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Efficiency Gains and Myopic Antitrust Authority in a Dynamic Merger Game*

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Abstract

This paper models a sequential merger formation game with endogenous efficiency gains in which every merger has to be submitted for approval to the Antitrust Authority (AA). Two different types of AA are studied: first, a myopic AA, which judges a given merger without considering that subsequent mergers may occur; and, second, a forward looking AA, which anticipates the ultimate market structure a given merger will lead to. By contrasting the decisions of these two types of AA, merger policy implications can be drawn. In particular, the *efficiency offence* argument does not find *any* justification under a forward looking AA.

Keywords: Endogenous mergers; Foresight, Efficiency offence.
JEL classification: D43; L13; L41.

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1 Introduction

Economic analysis suggests that efficiency gains play a crucial role in determining the effect of mergers on consumer and total welfare.[1] Accordingly, Antitrust Authorities (AAs) should try and estimate whether efficiency gains are likely or not to offset the higher market power enjoyed by the merging firms. This is precisely the approach indicated by the Merger Guidelines released by the US Department of Justice, which

> "...will not challenge a merger if cognizable efficiencies are of a character and magnitude such that the merger is not likely to be anticompetitive in any relevant market. To make the requisite determination, 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).

The European Commission (EC) has so far had a more ambiguous approach towards efficiency gains. It has been debated whether the wording of the European Merger Regulation No. 4064/89 allows or not for an efficiency defence.[2] However, in practice, the EC has so far never used efficiency gains arguments to clear a merger. In the past, whenever cost reductions have been claimed by the merging parties, the EC dismissed those claims on various grounds.[3]

Further, the EC used possible cost reductions as an argument *against* a merger in at least one of the early cases.[4] None the less, some of the recent EC decisions have raised doubts that the EC is using again some version of *efficiency offence* arguments. The widely discussed *General Electric-Honeywell* merger is a case in point.[5] General Electric is a leading producer of jet engines for large commercial aircraft and Honeywell of avionics products. Among other concerns, the EC thought that the merged firms could have bundled engine and avionics products, to the detriment of competitors. The EC argued that although the welfare effect would have been beneficial in the short-run, in the

[1] See Farrell and Shapiro (1990) and, for a general discussion of the effects of mergers, Motta (2003).

[2] See for instance Neven, Nuttall and Seabright (1993: 62-63, and 116-117), and Jacquemin (1990). However, article 1.1(b) of the Merger Regulation says that in its appraisal of the merger, the Commission shall take into account, among other things "...the interests of the intermediate and ultimate consumers, and the development of technical and economic progress provided that it is to consumers' advantage and does not form an obstacle to competition." This would seem to allow for efficiency considerations in mergers.

[3] For instance, in *Aérospatiale-Alenia/DeHavilland* (Case IV/M.053 (October 2, 1991), OJ L334/42, 1991, at 65) the EC argued that cost savings would have been negligible, had not been properly quantified, were not merger-specific (they could have been attained without the need of a concentration) and would have not gone in any case to consumers' advantage. Other cases where defendants raised efficiency considerations were *Accor/Wagon-Lits*, *MSG/Media Services*, *Mercedes-Benz/Kassbohrer*. See also Noël (1997: 512-514).

[4] See *AT&T/NCR*, Case IV/M.050 (18 January 1991). Other cases are discussed by Noël (1997: 512) and Neven et al. (1993: 116-117).

[5] *General Electric/Honeywell*, case COMP/M.2220.

long-run competitors would have left the industry and GE/Honeywell become a monopolist, thereby harming welfare.[6]

The extent to which the EC might still use efficiency offence arguments has probably been exaggerated, and we are convinced that European merger policy will soon explicitly accept efficiency defence arguments.[7] Nevertheless, a more general theoretical question remains open, and this deals with whether efficiency gains might indeed be anti-competitive in some cases.

In our opinion, there are two distinct, although possibly related, rationales for efficiency offence arguments. The first lies in the possibility that merged firms become so efficient that, even without engaging in strategic behaviour, their competitors will be unable to compete and will exit the market, causing an overall negative effect. The second resides in the possibility that, after merging, two firms might engage in strategic anti-competitive practices aimed at exploiting their increased (market or financial) power so as to force rivals to exit.

This paper focuses on the first possible motivation for an efficiency offence argument.[8] We analyse a simple model where a merger increases firms' capacity, which in turn leads to scale economies. When such efficiency gains are very small, there would be no merger (we use a Cournot model). When they are of intermediate importance, outsider firms lose competitiveness but continue to operate profitably, resulting in a more efficient market outcome, the case usually analysed in the literature. However, a merger might give the two merging firms such important cost savings that - without engaging in any predatory practice or any "strategic" action - rivals would be unable to survive in the industry.

The last case might seem to provide some rationale for the efficiency offence arguments. In fact, there exist two objections that should be considered before drawing the conclusion that efficiency gains might be detrimental. First, it is not enough to show that competitors would exit the industry to conclude that the merger has negative effects: one should show that consumers would be hurt as well (antitrust policy does not protect competitors, it protects competition!). Second, and perhaps more important, if the merger gives rise to such important cost savings, should we not expect that competitors would react to attain similar savings, rather than waiting to be forced out of the market?

Our simple formal setting allows to consider both points. First, we show that if efficiencies are strong, prices might be lower after the merger - even if the competitive disadvantage obliges some firms to exit. Second, we show that a static model where the effects of an *exogenous* merger are analysed might be

[6] Similar concerns have also been expressed in other cases where the EC has proposed the so called "*portfolio theory*" of merger effects. See e.g., *Guinness/Grand Metropolitan* (case IV/M.938); *Coca-Cola/Amalgamated Beverages* (case IV/M.796); *Coca-Cola/Carlsberg* (case IV/M.833).

[7] The recent EC Green Paper on the Reform of the Merger Regulation and the Draft Commission Notice on horizontal mergers (OJ C 331, 31.12.2002) are witnesses of the willingness to incorporate efficiency considerations in EU merger policy. See also Verouden et al. (2003).

[8] To our knowledge, the second motivation has never been the object of a formal analysis. The extent to which two firms might behave anti-competitively after merging seems an interesting topic of research as well.

misleading. In a dynamic setting such as the one we propose here, if a merger provides important cost savings, then it will be followed by a merger of the rivals. In other words, if there exist efficiency gains to be reaped from a merger, outsiders will respond by merging as well. This "defensive" merger will allow the outsiders to the first merger to match the efficiency gains of the first merger partners, leading to a final outcome which is positive for society. Indeed, we show that if the AA is forward looking, that is if it takes into account that the first merger will be followed by another, no efficiency offence argument would be justified. Either cost savings are small, and the merger(s) should be blocked; or cost savings are large, and the merger(s) should be allowed.

