to produce zero in equilibrium.[25] Second, if $f \geq \left(\frac{1-6\alpha}{4}\right)^2 \equiv \widetilde{f}_2$, outsiders would not be able to recover their fixed costs in case the merger goes through.

The analysis of the equilibrium decisions of the AA in this scenario can be summarized as follows:

- If $\alpha < 1/6$ and $f < \left((1-6\alpha)/4\right)^2 \equiv \widetilde{f}_2$, then the two merger outsiders are able to make positive profits after the merger has taken place and the AA will decide to authorize the submitted merger only if

$$p(2,1,1) = \frac{1+10\alpha}{4} \leq p(1,1,1,1) = \frac{1+16\alpha}{5}, \tag{13}$$

  which, as can be easily checked, holds if $\alpha \geq 1/14 \simeq 0.071429$.

- If $\alpha \geq 1/6$, then, in the absence of a rescue merger, the outsiders to the merger would exit the industry (efficiency gains are so high that they would produce zero in equilibrium). The AA, however, anticipates that, since $f \leq f_2^r$ in this region of parameter values (see eq. (8)), after this first merger, the merged entity will propose a rescue merger with the (exiting) outsider firms, leading to a final equilibrium market structure where there is a monopolist owning the entirety of industry capital. Therefore, the first merger will be approved by the AA if

$$p(4) = \frac{1+\alpha}{2} \leq p(1,1,1,1) = \frac{1+16\alpha}{5}, \tag{14}$$

[24] By restricting attention to symmetric SPNE, we are not considering here the case in which only one outsider firm exits the industry if a merger involving two firms is approved. Appendix B is devoted to the study of this asymmetric equilibrium case.

[25] From (3), it can be easily shown that $q(1;2,1) = \max\{0,(1-6\alpha)/4\}$.

which holds for any $\alpha \geq 1/9$. Hence, for any $\alpha \in [1/6, 1/4)$, the AA approves the merger involving two firms since it anticipates that this merger will ultimately lead to a monopoly industry structure and consumers' surplus will be higher than the one in the status quo industry structure.

- Lastly, if $\alpha < 1/6$ and $\left(\frac{1-6\alpha}{4}\right)^2 \equiv \widetilde{f}_2 \leq f < \overline{f}$, then two different subcases should be distinguished:

  1. If $f > f_2^r$, where f_2^r is given by eq. (8), the AA anticipates that this merger is not going to be followed by a rescue merger and the outsiders would be induced to exit the industry after the merger (since they would be unable to recover fixed costs). Hence, the AA would only approve the two-firm merger if the following condition holds:

  $$p(2) = \frac{1+2\alpha}{2} \leq p(1,1,1,1) = \frac{1+16\alpha}{5}, \tag{15}$$

  which is satisfied if efficiency gains are sufficiently high, i.e., if $\alpha \geq 3/22 \simeq 0.13636$. However, in the region of parameter values we are considering in this subcase, the previous condition always fails to hold. As a result, the AA will decide to block the merger involving two firms in the status quo industry structure.

  2. If instead $f \leq f_2^r$, then the AA anticipates that, in case of approval, the first merger is going to be followed by a rescue merger leading to complete monopolization of the industry. Hence, the AA will only approve the merger if $p\,(4) \leq p(1,1,1,1)$ and from eq. (14) we know that this is the case only if $\alpha \geq 1/9$.

Figure 1 illustrates this result.

Scenario 2: Merger Involving 3 Firms

Suppose now that there is a merger proposal between three of the four firms in the industry. If the merger is approved by the AA, then a larger (and, hence, more efficient) firm is created, owning 3 units of the industry capital. From (3), one has that in the post-merger Cournot equilibrium, the output levels of the merged entity and of the outsider firm are respectively given by:

$$q\,(3;1) = \frac{4\alpha+3}{9}, \tag{16}$$

$$q(1;3) = \max\left\{0, \frac{3-20\alpha}{9}\right\}. \tag{17}$$

Remark 1 *$q_s = 0$ if $\alpha \geq 3/20$.*

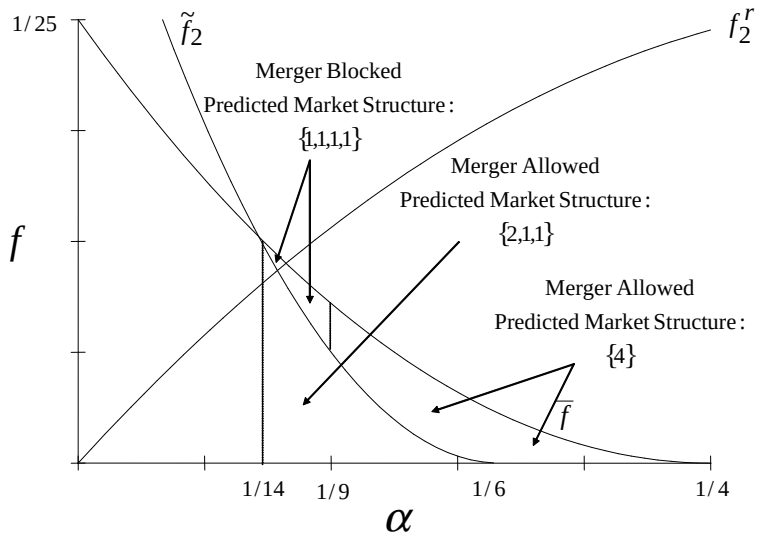

Figure 1: AA decisions - 2-firm merger proposal

Hence, if the merger gives rise to very high synergies, the (smaller) outsider firm is constrained to exit the market.

Suppose for the moment that $\alpha < 3/20$. From the equilibrium outputs above, one can obtain by substitution the equilibrium levels of profits for the merged entity and for the merger outsider:

$$\Pi(3;1) = \left(\frac{4\alpha+3}{9}\right)^2 - 3f, \tag{18}$$

$$\Pi(1;3) = \left(\frac{3-20\alpha}{9}\right)^2 - f. \tag{19}$$

Notice that if a merger between three of the four firms in the status quo market structure is unconditionally approved, then there are three possible induced market structures: $\{3,1\}$, $\{3\}$ and $\{4\}$. In particular:

(i) If $\alpha < 3/20$ (see Remark 1) and $f < \left((3-20\alpha)/9\right)^2 \equiv \widetilde{f}_3$, then from (19) it is clear that the outsider firm is able to make positive profits in equilibrium. The induced market structure is therefore a duopoly of the type $\{3,1\}$, and firms' equilibrium profits are given by eqs. (18) and (19).

(ii) If instead $\alpha \geq 3/20$ and/or $f \geq \left((3-20\alpha)/9\right)^2 \equiv \widetilde{f}_3$, then a three-firm merger will always induce a final monopoly industry structure. The monopolist can, however, own either 3 or 4 units of the industry capital. These two situations are discussed in turn. First, if a rescue merger is not proposed after the first merger, then the outsider firm is constrained to exit the industry and the resulting market

structure is a monopoly of the type $\{3\}$. Second, if the merged entity proposes subsequently a rescue merger so as to buy over the exiting unit of capital belonging to the outsider firm, the induced market structure is a monopoly of the type $\{4\}$.

We now turn to the study of the AA decisions when faced with a merger proposal involving three firms in the status quo industry structure.

When a merger involving three firms is submitted to the AA for approval, there are two possible divestitures that can be selected by the AA as a condition to clear the merger. In both cases, one unit of capital is divested. If this unit of capital is divested to the outsider of the proposed merger, then the induced market structure is $\{2,2\}$. If instead the AA requires that the unit of capital is divested to an entrant, then the ex-post merger market structure will be a triopoly of the type $\{2,1,1\}$. Let us start by comparing these two feasible divestitures from a consumers' welfare point of view. Making use of eq. (4), very simple algebra shows that:

$$p(2,2) = \frac{1+4\alpha}{3} \leq p(2,1,1) = \frac{1+10\alpha}{4} \text{ for } \alpha \geq 1/14, \tag{20}$$

$$p(2,2) = \frac{1+4\alpha}{3} \leq p(1,1,1,1) = \frac{16\alpha+1}{5} \text{ for } \alpha \geq 1/14, \tag{21}$$

$$p(2,2) = \frac{1+4\alpha}{3} \leq p(2) = \frac{1+2\alpha}{2} \text{ for } \alpha \leq 1/2, \tag{22}$$

$$p\left(2,2\right) = \frac{1+4\alpha}{3} \leq p(4) = \frac{1+\alpha}{2} \text{ for } \alpha \leq 1/5. \tag{23}$$

Now, two different cases should be distinguished:

- If $\alpha \in [1/14, 1/6)$ and $f < \left(\frac{1-6\alpha}{4}\right)^2 \equiv \widetilde{f}_2$, then the AA can either select a divestiture to the merger outsider (leading to a symmetric duopoly industry structure of the type $\{2,2\}$) or a divestiture to an entrant, in which case the induced market structure is $\{2,1,1\}$ (since both the new entrant and the merger outsider are able to make positive profits in equilibrium). However, from eq. (20), we have that in this range of parameter values $p(2,2) \leq p(2,1,1)$, which in turn implies that the AA will opt for a divestiture to the merger outsider.[26]

- If, instead,

  - (i) $\alpha \geq 1/6$, or

[26] At this point, one should also check that the rival (outsider) firm has an interest to buy the divested unit of capital. In case the outsider firm buys the divested assets, then its profit in the market structure induced by the merger-plus-divestiture equals $\Pi\left(2;2\right) = \left(\left(1-2\alpha\right)/3\right)^2 - 2f$ (see eqs. (3) and (5) for the derivation of this profit). If instead the same divested assets are bought by an entrant, then the outsider firm expects to earn $\Pi\left(1;2,1\right) = \left(\left(1-6\alpha\right)/4\right)^2 - f$ (see eq. (12)). Now, very simple algebra shows that in the region of parameter values considered in assumption 1, it is always the case that $\Pi\left(2;2\right) > \Pi\left(1;2,1\right)$, which in turn implies that the outsider firm always has an interest to buy the divested unit of capital.

– (*ii*) $\alpha < 1/6$ and $\left(\frac{1-6\alpha}{4}\right)^2 \equiv \widetilde{f}_2 \leq f < \overline{f}$,

the AA anticipates that if a divestiture to an entrant is required, then neither the new firm nor the outsider to the proposed merger are able to make positive profits and compete with the merged entity. This in turn implies that if this remedy is selected, two units of the capital asset would exit the industry, unless a rescue merger takes place in stage 3. As shown above, a rescue merger involving two exiting units of the industry capital would be proposed (and approved) only if fixed costs are sufficiently low, i.e., if $f \leq f_2^r$, where f_2^r is given by condition (8). Two subcases should then be considered. First, if $f > f_2^r$, then a rescue merger would not take place and the market structure induced by the merger-plus-divestiture to an entrant would be $\{2\}$. Hence, whether a divestiture to the merger outsider or to a new entrant attracted into the market is preferred depends on whether $p(2,2) < p(2)$, or otherwise. Now, from (22), it is clear that, in the subcase under study, the AA will opt for a divestiture to the merger outsider. Second, if instead $f \leq f_2^r$, then, in a situation where a divestiture to an entrant is selected by the AA, a rescue merger would be subsequently proposed (and approved), leading to a final market structure where a monopolist owns the entirety of the industry capital. So, the AA will prefer a divestiture to an entrant to a divestiture to the merger outsider only if $p(4) < p(2,2)$. Making use of eq. (23), one concludes that a divestiture to an entrant is preferred only if $\alpha > 1/5$.

Figure 2 summarizes this result.

To conclude the analysis of Scenario 2, we now turn to the study of the decision by the AA on whether to approve unconditionally the proposed merger or to partially approve it. As a preliminary remark, note that, making use of (4), very simple algebra shows that:

$$p(3,1) = \frac{3+16\alpha}{9} \leq p(1,1,1,1) = \frac{16\alpha+1}{5} \tag{24}$$

if efficiency gains are sufficiently high, i.e., if $\alpha \geq 3/32 \simeq 0.09375$. So, clearly, a three firms merger will never be *unconditionally* approved for $\alpha < 3/32$.

Now, three different cases should be addressed (as illustrated by Figure 3):

- If $\alpha \in [1/14, 3/20)$ and $f < \left((3-20\alpha)/9\right)^2 \equiv \widetilde{f}_3$, then if the merger was unconditionally approved, the outsider to the merger would be able to survive in the industry. In addition, in case a divestiture is required as a condition to approve the proposed merger, the AA always prefers a divestiture to the outsider to a divestiture to an entrant (see Figure 2). This implies that the proposed merger involving

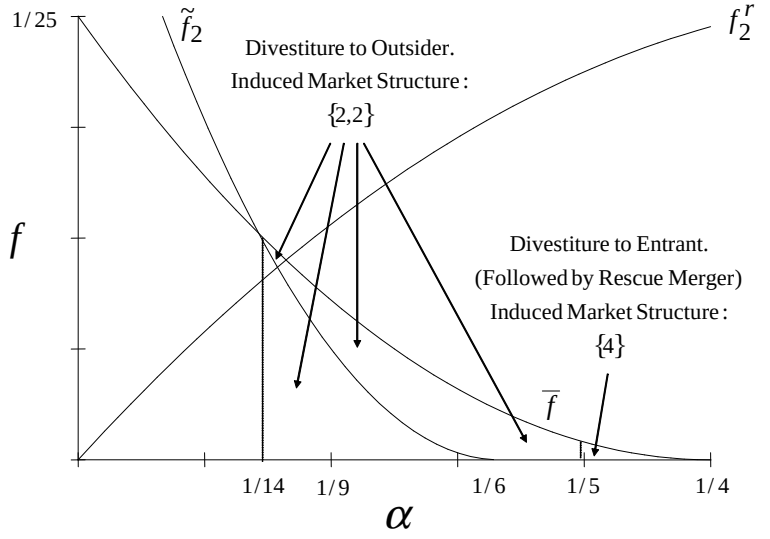

Figure 2: AA choice between divestitures - 3-firm merger

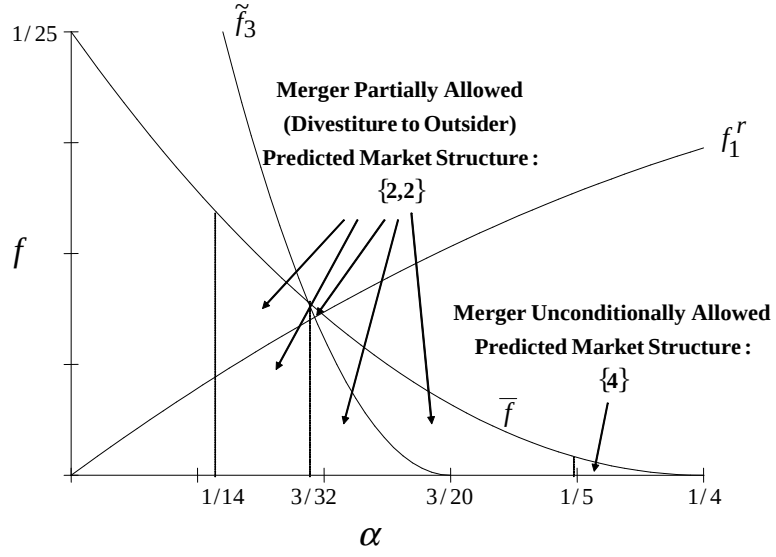

Figure 3: AA Decisions - 3-firm merger proposal

three firms would be unconditionally approved if:

$$p\,(3,1) = \frac{3+16\alpha}{9} \leq p(2,2) = \frac{1+4\alpha}{3}. \tag{25}$$

The previous condition, however, always fails to hold. This in turn implies that in this region of parameter values, the AA will always (partially) approve the merger subject to the condition that 1 unit of capital is divested to the merger outsider. The induced market structure will then be $\{2,2\}$.