While the possibility that AAs (and more particularly, the European Commission) might rely on efficiency offence arguments has received some attention in the press and in law articles (see e.g. Noël, 1997), economists have devoted scarce attention to this issue. Padilla (2002) offers an informal discussion of efficiency offence arguments in recent EC practice. Motta (2003, chapter 5) formally analyses an efficiency offence argument, but limits attention to the static framework that corresponds to section 3 of this paper.[9,10]

Apart from the discussion of the efficiency offence argument, we regard the dynamic feature of our merger model as the main contribution of this paper. Most of the existing models of mergers do not deal with the dynamics of the merger processes, as they simply compare a pre-merger situation with a post-merger situation, without taking into account that a merger might trigger other mergers. Exceptions are Gowrinsankaran (1999), Fauli-Oller (2000), and Nilssen and Sorgard (1998).

Relative to these papers, we explicitly model the presence of an Antitrust Authority that is an active player of our game, and is called to authorise or block a merger whenever one is proposed.

We contrast two games. In the first, the AA is myopic: when a merger is proposed, the AA judges it without considering that further mergers might occur (i.e., it thinks that either the outsiders stay "passively" in the industry or they leave it - it does not consider that outsiders might take actions such as merging themselves). This myopic behaviour leads the AA to use an efficiency offence argument and block the merger under some parameter constellations.

In the second game, the AA is forward looking and is able to correctly anticipate the future. Along the equilibrium path, if efficiency gains are large

[9] The treatment in Motta (2003) is based on a differentiated products model with price competition, but the similarities in the static analysis make us believe that the results we obtain in the dynamic setting would extend to his model.

[10] Of course, the economic literature on efficiency gains in general is much richer. The most authoritative formal treatment is still given by Farrell and Shapiro (1990)'s model, which is also the basis of a more recent assessment of efficiency gains by the same authors (Farrell and Shapiro, 2001). A formalisation and a discussion of efficiency gains can also be found in Motta (2003, chapter 5). Recent papers on efficiency gains include empirical and theoretical works. Among the former, Neven and Röller (2001) use the Eckbo test to evaluate efficiency gains in EU mergers. Among the latter, Heidhues and Lagerlof (2002) assume that the merger parties are privately informed about merger-specific efficiencies, and decide whether to (costly) transmit such information to the AA to influence its decision on their proposed merger.

enough the first merger between two firms will be authorised, because the AA knows that it will be followed by another merger by the outsiders - that will also be authorised, because otherwise there would be inefficient exit. (The remaining two firms will also want to merge to monopoly, but this last merger will not be authorised by the AA, unless efficiencies are extremely high.) Therefore, in our model, the efficiency offence argument does not find any justification under a forward looking AA.

The paper continues as follows. Section 2 introduces the basic model, which is chosen as the simplest possible setting where the elements we are interested in could emerge. Section 3 analyses the game where the AA behaves myopically. Section 4 analyses the dynamic game, where the AA is forward looking. Section 5 concludes the paper by discussing the results obtained.

2 Basic 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. For the sake of simplicity, the total quantity of capital available in the industry is normalized to one.[11] Let k_i, $k_i \in \left\{\frac{1}{4}, \frac{2}{4}, \frac{3}{4}, 1\right\}$, denote the fraction of the industry capital owned by firm i, $i \in \{1, ..., 4\}$.

The cost structure is a key feature of this model. The cost function of a firm which owns a fraction k_i of the industry capital and produces q_i units of output

[11] The assumption that capital is fixed, and that de novo entry into the industry is impossible, is made for simplicity. Otherwise, the model should consider not only external growth (i.e., growth by mergers) but also internal growth (i.e., growth by capital accumulation), which would greatly expand the set of strategies available to firms, considerably complicating the analysis. Still, there are several industries that are characterised by fixed capacity and difficult (or impossible) 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 characterised by a low degree of efficiency gains (that is, by a low value of α, see below).

Other industries which might fit the assumption of fixed capital are those where entry is regulated by law and subject to licenses or authorisation. Think for instance of radio, television, telecommunication services which make use of the spectrum of waves. 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 existing licenses from competitors (i.e., merging). 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). Yet another example of fixed capacity is given by landing and take-off slots at any given airport. The number of slots is fixed, and an airline can increase its slots if it merged with rivals. Since the frequency of flights is regarded by consumers as crucial in the choice of the airline they want to fly with, efficiency gains (at least in this particular respect) might well be created by the merger.

is given by:

$$C(q_i, k_i) = \frac{\alpha}{k_i} q_i + 4 k_i f, \tag{2}$$

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

Hence, we assume that each firm operates with a constant marginal cost of production, but the level of its marginal cost is a decreasing function of its share in the industry capital, k_i. In addition, it is assumed that there exists a plant specific fixed cost f, which has to be paid for each 1/4 of the industry capital owned by the firm.

The previous function aims at capturing two distinct cost effects induced by a merger. First, a merger brings the individual capital of merging firms into a single larger resulting firm and, therefore, it gives rise to endogenous efficiency gains by decreasing marginal costs. The higher the value of α, the stronger the efficiency gains induced by a merger.[12] Second, by creating a larger firm, a merger also has the effect of increasing fixed costs proportionally. This effect is captured by the parameter f in the cost function.[13]

In the analysis which follows, it will be assumed that firms compete *à la* Cournot and are allowed to merge before competition in the product market occurs. However, when firms want to merge, they will have to ask the Antitrust Authority (henceforth, AA) for authorisation.

Two different scenarios are dealt with. First, we assume that the AA has a completely myopic behaviour (section 3). When deciding whether to authorise or not a given merger, it does not take into account that the merger under consideration can be followed by other mergers. We then turn to a second scenario (section 4) in which it is assumed that the AA is forward looking in the sense that it anticipates the ultimate market structure a merger will lead to, and takes it into account when deciding on a proposed merger.

Throughout the paper, we assume that the AA maximises *consumer welfare*. This is consistent with the current standards used both in the US and in the EU to assess mergers. 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 consumer surplus).[14] In the EU, it is currently debated whether to switch to the SLC test or keep the

[12] This essential feature of a merger was first proposed by Perry and Porter (1985). In their framework firms' marginal cost is linear in output and mergers reduce variable costs. The same model is also used by Vasconcelos (2001), who analyses the possible pro-collusive effects of a merger.

[13] This specification is used to rule out further scale economies simply due to sharing of fixed costs. An effect of this specification is that efficiency gains benefit both consumers and the merging firms, and allows unnecessary divergences between a consumer welfare and a total welfare standard.

[14] Two oft-cited decisions are: FTC v. University Health, Inc., 938 F.2d 1206, 1222-1223 (11th Circ.1991); United States v. United Tote, Inc., 768 F. Supp. 1064, 1084-1085 (D. Del. 1991). The quote from the revised US Merger Guidelines at the beginning of this paper makes this approach explicit: efficiency gains arguments would be accepted only to the extent that they will prevent price increases in the market.

current dominance test, which would deem incompatible mergers that created or reinforced a dominant position (see also Verouden et al., 2003). It is less clear whether this test is closer to a consumer welfare or a total welfare standard, but the wording of article 1.1 (see footnote 2 above) states that an efficiency gain is in principle admitted to the extent that it benefits consumers, thus implying a consumer welfare standard.

By assuming that the AA assesses mergers according to a consumer surplus standard we do not want to imply that this *should* be the right standard.[15] We adopt this assumption only because it describes current practice in the major antitrust jurisdictions. An advantage of this assumption is also that it allows us to keep the analysis extremely simple.

3 "Static" analysis (myopic AA)

In this section, we analyse a simple game where from an initial symmetric market structure, two of the four firms consider to merge. In the first stage, the two firms decide whether to propose a merger (they will do it, when the merger gives higher profits). In the second stage, the AA decides whether to authorise the merger or not. This simple game is a restricted version of the dynamic game we present in the next section 4, where the first merger might be followed by other mergers. Since we assume in the present section that the AA is myopic, by definition it will not take into account that other mergers might occur, and consequently there is no need to consider the stages which follow the second stage of the game.

The reader should note that both in this section and in section 4, we restrict attention to symmetric equilibria, in the sense that we impose that firms which have the same share of the industry capital will also have the same outputs and profits at equilibrium. The Appendix will extend the analysis by discussing possible asymmetric equilibria.

Initial market structure Let us assume that the status quo industry structure is a symmetric one. Hence, each firm has a share 1/4 of the industry capital. Each firm i, therefore, chooses q_i by solving the following maximisation problem

$$\max_{q_i} \left\{ (1 - q_i - \sum_{j \neq i} q_j) q_i - 4\alpha q_i - f \right\}. \tag{3}$$

From here we find that, due to symmetry, the equilibrium quantities at the initial market structure are equal for all firms and are given by

$$q\left(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}, \frac{1}{4}\right) = \frac{1 - 4\alpha}{5}. \tag{4}$$

[15] See Lyons (2002) for arguments in favour of the consumer surplus standard in merger control.

It is easily checked that the associated equilibrium level of profit and the consumer surplus are given by:

$$\Pi\left(\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4}\right)=\left(\frac{1-4\alpha}{5}\right)^2-f, \tag{5}$$

$$CS(\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4})=\frac{8}{25}\left(1-4\alpha\right)^2. \tag{6}$$

Assumption 1 Let us assume that

$$\alpha<\frac{1}{4}\equiv\overline{\alpha};\quad f<\left(\frac{1-4\alpha}{5}\right)^2\equiv\overline{f}. \tag{7}$$

These two conditions are imposed to exclude the trivial case in which production is not viable at the status quo market structure.[16]

A merger between two firms Suppose that there is a merger proposal between two of the four firms in the industry. If the merger occurs, then a larger (and, hence, more efficient) firm is created, owning 2/4 of the industry capital. In the post-merger Cournot equilibrium, the merged entity (say, firm l) and a representative outsider (say, firm s_i) will choose their levels of output by solving the following maximisation problems, respectively,

$$\max_{q_l}\left\{\left(1-q_l-\sum_{j\neq l}q_j\right)q_l-2\alpha q_l-2f\right\}, \tag{8}$$

$$\max_{q_{s_i}}=\left\{\left(1-q_{s_i}-\sum_{h\neq s_i}q_h\right)q_{s_i}-4\alpha q_{s_i}-f\right\}. \tag{9}$$

Since we focus on symmetric equilibria, we have that $q_{s_i}=q_{s_j}=q_s$. Very simple algebra shows that the equilibrium level of output for the merged entity (firm l) and for each of the two outsiders to this merger are respectively given by

$$q_l\left(\frac{2}{4},\frac{1}{4},\frac{1}{4}\right)=\frac{1+2\alpha}{4}, \tag{10}$$

$$q_s\left(\frac{2}{4},\frac{1}{4},\frac{1}{4}\right)=\max\left\{0,\frac{1-6\alpha}{4}\right\}. \tag{11}$$

[16] If $\alpha\geq 1/4$, then $dC(q_i,1/4)/dq_i=4\alpha\geq 1$, which in turn implies that $q\left(\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4}\right)=0$. Likewise, four firms would not co-exist if $f>\overline{f}$.

Remark 1 $q_s = 0$ *if* $\alpha \geq 1/6$.

Hence, if the merger gives rise to very high synergies, in a symmetric equilibrium, the two (smaller) outsider firms are constrained to exit the market (in the Appendix we study the asymmetric equilibrium case where only one of the two outsiders leaves the industry).

Suppose for the moment that $\alpha < 1/6$. From the equilibrium outputs above, one can obtain by substitution the equilibrium levels of profits for the merged entity and for each of the merger outsiders

$$\Pi_l\left(\frac{2}{4},\frac{1}{4},\frac{1}{4}\right) = \left(\frac{1+2\alpha}{4}\right)^2 - 2f, \tag{12}$$

$$\Pi_s\left(\frac{2}{4},\frac{1}{4},\frac{1}{4}\right) = \left(\frac{1-6\alpha}{4}\right)^2 - f. \tag{13}$$

In addition, consumer surplus is given by

$$CS(\frac{2}{4},\frac{1}{4},\frac{1}{4}) = \frac{1}{32}\left(3-10\alpha\right)^2 \tag{14}$$

Now, notice that after a merger between two of the firms in the status quo market structure, the induced post-merger market structure might be either $\left\{\frac{2}{4},\frac{1}{4},\frac{1}{4}\right\}$ or simply a monopoly market structure of the type $\left\{\frac{2}{4}\right\}$, depending on whether after the merger the two outsiders are able to make positive profits or not. These two different cases will be dealt with in the analysis that follows, where we seek the *symmetric* sub-game perfect Nash equilibrium (henceforth, SPNE) in pure strategies of the proposed two stage game.