- If $\alpha < 1/5$ and $\widetilde{f}_3 \leq f < \overline{f}$, then the AA knows that, in case the merger is partially approved, 1 unit of capital is divested to the merger outsider and the induced market structure will be a symmetric duopoly of the type $\{2,2\}$. In case, however, the AA unconditionally approves the merger, then, in the absence of a subsequent rescue merger, the outsider firm would be pushed out of the industry. So, two different scenarios should be considered:

  1. If $f \leq f_1^r$, where f_1^r is given by eq. (10), in case the first merger is unconditionally approved by the AA, a subsequent rescue merger takes place and the induced market structure is a monopoly of the type $\{4\}$. However, since in the region of parameter values we are considering in this scenario $p\,(2,2) < p(4)$ (see eq. (23)), the AA will decide to approve the first merger subject to the condition that one unit of capital is divested to the merger outsider, leading to a merger-plus-divestiture market structure of the type $\{2,2\}$.

  2. If $f > f_1^r$, then a rescue merger would never follow the first (unconditionally approved) merger and, therefore, the AA would only approve unconditionally the three-firm merger if

  $$p\,(3) = \frac{3+4\alpha}{6} \leq p(2,2) = \frac{1+4\alpha}{3}. \tag{26}$$

  However, the previous condition is false for any parameter value in the region defined by Assumption 1. This implies that the AA will again authorize the proposed merger subject to the condition that 1 unit of capital is divested to the merger outsider (and the induced market structure will be $\{2,2\}$, as in the previous case).

- If instead $\alpha \geq 1/5$, the AA has two options. First, it can approve the merger unconditionally, anticipating that this merger will be followed by a rescue merger leading to a final market structure of the type $\{4\}$, since $f \leq f_1^r$ whenever $\alpha \geq 1/5$ (see eq. (10) and Figure 3). Second, it can partially approve the merger subject to the condition that one unit of capital is divested to an entrant. However, both this

entrant and the merger outsider will not be able to survive in the market, which in turn implies that a rescue merger will follow the (partially approved) merger and the final industry structure will again be a monopolist owning the entirety of the industry capital. The AA is therefore indifferent between the two options. In what follows, we assume that in this case the AA will unconditionally approve the first merger.

Scenario 3: Merger to Monopoly

Suppose now that the randomly selected firm (at stage 1) proposes a merger to the AA leading to complete monopolization of the industry. If this is the case, then the AA has to choose between approving the proposed merger unconditionally, reject the merger and approve the merger partially. There are three possible partial mergers since the AA can select in this case 3 possible divestitures: (*i*) divestiture of 2 units of capital to an entrant (leading to the market structure $\{2,2\}$); (*ii*) divestiture of 1 unit of capital to an entrant (leading to a duopoly market structure of the type $\{3,1\}$ or to a monopoly market structure, depending on whether the new entrant is able or not to make positive profits when operating with the acquired assets, respectively), and (*iii*) divestiture of 1 unit of capital to a first entrant and 1 unit of capital to a second entrant (leading to a triopoly market structure of the type $\{2,1,1\}$ or to a monopoly industry structure, depending on whether the entrants will be able to operate profitably or not with the unit of capital which is allocated to each of them).

If we start by studying the AA preferences over the three possible divestitures just described, we could describe the AA preferences with a figure very similar to Figure 3. The conclusions would, therefore, be that:

- The AA will never choose to divest 1 unit of capital to a first entrant and 1 unit of capital to a second entrant;
- If $\alpha \in [1/14, 1/5]$, the AA prefers the divestiture of 2 units of capital to an entrant (leading to the symmetric duopolistic industry structure $\{2,2\}$);
- If instead $\alpha > 1/5$, the AA would be indifferent between unconditionally approving the merger and asking for a divestiture of 1 unit of capital to an entrant. If a divestiture is required, the entrant is not able to operate profitably with that unit in equilibrium and a rescue merger is going to follow the first (partially approved) merger, where the merged entity resulting from the first merger buys back the divested unit of capital.

Knowing the AA preferences over the three possible partial mergers just described, we can now study the AA decision between fully approving the proposed merger to monopoly and partially approving it. When

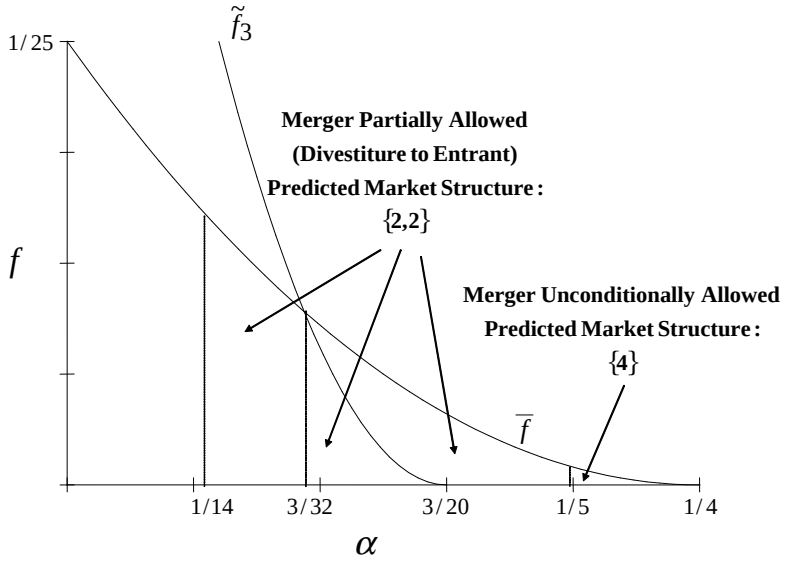

Figure 4: AA Decicions - 4-firm merger proposal

the proposed merger is unconditionally approved, the resulting industry structure will be $\{4\}$. From eqs. (3) and (5), one can easily conclude that the monopolist's equilibrium level of profit is given by:

$$\Pi(4) = \left(\frac{1-\alpha}{2}\right)^2 - 4f. \tag{27}$$

Now, from (23), we have that $p\,(2,2) \leq p(4)$ for $\alpha \leq 1/5$. Hence, the final decision taken by the AA when faced with a merger to monopoly proposal is:

- If $\alpha \in [1/14, 1/5]$, the AA approves the merger subject to the condition that 2 units of capital are divested to an entrant which is attracted into the market and a perfectly symmetric duopolistic structure is created;
- If instead $\alpha > 1/5$, efficiency gains are so strong that the AA decides to unconditionally approve the merger since it gives rise to the best possible outcome for the society.