Analysis of Stage 2 At the *second* stage of the game, the AA has to decide whether or not to allow a merger between two randomly selected firms, if the merger has been submitted for approval. The behaviour of the AA in each of the above mentioned possible scenarios is as follows.

- If $\alpha < 1/6$ and $f < \left(\left(1-6\alpha\right)/4\right)^2 \equiv \widetilde{f}$, then from eq. (13), one concludes that the two merger outsiders are able to make positive profits after the merger has taken place. If this is the case, then the AA will decide to authorise the submitted merger only if:

$$CS(\frac{2}{4},\frac{1}{4},\frac{1}{4}) = \frac{1}{32}\left(3-10\alpha\right)^2 > CS(\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4}) = \frac{8}{25}\left(1-4\alpha\right)^2, \tag{15}$$

  which is equivalent to

$$\frac{1}{14} \simeq 0.071429 \leq \alpha < \frac{1}{6}. \tag{16}$$

  Hence, in order to authorise the merger, the AA will require that the efficiency gains obtained through the merger are sufficiently high.

- If, instead,
  - (i) $\alpha \geq 1/6$, or
  - (ii) $\alpha < 1/6$ and $\left(\frac{1-6\alpha}{4}\right)^2 \equiv \widetilde{f} \leq f < \overline{f}$,

  then from Remark 1 and eq. (13), one concludes that in this case the merger induces the outsiders to exit the industry. Notice that when after the merger the relevant market structure is characterised by a single monopolist operating with 2/4 of the industry capital, very simple algebra shows that the merged entity equilibrium profit and the associated consumer surplus are given by:

$$\Pi\left(\frac{2}{4}\right) = \left(\frac{1-2\alpha}{2}\right)^2 - 2f, \tag{17}$$

$$CS(\frac{2}{4}) = \frac{1}{8}(1-2\alpha)^2. \tag{18}$$

  Now, the AA faced with such a merger proposal inducing the exit by outsiders, will decide to veto it if the following inequality holds:

$$CS(\frac{2}{4}) = \frac{1}{8}(1-2\alpha)^2 < CS(\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4}) = \frac{8}{25}(1-4\alpha)^2, \tag{19}$$

  which in turn implies that a merger would *not* be authorised by the (myopic) AA if efficiency gains induced by the merger are sufficiently low, i.e., if:

$$\alpha < \frac{3}{22} \simeq 0.13636. \tag{20}$$

Let us now turn to the analysis of the firms' decisions at the first stage of the game.

Analysis of Stage 1 As a preliminary remark, it should be stressed that we assume there are no administrative costs that firms must incur for submitting the merger to the AA. Hence, when firms anticipate that the merger will be blocked, they are indifferent between asking or not the AA for authorisation. We assume throughout that in case of indifference, firms do propose a merger to the AA.[17]

In order to investigate the firms' merger decision at the *first stage* on whether or not to submit a merger, one has to distinguish again between the scenario in which a merger does not constrain outsiders to leave the industry and the scenario in which it does push outsiders out of the market.

[17] This implicitly means that the firms do not incur any administrative cost from filing a merger. As will become clear, this assumption does not matter much, as the equilibrium outcome would not change if we assumed positive filing costs (or that, when indifferent, the firms do not propose the merger.)

- If $\alpha < 1/6$ and $f < \left((1-6\alpha)/4\right)^2 \equiv \widetilde{f}$, then, as explained above, the two merger outsiders are able to make positive profits after the merger has taken place. Therefore, from (5) and (12), one has that the insider firms will find this merger profitable if the following condition holds:

$$\Pi_l\left(\frac{2}{4},\frac{1}{4},\frac{1}{4}\right) = \left(\frac{1+2\alpha}{4}\right)^2 - 2f > 2\Pi\left(\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4}\right) = 2\left[\left(\frac{1-4\alpha}{5}\right)^2 - f\right], \tag{21}$$

which in turn implies that the merger is submitted to the AA if

$$\frac{1}{2}\left(\frac{89-60\sqrt{2}}{103}\right) \simeq 0.020132 \leq \alpha < \frac{1}{6}. \tag{22}$$

Hence, in order for the insider firms to find the merger profitable, they will require efficiency gains obtained through the merger to be sufficiently high.[18] It should be stressed, however, that the set of parameter values given by the previous condition is larger than the one described by eq. (16), which means that for low values of the efficiency parameter α, namely for $\alpha \in [0.020132, 1/14)$, the merger will be submitted by the firms but blocked by the myopic AA.

- If, instead,
  - (i) $\alpha \geq 1/6$, or
  - (ii) $\alpha < 1/6$ and $\left(\frac{1-6\alpha}{4}\right)^2 \equiv \widetilde{f} \leq f < \overline{f}$,

  then outsiders are constrained to exit the market after the merger. Hence, from (5) and (17), one concludes that the two potential merging parties will decide to merge if:

$$\Pi\left(\frac{2}{4}\right) = \left(\frac{1-2\alpha}{2}\right)^2 - 2f > 2\Pi(\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4}) = 2\left[\left(\frac{1-4\alpha}{5}\right)^2 - f\right], \tag{23}$$

  which turns out to be satisfied for all $\alpha \in [0, \overline{\alpha})$, where $\overline{\alpha}$ is given by eq. (7). Hence, the selected firms will always decide to submit the merger to the AA.

  The behaviour of a myopic AA when deciding whether or not to authorise a merger which triggers the exit of the outsiders to such a merger can be summarised as follows:[19]

[18] Notice, in particular, that in the extreme case in which $\alpha = 0$ (no efficiency gains), no merger would occur. This is related to Salant, Switzer and Reynolds (1983). Their well known result in static Cournot games with constant marginal costs can be summarised as follows. Two (coalitions of) firms will never be interested in merging if they only care about present profits and there are at least three existing (coalitions of) firms in the industry.

[19] Remember that from Assumption 1, $f < \overline{f}$.

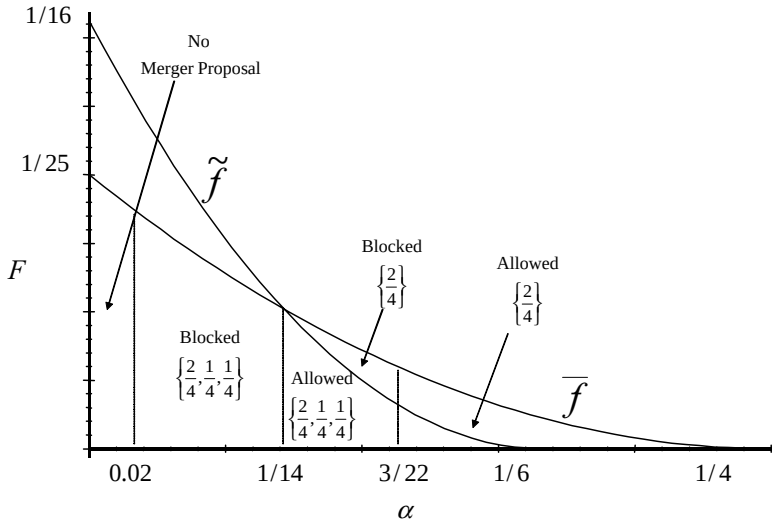

Figure 1: Equilibria of the game with a myopic AA

1. If
   (a) $\alpha \geq 1/6$, or
   (b) $3/22 \leq \alpha < 1/6$ and $f \geq \left(\frac{1-6\alpha}{4}\right)^2 \equiv \widetilde{f}$,
   then the merger will always be authorised. Outsiders would be pushed out of the market after the merger has taken place but efficiency gains are so high that consumers would gain.

2. If, instead, $1/14 \leq \alpha < 3/22$ and $f \geq \left(\frac{1-6\alpha}{4}\right)^2 \equiv \widetilde{f}$, then the merger would *not* be authorised by the AA. After the merger, outsiders are not able to recover their fixed cost but consumers would be worse off. This is the *efficiency offence scenario* and in what follows we argue that the AA is behaving myopically when deciding to block such a merger.

Figure 1 illustrates the full (that is, including the cases where the merger would not trigger exit by outsiders) equilibrium outcome of this two stage game.

4 Dynamic analysis (forward looking AA)

In this section, starting from the same status quo industry structure $\left\{\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4}\right\}$, our aim is to investigate the strategic interaction between firms (potential merging parties) and the AA, in a situation where the AA is endowed with foresight.

The AA, when making a decision on whether or not to allow a given merger, takes into account that the merger may be followed by further mergers and, therefore, it speculates on the (consumer) welfare associated with the market structure that the merger will lead to. This situation is modelled as a six-stage game involving the following sequence of decisions.

- In the *first stage*, nature allows two of the four firms in the status quo industry structure to merge if they wish so. If they decide to merge, they will have to ask the AA for authorisation.
- In the *second stage*, the AA decides whether to authorise the merger or not. If it does not authorise it, then the game will have come to a final node (since even restarting at this node would always lead us to a similar merger proposed and refused by the AA) and product market competition occurs between the four symmetric firms in the status quo industry structure.
- In the *third stage*, if the AA has decided to authorise the merger at stage 2, it is the turn of the next two firms (the outsiders to the previous merger) to decide if they want to merge or not. If they do not want to, then the merger game stops and market realisation occurs. If, instead, they want to merge, they have to ask the AA for authorisation.
- In the *fourth* stage, the AA decides whether it wants to authorise the defensive merger between the outsiders of the first merger. If the AA vetoes the merger, the merger game stops here and the product market stage occurs, with associated payoff realisation. Else, we find ourselves at a structure $\left\{\frac{2}{4}, \frac{2}{4}\right\}$, but we allow for a further round of the merger game.
- In the *fifth* stage, the firms are allowed to seek a merger to monopoly. If they decide not to do it, the merger game stops and product market competition occurs. If, instead, they want to merge, they will have to ask the AA for authorisation.
- In the *sixth* stage, the AA decides whether or not to allow the merger to monopoly and, after its decision has been taken, product market competition occurs.

As in the previous section, we will seek the symmetric SPNE in pure strategies, so that we proceed by solving the game by backward induction.

4.1 Analysis of the SPNE of the game

Analysis of Stage 6 If the game arrives at the *sixth stage*, then the AA will have to choose between the two alternative market structures $\left\{\frac{2}{4}, \frac{2}{4}\right\}$ and $\{1\}$. If the AA decides to block the merger, then the resulting market structure will be $\left\{\frac{2}{4}, \frac{2}{4}\right\}$. This industry structure results from two previous mergers (approved in stages two and four, respectively) and is composed of two equally efficient firms (say, firms i and j), owning 2/4 of the industry capital

each. When this is the industry structure, firm i chooses its level of production q_i by solving the following maximisation programme:

$$\max_{q_i} \left\{ (1 - q_i - q_j) q_i - 2\alpha q_i - 2f \right\}. \tag{24}$$

Now, due to symmetry, the equilibrium quantities are equal for both firms and they are given by:

$$q\left(\frac{2}{4}, \frac{2}{4}\right) = \frac{1 - 2\alpha}{3}. \tag{25}$$

Hence, the Cournot profits per-firm in an industry structure $\left\{\frac{2}{4}, \frac{2}{4}\right\}$ are:

$$\Pi\left(\frac{2}{4}, \frac{2}{4}\right) = \left(\frac{1 - 2\alpha}{3}\right)^2 - 2f. \tag{26}$$

In addition, consumer surplus is given by:

$$CS(\frac{2}{4}, \frac{2}{4}) = \frac{2}{9}(1 - 2\alpha)^2. \tag{27}$$

If, instead, the AA decides to approve the merger, then the resulting market structure will be a monopoly operating with the whole industry capital, $\{1\}$. When this is the case, very simple algebra shows that the equilibrium level of profit and the consumer surplus are, respectively, given by:

$$\Pi(1) = \left(\frac{1 - \alpha}{2}\right)^2 - 4f, \tag{28}$$

$$CS(1) = \frac{1}{8}(1 - \alpha)^2. \tag{29}$$

Now, making use of (27) and (29), one concludes that the AA will decide to block a merger between two firms owning 2/4 of the industry capital towards complete monopolisation of the industry if

$$CS(1) = \frac{1}{8}(1 - \alpha)^2 < CS(\frac{2}{4}, \frac{2}{4}) = \frac{2}{9}(1 - 2\alpha)^2, \tag{30}$$

or, equivalently,

$$-\frac{1}{72}(1 - 5\alpha)(7 - 11\alpha) < 0$$

which in turn implies that the merger will be blocked if:[20]

$$\alpha < \frac{1}{5}. \tag{31}$$

Therefore, *the AA will allow the merger to monopoly* only if $\alpha \geq 1/5$.