This result is illustrated in Figure 4.

Analysis of the first stage At the *first* stage, the randomly selected firm in the status quo industry structure is given the opportunity to propose a merger to the AA. As a preliminary remark, it should be stressed that we assume that, in case a divestiture is required by the AA, the merging firm does not earn

additional capital gains resulting from being forced to divest assets.[27,28]

Let us first consider the case in which $\alpha \in [1/14, 1/5]$. When this is the case, then from Figures 3 and 4, one has that a merger between 3 or 4 firms in the status quo industry structure will never be unconditionally approved. If a merger between 3 firms is proposed, then at stage 2 the AA will require a divestiture of 1 unit of capital to the merger outsider and the induced market structure is a symmetric duopoly of the type $\{2, 2\}$. If instead a merger to monopoly is submitted, firms anticipate that in the following stage the AA will require that 2 units of capital are divested to a new entrant which is attracted into the market, and the induced market structure will again be $\{2, 2\}$. Making use of eq. (5), simple algebra shows that the equilibrium profit in this duopoly industry structure is given by:

$$\Pi(2;2) = \left(\frac{1-2\alpha}{3}\right)^2 - 2f. \tag{28}$$

Hence, at stage 1, the randomly selected firm is indifferent between proposing a merger involving 3 firms or all firms in the status quo industry structure since the merger-plus-divestiture induced industry structure will be the same in both cases. The firm may, however, opt for a merger involving two firms only (scenario 1) and the corresponding AA decisions in that case are illustrated in Figure 1. So, combining the results illustrated in Figures 1, 3 and 4, one concludes that three different subcases should be distinguished (when we have that $\alpha \in [1/14, 1/5]$):

(i) If $\alpha \in [1/14, 1/6)$ and $f < ((1-6\alpha)/4)^2 \equiv \widetilde{f}_2$, then if there is a two-firm merger proposal, the AA will, as explained above, unconditionally approve it and, if this merger takes place, the two merger outsiders are able to make positive profits in equilibrium. Hence, in this region of parameter values, the randomly selected firm will prefer to submit a merger proposal involving two firms to a merger proposal involving

[27] The motivation behind this assumption is that we do not want that the fact that a merged entity anticipates that it is going to be forced to sell some asset (plant) initially included in the merger project will create additional incentives for the merger to be proposed in the first stage.

[28] Take for instance the case in which in which $\alpha \in [1/14, 1/5]$ and assume that the owner of the randomly selected plant (firm) at stage 1 wants to submit a three-firm merger proposal. One can suppose that this owner will have to buy two plants (from two other target owners) so as to be able to submit the merger proposal to the AA. The target owners anticipate that, if the project goes through, in the merger-plus-divestiture industry structure, each plant will create a profit equal to $\Pi(2;2)/2$. So, the randomly selected owner will have to offer to each target owner a price p^B for their plant such that $p^B \in (\Pi(1,1,1,1), \Pi(2;2)/2]$. Then, at stage 2, the AA asks for the divestiture of one of the acquired plants as a condition to clear the merger. The randomly selected owner knows that it can sell that plant either to the merger outsider, in which case the divested plant will create a profit $\Pi(2;2)/2$, or to a new entrant, in which case the divested plant would create a profit equal to $\Pi(1;2,1)$. This implies that the randomly selected owner at stage 1 knows that he can earn a price $p^S \in [\Pi(1;2,1), \Pi(2;2)/2]$ by divesting (selling) at stage 2 one of its acquired plants.

Now, it is important to note that assuming that the merging firm does not earn additional capital gains resulting from being forced to divest assets is equivalent to implicitly assume that $p^B = p^S$, which is an assumption compatible with the fundamentals of the model since $(\Pi(1,1,1,1), \Pi(2;2)/2] \cap [\Pi(1;2,1), \Pi(2;2)/2]$ is always a non-empty interval.

three or all firms in the status quo industry structure if (see eqs. (11) and (28)):

$$\frac{\Pi(2;1,1)}{2} = \frac{1}{2}\left(\frac{1+2\alpha}{4}\right)^2 - f \geq \frac{\Pi(2;2)}{2} = \frac{1}{2}\left(\frac{1-2\alpha}{3}\right)^2 - f, \tag{29}$$

which turns out to be satisfied for all $\alpha \in [1/14, \overline{\alpha})$.[29] Hence, in this region of parameter values, the randomly selected firm will always decide to submit a merger involving two firms to the AA.

(ii) If $\alpha \in [1/9, 1/5]$ and $\left(\frac{1-6\alpha}{4}\right)^2 \equiv \widetilde{f}_2 \leq f < \overline{f}$, then, as explained above, if there is a two-firm merger proposal, the AA unconditionally approves it since it anticipates that this first merger is going to be followed by a rescue merger leading to complete monopolization of the industry, $\{4\}$. Thus, the randomly selected firm will, in this region of parameter values, submit a two-firm merger to the AA for approval rather than a merger involving an higher number of merging parties if the following condition holds:

$$\frac{\Pi(4)}{4} = \frac{1}{4}\left(\frac{1-\alpha}{2}\right)^2 - f \geq \frac{\Pi(2;2)}{2} = \frac{1}{2}\left(\frac{1-2\alpha}{3}\right)^2 - f. \tag{30}$$

The previous condition, however, turns out to be always satisfied whenever $\alpha < (1/4) \equiv \overline{\alpha}$ (assumption 1). This in turn implies that in this region of parameter values, the randomly selected firm will always decide, as in the previous case, to submit a merger proposal involving 2 firms to the AA. In the case under analysis, however, this first two-firm merger will induce a subsequent rescue merger leading to complete monopolization of the industry.[30]

(iii) Lastly, if $\alpha \in [1/14, 1/9)$ and $\left(\frac{1-6\alpha}{4}\right)^2 \equiv \widetilde{f}_2 \leq f < \overline{f}$, then the randomly selected firm anticipates that the only two merger proposals which are going to be approved by the AA in the following stage are the ones involving three or all firms in the status quo industry structure. Besides, this firm is indifferent between these two merger proposals since both of them are going to be partially approved by the AA (in the following stage) and the induced market structure after the merger-plus-divestiture is, in both cases, a symmetric duopoly of the type $\{2,2\}$, as explained above.[31]

Let us now turn to the analysis of the case in which $\alpha > 1/5$. In this region of parameter values, it is clear that the randomly selected firm is indifferent between a merger involving two, three or all firms in the status quo industry structure. A merger involving all firms is always unconditionally approved by the AA. In the alternative scenarios where a merger involving two or three firms is proposed, the AA decides to

[29] It is worth remarking at this point that, making use of eq. (5), it can be easily shown that $\Pi(2;1,1)/2 > \Pi(1;1,1,1)$ in the region of parameter values we are considering in this case.

[30] From eq. (5) it is straightforward to check that $\Pi(4)/4 \geq \Pi(1;1,1,1)$ for all $\alpha < (1/4) \equiv \overline{\alpha}$ (assumption 1).

[31] Making use of eq. (5), it can be easily shown that the condition $\Pi(2;2)/2 \geq \Pi(1;1,1,1)$ is always satisfied for $\alpha < (1/4) \equiv \overline{\alpha}$ (assumption 1).