[20] Notice that the second root is given by $\alpha = 7/11$ which is greater than $\overline{\alpha}$ (assumption 1) and, therefore, should be discarded.

Analysis of Stage 5 In the *fifth* stage, if a duopolistic structure has emerged from the previous stages of the game, firms have to decide whether or not to seek a merger to monopoly. As in the previous section, we assume that there are no administrative costs that firms must incur for submitting the merger to the AA and that in case of indifference between proposing or not, firms do propose the merger to the AA. Now, from (26) and (28), one has that firms will have an interest in merging to monopoly if:

$$\Pi(1) = \left(\frac{1-\alpha}{2}\right)^2 - 4f > 2\Pi(\frac{2}{4}, \frac{2}{4}) = 2\left[\left(\frac{1-2\alpha}{3}\right)^2 - 2f\right], \qquad (32)$$

which turns out to be satisfied for all $\alpha \in (0, \overline{\alpha})$, where $\overline{\alpha}$ is given by eq. (7). Hence, at the fifth stage of the game the two coalitions in the market will always decide seek a merger leading to complete monopolisation of the industry.

This result is not surprising. Even in a Cournot setting with linear demand where firms have the same (constant) marginal cost both before and after the merger, a merger from duopoly to monopoly is always found to be profitable (see Salant, Switzer and Reynolds (1983)). In our setting, firms have a double incentive to participate in the merger. Apart from reducing competition in the market, a merger allows the involved firms to realise a cost advantage through endogenous efficiency gains. Hence, the incentive for merger is reinforced.[21]

Analysis of Stage 4 In the *fourth* stage, the AA has to decide whether to accept a merger between the outsiders to the first merger. Two cases must be considered here.

1. If $\alpha \geq 1/5$, the AA anticipates that if the merger is approved, the final equilibrium market structure will be a monopoly. It also anticipates that if it vetoes the merger, the outsiders of the first merger would be constrained to exit the industry.[22] Therefore, it will authorise the merger if:

$$CS(1) = \frac{1}{8}(1-\alpha)^2 \geq CS(\frac{2}{4}) = \frac{1}{8}(1-2\alpha)^2, \qquad (33)$$

   which always holds: since the merger allows to keep assets that otherwise would be forced to disappear from the industry, it is always better to authorise it.[23]

2. If $\alpha < 1/5$, the merger will lead to the creation of a perfectly symmetric duopolistic structure, $\left\{\frac{2}{4}, \frac{2}{4}\right\}$. Two sub-cases should be considered here:

[21] Recall that fixed costs play no role in firms' merger decision. Each firm's share in the monopoly fixed cost equals the fixed cost the firm would pay as an independent duopolist with $2/4$ of the industry capital, $2f$.

[22] See Remark 1.

[23] It is better in terms of welfare to have a (more efficient) monopolist owning the whole industry capital, than having a monopolist with only half of the industry capital.

- If $\left(\frac{1-6\alpha}{4}\right)^2 \equiv \widetilde{f} \leq f$, the AA correctly anticipates that if it said no to the merger the two outsiders of the first merger would be constrained to exit the industry (they would not be able to cover fixed costs of production) and, therefore, the market structure at equilibrium would be $\left\{\frac{2}{4}\right\}$. As a result, from (18) and (27), one concludes that the merger will be allowed only if:

$$CS(\frac{2}{4}) = \frac{1}{8}(1-2\alpha)^2 < CS(\frac{2}{4},\frac{2}{4}) = \frac{2}{9}(1-2\alpha)^2, \tag{34}$$

or, equivalently,

$$-\frac{7}{72}(1-2\alpha)^2 < 0, \tag{35}$$

which is always true. Thus, the AA will always allow the defensive merger in this interval.

- If $f < \widetilde{f}$, the outsiders will not exit the industry if their merger were blocked. Therefore, the merger will be allowed if:

$$CS(\frac{2}{4},\frac{2}{4}) = \frac{2}{9}(1-2\alpha)^2 \geq CS(\frac{2}{4},\frac{1}{4},\frac{1}{4}) = \frac{1}{32}(3-10\alpha)^2, \tag{36}$$

which turns out to be satisfied for $\alpha \geq 1/14$.

Analysis of Stage 3 In the *third* stage, we have to check whether the outsiders of the first merger (if it has been proposed in the first stage and approved in the second stage by the AA) will want to merge or not. Again, we have to consider different cases according to the level of efficiency gains.

1. If $\alpha \geq 1/5$, it is easy to check that the merger is always profitable. By merging, firms will eventually end up in a full monopoly, whereas by not merging, they will get zero profit, since they would be unable to cover fixed cost and, therefore, would be constrained to exit the market.

2. If $\alpha < 1/5$, two sub-cases arise:

   (a) If $1/14 \leq \alpha < 1/5$, firms anticipate that by merging they will eventually be in a duopolistic structure, whereas by not merging they would be obliged to exit. Hence, using (26), we have that the merger will be profitable if:

$$\Pi(\frac{2}{4},\frac{2}{4}) = \left(\frac{1-2\alpha}{3}\right)^2 - 2f \geq 0,$$

   which is satisfied if:

$$f \leq \frac{1}{2}\left(\frac{1-2\alpha}{3}\right)^2 \equiv f'. \tag{37}$$

But it is easy to check that this condition is always satisfied in the relevant range of parameter values as described by assumption 1. Therefore, the two firms that have not been involved in the first merger will always want to merge in this interval.

(b) If, instead, $\alpha < 1/14$, then outsiders correctly anticipate that by merging they will be in a duopoly structure, but by not merging they will survive. Therefore, the merger is profitable if:

$$\Pi(\frac{2}{4},\frac{2}{4}) = \left(\frac{1-2\alpha}{3}\right)^2 - 2f \geq 2\Pi_s\left(\frac{2}{4},\frac{1}{4},\frac{1}{4}\right) = 2\left(\frac{1-6\alpha}{4}\right)^2 - 2f, \tag{38}$$

which holds for $\alpha \geq (19-12\sqrt{2})/146 \cong .0139$. Therefore, the merger will not be proposed only if $\alpha < (19-12\sqrt{2})/146$, which is lower than $1/14$.

Analysis of Stage 2 In the *second* stage, if the two randomly selected firms at the first stage decide to submit a merger to the AA, the AA has to decide whether to allow it or not.

Three separate cases should be considered:

1. If $\alpha \geq 1/5$, the first merger will ultimately lead to a monopoly. Therefore, it will be allowed if:

$$CS(1) = \frac{1}{8}(1-\alpha)^2 \geq CS(\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4}) = \frac{8}{25}(1-4\alpha)^2, \tag{39}$$

that is always true in the interval $1/9 \leq \alpha \leq 1/4$. Hence, it will always be authorised.

2. If $1/14 \leq \alpha < 1/5$, the AA anticipates that this first merger will be followed by a second merger that will give rise to a perfectly symmetric duopolistic structure. Therefore, the right comparison is not between $CS(\frac{2}{4})$ and $CS(\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4})$, which is what a myopic authority would do, but rather the first merger will be authorised if the following inequality holds:

$$CS(\frac{2}{4},\frac{2}{4}) = \frac{2}{9}(1-2\alpha)^2 \geq CS(\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4}) = \frac{8}{25}(1-4\alpha)^2, \tag{40}$$

which, as can be easily checked, holds if $\alpha \geq 1/14$, or $\alpha \gtrsim .0714286$. Therefore, in the interval we consider here, the first merger will be allowed.

3. If $\alpha < 1/14$, the AA anticipates that the first merger will not be followed by another,[24] implying that the first merger will be authorised if:

$$CS(\frac{2}{4},\frac{1}{4},\frac{1}{4}) = \frac{1}{32}(3-10\alpha)^2 \geq CS(\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4}) = \frac{8}{25}(1-4\alpha)^2. \tag{41}$$

[24] From (36), one has that a defensive merger would be blocked by the AA at stage 4 when $\alpha < 1/14$.

But we know from section 3 (in particular, from eqs. (15) and (16)) that this inequality is always false in the interval considered. Therefore, the merger will not be authorised.

Case 2 is the most interesting among those analysed here. As can be seen from Figure 2, our result implies that the merger will be authorised *even in the area where* $1/14 \leq \alpha < 3/22$ and $\widetilde{f} \leq f < \overline{f}$, that corresponds to mergers blocked by a myopic AA under an efficiency offence.

The comparison with section 3 shows that when $\alpha \in [1/14, 3/22)$ and $f \geq \widetilde{f}$, a myopic AA would want to block a merger by using an *efficiency offence* argument, but a forward looking AA would authorise the same merger because it expects that the outsiders would react by merging in their turn, thus leading to a market structure that is associated with a higher consumer welfare. In other words, having an AA that, in making a decision about a given merger, takes fully into account the reactions of firms in response to this merger, avoids the mistake of blocking some mergers in which the outsiders are expected to react by merging too, thus avoiding exiting the industry and giving rise to a final market structure where consumer welfare is enhanced.

Analysis of Stage 1 In the *first stage* of the game, two randomly selected firms in the status quo industry structure are given the opportunity to decide whether or not to merge. As explained above, there are no administrative costs of submitting a merger to the AA for approval. Thus, when firms anticipate that a merger will be blocked, they are indifferent between submitting or not the merger to the AA.

Three cases are relevant here:

1. If $\alpha \geq 1/5$, firms anticipate that the first merger will be followed by a merger by outsiders, and eventually by a merger grouping the whole industry. Therefore, the first merger will be proposed if:

$$\Pi(1) = \frac{1}{2}\left[\left(\frac{1-\alpha}{2}\right)^2 - 4f\right] \geq 2\Pi(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}, \frac{1}{4}) = 2\left[\left(\frac{1-4\alpha}{5}\right)^2 - f\right]. \tag{42}$$

   It is possible to check that this inequality is true in the interval considered: the merger will be proposed.

2. If $1/14 \leq \alpha < 1/5$, firms anticipate that if the first merger is approved, then the outsiders will react by merging in their turn, thus leading to a symmetric duopoly market structure, $\{\frac{2}{4}, \frac{2}{4}\}$.[25] As a result, and making

[25] From (34), one knows that a defensive merger will always be allowed by the AA at the fourth stage. On the other hand, eq. (31) implies that a merger from a symmetric duopoly towards complete monopolisation will not be allowed by the AA (at the sixth stage) for the considered range of values for the efficiency parameter α.

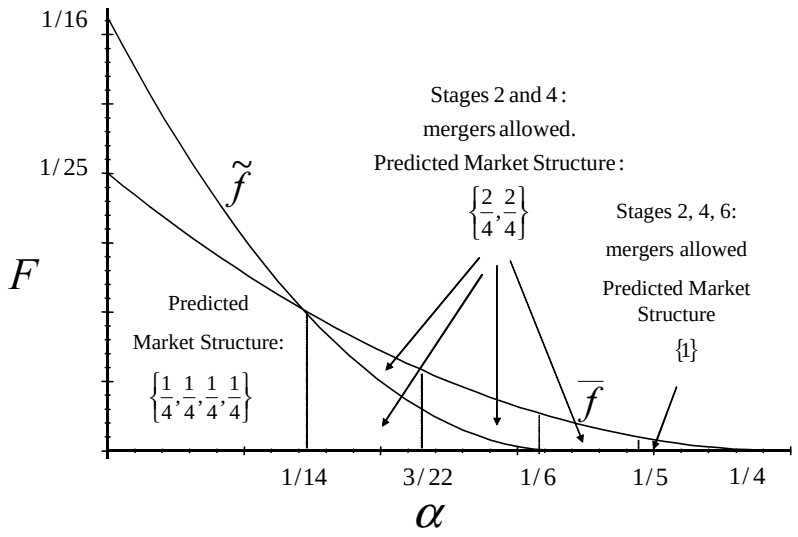

Figure 2: Equilibrium outcomes with a forward looking AA

use of eqs. (5) and (26), one concludes that the selected firms will decide to submit the merger to the AA if

$$\Pi(\frac{2}{4},\frac{2}{4}) = \left(\frac{1-2\alpha}{3}\right)^2 - 2f \geq 2\Pi(\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4}) = 2\left[\left(\frac{1-4\alpha}{5}\right)^2 - f\right]. \tag{43}$$

The previous condition turns out to be satisfied for all $\alpha \in [0,\overline{\alpha})$, where $\overline{\alpha}$ is given by eq.(7), which implies that selected firms will always decide to merge and submit the proposal to the AA.