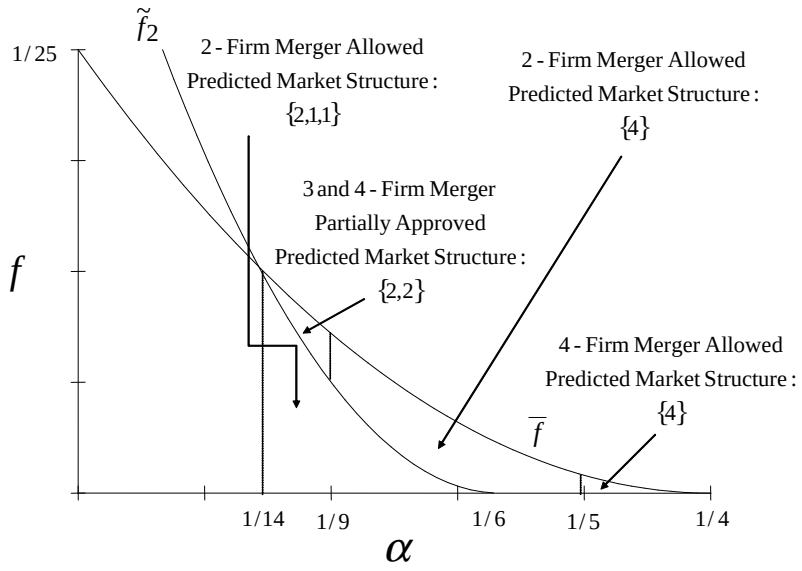

Figure 5: Equilibria of the game (with remedies)

unconditionally approve the notified concentration as well and, along the equilibrium path, a rescue merger follows the first merger. This implies that the capital belonging to the outsider firm(s) ends up being absorbed by the merged entity resulting from the first merger. So, in all cases, the final market structure is going to be {4}.

Figure 5 illustrates the full equilibrium outcome of the proposed three-stage game. In particular, this figure indicates, for each relevant region of parameter values, the AA decision at stage 2 and the final equilibrium industry structure induced by this policy decision.

3 Ex-Ante Evaluation of Remedies

The objective of this section is twofold. First, it aims at identifying the effects that merger remedies have in comparison with a situation where the merger policy consists of a yes/no answer by the AA to the merger proposal. Second, it answers the question of whether merger remedies (such as the ones contemplated by the present paper) are good or bad.

Figure 6 illustrates the full equilibrium outcome of a modified three-stage game where the AA does *not* have the power to restructure. Comparing the results in Figures 5 and 6, one can understand how having structural remedies makes a difference. In particular, the following effects can be identified.

First, by enriching the toolbox available for merger control, structural remedies allow the AA to be much

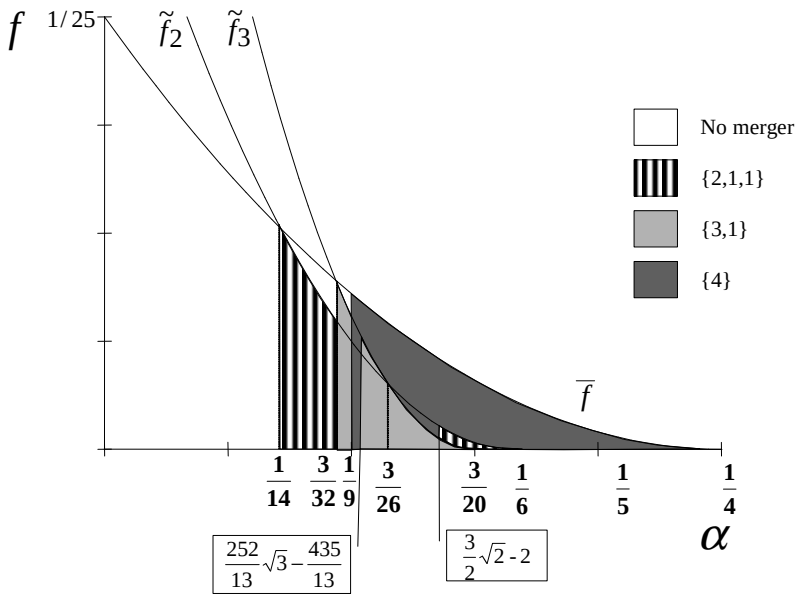

Figure 6: Equilibria of the game (without remedies)

more specific in its final decisions.[32] This implies that some merger proposals which wouldn't be cleared if an unconditional decision had to be taken end up being partially accepted when remedies are available. Take, for instance, the region where $\alpha \in [1/14, 3/32)$ and $\widetilde{f}_2 \leq f < \overline{f}$. If remedies are not feasible, no merger proposal is made (and, hence, no merger occurs). If instead mergers can be subjected to remedies, a merger involving three or all firms in the industry takes place and the final industry structure induced by the merger-plus-divestiture is $\{2, 2\}$.

Second, when merger proposals can be subjected to a remedy and partial mergers are part of the equilibrium path, we end up with a *more* competitive outcome (lower equilibrium prices) after the merger-plus-divestiture than prevailed before (in the status quo industry structure). Hence, this simple model provides a theoretical rationale for the "over-fixing" effect of (structural) remedies which was noted by Farrell (2003, p. 98). The intuition behind this result is simple. The AA waits for the merger proposal and uses this opportunity to make use of its enlarged toolbox available for merger control to reshape the industry structure by reallocating the available assets in the industry so as to *maximize* consumer welfare.

Third, the ability of the AA to order partial divestiture may induce firms to abandon merger proposals comprising larger (and, hence, more efficient) mergers, resulting in an outcome in which consumer surplus is *lower* than if the AA couldn't order partial divestiture. Let $\alpha \in \left[\frac{252}{13}\sqrt{3} - \frac{435}{13}, \frac{3}{26}\right)$ and $\widetilde{f}_2 \leq f < \widetilde{f}_3$. Then,

[32] Structural remedies allow for reallocation of assets among firms that are not possible simply with mergers.

in case the AA decision amounts to a yes/no decision (no remedies), the randomly selected firm proposes (at stage 2) a merger involving three firms (and the AA accepts it). However, if the merger proposals can be subjected to a remedy, the firm will refrain from proposing this three-firm merger since it wants to avoid over-fixing by the AA.[33] It will instead opt for a two-firm merger where the acquired unit of capital, being indivisible, cannot be partially divested. This two-firm merger will then be followed by a rescue merger where the merger outsiders are acquired by the merged entity resulting from the first merger, leading to a completely monopolized industry structure, $\{4\}$. Now, making use of (4), it is straightforward to show that, in the region we are considering here, $p(3,1) < p(4)$. Another example illustrating this point regards the region where $\alpha \in [3/26, 3/20)$ and $f < ((3-20\alpha)/9)^2 \equiv \widetilde{f}_3$. In this region, if the AA decision amounted to a yes/no decision, the randomly selected firm would submit to the AA a three-firm merger and the merger would be approved by the AA. In the presence of structural remedies, however, the firm does not submit a merger proposal involving three firms since it anticipates that the merger-plus-divestiture induced market structure would be a symmetric duopoly of the type $\{2,2\}$ (see Figure 3), where the merged entity earns a profit which is lower than the one it obtains in the market structure $\{2,1,1\}$. In addition, from (4), simple algebra shows that $p(3,1) < p(2,1,1)$ for $\alpha > 3/26$.

Finally, both in the case where mergers can be subjected to remedies and in the case where remedies cannot be used, the randomly selected firm at stage 1 can strategically embark on mergers which make other firms fail and then buy over the capital belonging to the exiting outsider firm(s) under the failing firm defence concept. Notice, however, that the region where this strategy of inducing a two-steps merger process leading to complete monopolization of the industry is adopted is larger when merger remedies are part of the toolbox available for merger control than when remedies are not feasible see Figures 5-6).[34]

Note that the first two of the previously identified effects of merger remedies are positive, while the remaining two effects are negative. So, the central question at this point is whether merger remedies are good or bad. Put another way, in what follows we investigate whether the negative effects of merger remedies are sufficiently important to more than compensate the positive effects of merger remedies, or otherwise. If f and α are are assumed to be uniformly distributed, one can then compute whether consumer surplus

[33] In case the three-firm merger was proposed, the merger-plus-divestiture induced market structure would be a symmetric duopoly of the type $\{2,2\}$ (see Figure 3).

[34] This result seems somehow consistent with the recent experience of the Italian pay-TV market (a high α industry, as explained in footnote 12), where the Australian media group Newscorp embarked on a two-steps operation leading to a near-monopoly situation. Prior to the concentration, Stream and Telepiù were virtually the only providers of pay-TV services in Italy. In 2000, Newscorp created a 50/50 Joint-Venture with Telecom Italia so as to jointly control Stream. Then, a couple of years later, Newscorp proposed to the EC the acquisition Telepiù from Vivendi Universal, where the proposal specified that Stream and Telepiù would be merged into a combined pay-TV platform and Telecom Italia would hold a minority stake. Whilst not accepting the application of the failing-firm defence concept (invoked by Newscorp), the EC has taken into account the financial difficulties faced by market operators (due to high programming costs coupled with limited rate of penetration of pay-TV in Italy). The merger was authorized and the EC considered that approving it was more beneficial to consumers than the disruption that would have been caused in case at least one of the two main operators would have left the market (see EC Case No. Comp/M.2876 - *Newscorp/Telepiù*; Article 8(2), Decision of 2/04/2003).

ex-ante is higher with or without remedies. This analysis is performed in Appendix C and the answer to the question raised above is that the net effect of merger remedies is *positive*. Merger remedies turn out to enhance consumers' surplus from an ex-ante point of view.

4 Conclusion

If the analysis performed by an AA shows that the effect of a proposed merger will be to substantially lessen competition in the relevant market, the AA may still decide not to block the merger. It can approve a modified version of the merger proposal where merging parties adopt certain commitments to modify the notified concentration.

In Europe, for instance, the number of cases in which the EC has cleared a merger subject to remedial conditions that restructure the notified transaction has been much higher than the number of cases in which the proposed concentration was prohibited outright. Economic theory has, however, devoted very scarce attention to the study of the equilibrium impact of remedies to mergers.

The present paper studies the role of structural remedies in merger control in a setting where firms compete *à la* Cournot in the product market and mergers are motivated by prospective efficiency gains. The strategic interaction between the firms and the AA is modelled as a dynamic game where: (i) the merger process is fully endogenized; and (ii) every merger has to be submitted for approval to an AA, which is an active player of the game and is endowed with an enriched toolbox for merger control: whenever a merger is proposed, the AA can decide to unconditionally authorize or block it, but it has also the possibility to approve the merger subject to the condition that some assets are divested to an AA approved purchaser (partially approve the merger).

Some important merger policy implications can be obtained with our simple formal setting. First, by enriching the toolbox available for merger control, structural remedies allow the AA to take decisions at a more specific level, which in turn implies that some mergers that, in the absence of structural remedies, would be blocked by the AA, end up being partially approved (structural remedies create new merger opportunities to firms). Second, whenever partial mergers are part of the equilibrium path, the AA goes beyond recreating the level of competition that existed prior to the proposed transaction. The AA tends to demand divestitures to clear the merger proposal that will make the market more competitive than in the status quo industry structure (this represents the so called "over-fixing" effect of remedies). Third, there is a negative effect of merger remedies. The anticipation that the AA insists in over-fixing may, in some circumstances, lead the firms to size down their merger proposals, inducing a final outcome in which consumers' surplus is lower than in a situation where the AA cannot order partial divestiture as a condition to clear a merger.

By studying the interplay between the identified effects of structural merger remedies, this paper also shows that merger remedies are good. Consumers' surplus ex-ante is higher with than without remedies.

A natural extension of the model developed in this paper would be to rule out the assumption that the industry capital is initially fully distributed so as to allow firms to enter into the industry with new capacity. For the purposes of this paper, however, models of this sort are left for further research.

A The Asymmetric Cournot Equilibrium

Let c_i denote the marginal cost of firm i. Now, from Lehto and Tombak (1997), we have that in a $n-$firm Cournot equilibrium with (constant) asymmetric marginal costs (and no fixed costs) where the inverse demand is given by (1), the individual output, the market price and the individual profits are respectively given by:

$$q_i^* = \frac{1 - nc_i + \sum_{j \neq i} c_j}{n+1}, \tag{31}$$

$$p^* = \frac{1 + \sum_{i=1}^{n} c_i}{n+1}, \tag{32}$$

$$\pi_i^* = \left(q_i^*\right)^2. \tag{33}$$

In our setting, $c_i = \alpha K / k_i$ and firm i's fixed costs are $k_i f$. Therefore, the specific form of the previous three functions (for the case in which n firms are active) is the following:

$$q\left(k_i; \mathbf{k}_{-i}\right) = \frac{1 - \alpha K \left(\frac{n}{k_i} - \sum_{j \neq i} \frac{1}{k_j}\right)}{n+1}, \tag{34}$$

$$p\left(k_i, \mathbf{k}_{-i}\right) = \frac{1 + \alpha K \sum_{j=1}^{n} \frac{1}{k_j}}{n+1}, \tag{35}$$

$$\Pi\left(k_i; \mathbf{k}_{-i}\right) = \left(q\left(k_i; \mathbf{k}_{-i}\right)\right)^2 - k_i f, \tag{36}$$

where $\mathbf{k}_{-i}$ is a vector of dimension $(n-1)$ with the rival firms' capital holdings.

B The Asymmetric Case

So far, we have only looked at symmetric equilibria, in the sense that firms with the same amount of capital were assumed to have the same output and profits at equilibrium. However, in the proposed merger game, asymmetric equilibria arise - for certain parameter values - under many of the configurations analyzed. For

example, under the initial market structure $\{1,1,1,1\}$, there might also exist at least another equilibrium where three firms sell a larger (symmetric) quantity and the fourth firm's best response is to sell zero.[35]

A complete treatment would require dealing with all possible asymmetric equilibria, leading us to a richer but much more complex game. Nevertheless, there is one asymmetric case which is worth considering, and to which this appendix is devoted. We have assumed that if costs (fixed or variable) are high enough (namely, if $\alpha \geq 1/6$ and/or $f \geq \left(\frac{1-6\alpha}{4}\right)^2 \equiv \widetilde{f}_2$), then, after a two-firm merger and in the absence of a subsequent merger, the two merger outsiders would exit the industry. It is natural to wonder, however, whether, after a two-firm merger, it may be optimal for one of the two outsider firms to remain active in the industry if and only if the other outsider firm exits. In what follows, we first identify under which conditions this specific asymmetric equilibrium exists and then characterize the predicted industry structures.

B.1 Existence

Consider the situation where a two-firm merger has occurred, so that the post-merger distribution of capital is such that the firm resulting from the merger has two units of the industry capital and the two outsider firms hold one unit of it each. Let us look for the asymmetric equilibrium in which one of the outsiders sells positive output and the other sells zero output.

Let q_l and q_s denote the outputs of the large firm and of the active outsider firm, respectively. Since the exiting outsider sells zero output, the large firm will choose q_l so as to maximize $\Pi_l = (1 - q_l - q_s - 2\alpha)\, q_l - 2f$, while the active outsider chooses q_s so as to maximize $\Pi_s = (1 - q_l - q_s - 4\alpha)\, q_s - f$. Now, solving the first-order conditions (FOCs), gives the equilibrium quantities of the large firm and the active outsider firm, and the resulting equilibrium price:

$$q_l\,(2;1) = \frac{1}{3}, \quad q_s\,(1;2) = \frac{1-6\alpha}{3}, \quad p(2,1) = \frac{1+6\alpha}{3}. \tag{37}$$

The equilibrium profits are therefore:

$$\Pi_l\,(2;1) = \frac{1}{9} - 2f, \quad \Pi_s\,(1;2) = \frac{(1-6\alpha)^2}{9} - f. \tag{38}$$

These quantities and profits are positive for values of the parameters such that $\alpha < 1/6$ and $f < (1-6\alpha)^2/9$.[36] Now, we have to check that, given that $q_l\,(2;1) = 1/3$ and $q_s\,(1;2) = (1-6\alpha)/3$, it is

[35] To be more precise, there are four equilibria of the same sort, differing only in which firm ($1, 2, 3$ or 4) produces zero. It is possible to show that this type of asymmetric equilibrium exists if $(1-4\alpha)^2/64 < f < (1-4\alpha)^2/16$.

[36] $\Pi_l\,(2;1)$ is always positive since Assumption 1, which restricts attention to $f < \overline{f}$, ensures that $f < 1/18$.

optimal for the other outsider firm (say, firm 4) to leave the market. If firm 4 decides instead to produce, its profit will be $\Pi_4(q_4) = (1 - 1/3 - (1-6\alpha)/3 - q_4 - 4\alpha)\, q_4 - f$, from which one can easily check that the profit maximizing output is $q_4 = (1-6\alpha)/6$, resulting in profit $\Pi_4 = (1-6\alpha)^2/36 - f$. Therefore, this asymmetric equilibrium exists only if:

$$\alpha < 1/6 \text{ and } (1-6\alpha)^2/36 < f < \min\left\{\overline{f}, (1-6\alpha)^2/9\right\} \tag{39}$$

where $\overline{f}$ is given by eq. (6) (Assumption 1).

B.2 Equilibrium Analysis

In this section we solve by backward induction the game described in section 2.1, restricting attention to the region of parameter values defined by (39), where an asymmetric equilibrium might arise after a two-firm merger takes place.

Analysis of the third stage There are two cases in which a rescue merger might occur at the *third* stage. First, as shown in Section 2.2, if a previously approved merger involves three firms and the outsider to this merger is pushed out of the industry as a result of this merger, then the merged entity will propose a rescue merger if condition (10) holds. Second, if the unique merger which occurred in the previous stages is a two-firm merger and only one of the outsider firms exits the industry while the other outsider firm remains, we can also have a rescue merger. In this second case, however, there are two potential acquirers of the exiting firm: the large merged entity resulting from the previous two-firm merger and the small active outsider to this merger.

Suppose the two potential acquirers simultaneously make a take-it-or-leave-it offer to acquire the exiting firm. Clearly, the maximum "price" the large and the small potential acquirers would be willing to pay for the exiting firm is, respectively, $\Pi(3;1) - \Pi_l(2;1)$ and $\Pi(2;2) - \Pi_s(1;2)$ (the marginal contribution of the acquired plant to the total profits of the acquirer firm). So, whether the acquirer of the exiting unit of capital is going to be the large or the small firm will depend on whether

$$\Pi(3,1) - \Pi_l(2;1) > \Pi(2,2) - \Pi_s(1;2), \tag{40}$$

or otherwise. Now, making use of eqs. (18), (28) and (38), some algebra shows that the previous condition holds if and only if $\alpha > 3/19$.

Analysis of the second stage In the *second* stage, the AA can be faced with a merger proposal involving two, three or all firms in the industry. The analysis regarding the AA decisions when faced with merger involving three or all firms in the industry is the same as in Section 2.2. In particular, when $\alpha \in [1/14, 1/6)$, the AA will, in both cases, partially approve the merger proposal and the induced industry structure is a symmetric duopoly of the type $\{2,2\}$ (see Figures 3 and 4). If, however, the randomly selected firm at stage 1 decides to submit a two-firm merger to the AA, then the AA anticipates that, in the continuation game, this first two-firm merger will be followed by a rescue merger, and two different cases should be distinguished:

(i) If $\alpha \leq 3/19$, the exiting outsider firm is absorbed by the active outsider to the previous two-firm merger and the induced market structure is $\{2,2\}$ (the same that would result from a three- or four-firm merger). So, from eq. (21), one may conclude that the two-firm merger will only be approved when $\alpha \in [1/14, 3/19]$

(ii) If instead $\alpha > 3/19$, the exiting firm is absorbed by the merged entity resulting from the previous two-firm merger and the final induced market structure is $\{3,1\}$. Now, since $p(3,1) < p(1,1,1,1)$ in this range of parameter values (see eq. (24)), the AA approves the two-firm merger.

Analysis of the first stage In the *first* stage of the game, the randomly selected firm is given the opportunity to propose a merger to the AA. Three different scenarios should be distinguished:

1. If $\alpha < 1/14$ the firm anticipates that no merger is going to be accepted by the AA and, therefore, decides not to submit a merger proposal.

2. If $\alpha \in [1/14, 3/19]$, the firm is indifferent between submitting a merger proposal involving two, three or all firms in the industry, since in all cases the induced final market structure is a perfectly symmetric duopoly, $\{2,2\}$. If a two-firm merger is proposed, it is accepted by the AA and, in the continuation game, a subsequent rescue merger takes place where the active outsider absorbs the exiting one. If instead a merger involving three or all firms is proposed, the AA will partially approve it and, in both cases, the resulting market structure is again $\{2,2\}$ (see Figures 3 and 4).

3. If instead $\alpha \in (3/19, 1/6)$, the randomly selected firm will propose a two-firm merger if the net aggregate payoff of the merged entity it will belong to in the resulting industry structure $\{3,1\}$ exceeds $\Pi(2,2)$, i.e., if[37]

$$\Pi(3,1) - (\Pi(2,2) - \Pi_s(1;2)) > \Pi(2,2). \tag{41}$$

[37] Notice that when the merged entity resulting from a two-firm merger wins the (Bertrand) competition to buy the exiting outsider firm, it will pay for this firm the maximum price that the rival potential (smaller) acquirer would be willing to pay for that exiting firm, $\Pi(2,2) - \Pi_s(1;2)$.

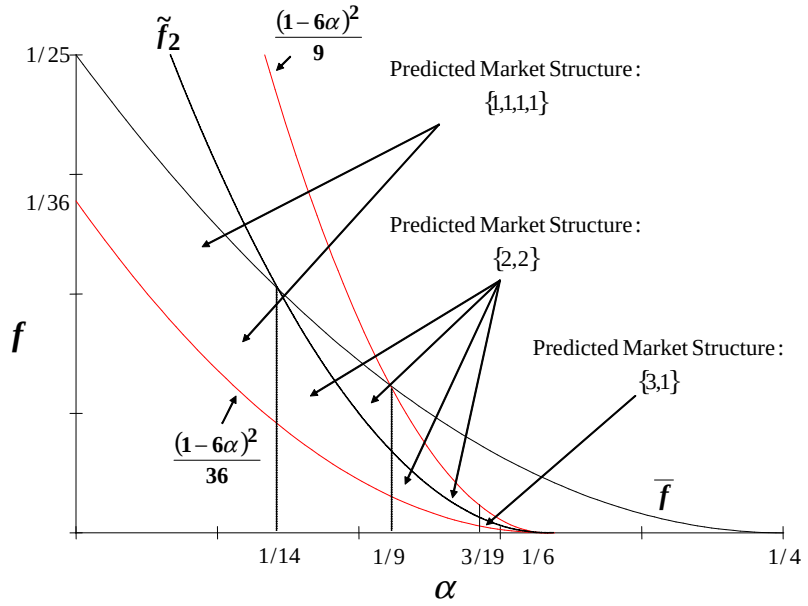

Figure 7: Equilibrium outcomes - Asymmetric case

Making use of eqs. (18), (28) and (38), one can show that the previous condition always holds in the region of parameter values under consideration, which in turn implies that the randomly selected firm opts for a two-firm merger and the final induced industry structure is $\{3,1\}$.

This completes the analysis of the whole game, whose predicted industry structures are summarized in Figure 7. From the comparison of results in Figures 5 and 7, two notes are in order, regarding the two regions of parameter values where the predicted market structures do no coincide in the two figures. First, even though there is a difference in the predicted market structure in the region where $\alpha \in [1/9, 1/6)$ and $\widetilde{f}_2 < f < (1-6\alpha)^2/9$, there still remains an area - namely, $(1-6\alpha)^2/9 \leq f < \overline{f}$ and $\alpha \in [1/9, 1/4)$ - where an asymmetric equilibrium does not exist and, hence, the firm randomly selected at stage 1 strategically uses asset indivisibility to monopolize the industry. This is done by embarking on a two-firm merger which makes outsiders fail and then buying over the capital belonging to the exiting outsiders under the failing firm defence concept. Second, there is also a difference in predictions regarding the region where $\alpha \in [1/14, 1/6)$ and $(1-6\alpha)^2/36 < f < \widetilde{f}_2$. However, there still remains an area - namely, $\alpha \in [3/26, 3/20)$ and $f < \min\left\{\widetilde{f}_3, (1-6\alpha)^2/36\right\}$ - where the randomly selected firm sizes down its merger proposal (which comprises two rather than three firms) so as to avoid partial divestiture, resulting in a less desirable outcome from a social viewpoint. This being said, one finally concludes that the qualitative results of the basic model are confirmed when the asymmetric equilibrium case is considered.

C Consumer Surplus Ex-ante

Let A be the region of parameter values defined by Assumption 1.[38] Now, suppose (α, f) is uniformly distributed on $[0, 1/4] \times [0, 1/25]$. Then,

$$P(A) = 100 \int_0^{1/4} \overline{f}(\alpha)\, d\alpha, \tag{42}$$

where $\overline{f}(\alpha)$ is given by eq. (6). Simple algebra shows that $P(A) = 1/3$.

In what follows, our goal is to compute the expected value of the price, conditional on the fact that we are restricting attention to region A of parameter values. This will be done both for the case where merger proposals can be subjected to remedies and for the case where remedies are not available. This exercise will allow us to answer the question of whether consumer surplus ex-ante is higher with or without remedies.

Consider first the case in which merger proposals can be subjected to remedies. Then, from Figure 5, one concludes that:

$$\begin{aligned} E(p|A)|_R &= \frac{100}{P(A)} \left(\int_0^{1/14} p(1,1,1,1)\, \overline{f}(\alpha)\, d\alpha + \int_{1/14}^{1/6} p(2,1,1)\, \widetilde{f}_2(\alpha)\, d\alpha \right. \\ &\quad + \int_{1/14}^{1/9} p(2,2) \left(\overline{f}(\alpha) - \widetilde{f}_2(\alpha) \right) d\alpha + \int_{1/9}^{1/6} p(4) \left(\overline{f}(\alpha) - \widetilde{f}_2(\alpha) \right) d\alpha \\ &\quad \left. + \int_{1/6}^{1/4} p(4)\, \overline{f}(\alpha)\, d\alpha \right), \end{aligned}$$

where $\overline{f}(\alpha)$ and $P(A)$ are given by eqs. (6) and (42), respectively, and $\widetilde{f}_2(\alpha) = ((1 - 6\alpha)/4)^2$. Now, making use of eq. (4), some algebra shows that $E(p|A)|_R = 0.38036$.

Consider now the case in which merger proposals cannot be subjected to remedies. Then, from Figure 6,

[38] In the previous figures, area A is given by the area underneath the $\overline{f}$ curve for $\alpha \in [0, 1/4]$.

one may conclude that:

$$
\begin{aligned}
E\left(p|\,A\right)|_{NR} \;=\; & \frac{100}{P(A)}\left(\int_{0}^{1/14} p\left(1,1,1,1\right)\overline{f}\left(\alpha\right)d\alpha+\int_{1/14}^{3/32} p\left(1,1,1,1\right)\left(\overline{f}\left(\alpha\right)-\widetilde{f}_{2}\left(\alpha\right)\right)d\alpha\right.\\
& +\int_{3/32}^{1/9} p\left(1,1,1,1\right)\left(\overline{f}\left(\alpha\right)-\widetilde{f}_{3}\left(\alpha\right)\right)d\alpha+\int_{1/14}^{3/32} p\left(2,1,1\right)\widetilde{f}_{2}\left(\alpha\right)d\alpha\\
& +\int_{\frac{3}{2}\sqrt{2}-2}^{3/20} p\left(2,1,1\right)\left(\widetilde{f}_{2}\left(\alpha\right)-\widetilde{f}_{3}\left(\alpha\right)\right)d\alpha+\int_{3/20}^{1/6} p\left(2,1,1\right)\widetilde{f}_{2}\left(\alpha\right)d\alpha\\
& +\int_{3/32}^{1/9} p\left(3,1\right)\widetilde{f}_{3}\left(\alpha\right)d\alpha+\int_{\frac{252}{13}\sqrt{3}-\frac{435}{13}}^{3/20} p\left(3,1\right)\widetilde{f}_{3}\left(\alpha\right)d\alpha\\
& +\int_{1/9}^{\frac{252}{13}\sqrt{3}-\frac{435}{13}} p\left(4\right)\overline{f}\left(\alpha\right)d\alpha+\int_{\frac{252}{13}\sqrt{3}-\frac{435}{13}}^{\frac{3}{2}\sqrt{2}-2} p(4)\left(\overline{f}\left(\alpha\right)-\widetilde{f}_{3}\left(\alpha\right)\right)d\alpha\\
& \left.+\int_{\frac{3}{2}\sqrt{2}-2}^{1/6} p\left(4\right)\left(\overline{f}\left(\alpha\right)-\widetilde{f}_{2}\left(\alpha\right)\right)d\alpha+\int_{1/6}^{1/4} p\left(4\right)\overline{f}\left(\alpha\right)d\alpha\right),
\end{aligned}
$$

where $\overline{f}\left(\alpha\right)$ and $P(A)$ are given by eqs. (6) and (42), respectively. In addition, $\widetilde{f}_{2}\left(\alpha\right)=\left(\left(1-6\alpha\right)/4\right)^{2}$ and $\widetilde{f}_{3}\left(\alpha\right)=\left(\left(3-20\alpha\right)/9\right)^{2}$. Now, using eq. (4), some algebra shows that $E\left(p|\,A\right)|_{NR}=0.38253>E\left(p|\,A\right)|_{R}$. Consumers' surplus ex-ante is higher with remedies than without remedies.

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