3. If $\alpha < 1/14$, the first merger will not be followed by others. The merger is profitable if $\Pi_l\left(\frac{2}{4},\frac{1}{4},\frac{1}{4}\right) \geq 2\Pi\left(\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4}\right)$, a case we have already analysed in section 3, where we found this inequality holds for $\alpha \geq 0.020132$.[26]

This completes the analysis of the whole game, which is summarised by Figure 2.

Notice that in the area where $\alpha < 1/6$ and $\widetilde{f} \leq f < \overline{f}$ (that is, where an efficiency offence argument would push the AA to block the merger), the AA will authorise the merger submitted for its approval at stage 2. The reason for this is that the AA knows that along the equilibrium path, this merger will

[26] See eqs. (21) and (22).

be followed by a defensive merger by the first merger outsiders. The defensive merger (but not a further merger which would lead to complete monopolisation of the industry) will also be authorised at stage 4, and consumer welfare will increase.

Furthermore, note that our dynamic mergers game where the AA plays an active role in authorising mergers predicts (in the case where the AA is forward-looking) a market structure which depends on the efficiency gains. The higher the scope for efficiency gains, the more concentrated the market structure that will arise from this dynamic merger game.

5 Conclusion

This paper has taken seriously the efficiency offence argument that has (rightly or wrongly) sometimes been attributed to the EC. We have showed that efficiency gains attained by merging parties are never detrimental in our model, even when they might lead to exit of competitors. This is for two reasons. First, in some cases there might be such important efficiency gains that they would lead to lower prices despite the lower number of firms in the industry (but even a myopic Antitrust Authority would recognise this argument). Second, and more important, we have showed that when there exist efficiency gains, a merger between two firms will be followed by a merger between its rivals, that also want to take the opportunity of saving costs. The final structure after the two mergers would be more concentrated but more efficient (if a further merger to monopoly is proposed, it will not be authorised unless efficiency gains are extremely high - and in this case complete monopolisation would be beneficial too). A forward looking AA would anticipate this outcome, and rightly allow the first merger, knowing that it will be followed by a second one. A myopic AA would instead block the first merger whenever it puts (un-merged) rivals in such a competitive disadvantage that they would be forced to exit the industry.

Apart from hopefully clarifying the weak rationale behind efficiency offence arguments, our main contribution here probably lies in the attempt of going beyond a static setting when analysing the effects of mergers, and in explicitly considering the role of the Antitrust Authority in a dynamic merger game. Nevertheless, we are fully aware that the game we analyse here is an extremely simple one, and we plan to fully endogenise the merger process, by allowing any coalition among the firms in the industry to be possibly formed.[27,28] Currently, we are also working to endogenise the game in another respect, which is to allow firms to attain efficiency gains through internal, rather than external

[27] For instance, after the first merger between two firms, there might be either a merger between the two outsiders, or a merger that involves an outsider and the two first merger insiders. This leads to a richer, but also more complex, game. Given our focus on the effects of efficiency gains, we have chosen here the simpler game within which our results could be showed.

[28] For endogenous mergers, see for instance Kamien and Zang (1990), Horn ad Persson (2001 a,b) and Gowrisankaran (1999).

growth, that is to let them choose between merging or investing in accumulating additional capacity.[29,30]

To conclude the paper, let us make some comments on the policy issue of whether AAs should be *forward-looking* in the sense described by our paper.

Merger control is already a predictive exercise, and therefore it is by its nature a forward-looking one. Our paper suggests that when predicting the possible impact of the merger, possible reactions by the outsiders should be properly taken into account. More particularly, before hastily concluding that a merger will create such a more efficient merged entity that rivals would not be able to compete with it, AAs should consider whether in the industry at hand there exists room for further mergers allowing outsiders to attain similar efficiency levels, and/or whether the outsiders might be able to enhance efficiency through internal growth (although our model considers only the former mechanism, not the latter).

Of course, anyone is aware of the fact that AAs might make mistakes in the real world, and that further mergers are hard to predict. But AAs might make mistakes also in predicting that following a merger outsiders might leave. Indeed, this efficiency offence argument is based itself on a prediction which might be wrong. Consider efficiency offence in our model. We simply compare two equilibria: before the merger - when all firms sell - and after the merger - when two (or one, in the asymmetric case) firms leave the market. Clearly, in reality the latter case refers to a medium/long-run equilibrium. In the short-run (that is, before firms adjust outputs and divest their assets), there will be a disequilibrium situation (not illustrated in the paper, which just compares equilibrium outcomes) where the two outsiders will continue to sell at a loss. One of two possible medium/long-run equilibria might then follow. Either the one where outsiders will not be able to adjust by merging in their turn (or by investing, in a more general model) and will exit the industry. Or, in alternative to the first, an equilibrium where the outsiders will react by merging (or investing, or by pursuing other business strategies) and will be able to survive. We regard the second equilibrium (that we would call 'dynamic') as the more likely because it takes into account that firms are not passive players, and will take actions that counter the merging strategies of the insiders. Of course, in reality there might well be industries where, for several reasons (going from imperfect capital markets to non-rational or non-profit maximising behaviour of players), merging or investing are not feasible strategies for the outsiders. But in any event, AAs should not spouse an efficiency offence argument without considering the capability of reaction by the outsiders.

There is another possible reading of our results. In the short-run (that is, in

[29] Gowrisankaran (1999) considers a dynamic model where firms take merger, entry, exit, *investment* and production decisions. The price to pay is that the analysis becomes extremely complex, though: analytical results are not obtained in his model.

[30] Obviously, in the real world there might well be situations where the outsiders of a merger - for whatever reasons - are unlikely to merge. This case was not considered here, but could be addressed properly in a model where the outsiders could respond by increasing their capacity by investing, rather than by merging.

a disequilibrium situation not illustrated in the model), a merger which entails efficiency gains has a positive impact on welfare. Indeed, before outsiders might take any exit decision (or any counter-strategies), the immediate impact of the merger is to increase welfare (the more efficient firms produce more and prices will fall). An AA speculating that the efficiency gains (which, incidentally, often do not materialise immediately in the real world) obtained by the merging firms will make rival firms exit the industry is trading off a (relatively) certain welfare gain with a future (and more uncertain) welfare loss (i.e., when firms leave). What the paper points out is that: first, if efficiency gains are strong enough, the final outcome would be positive even if it leads to exit of rivals (see Figures 1 and 2, for high values of α); second, that the future welfare losses, if any (intermediate values of α), are rendered even more uncertain by the presence of possible counter-strategies by the outsiders.

A Appendix: the asymmetric case

So far, we have considered only symmetric equilibria, in the sense that we have imposed that firms endowed with the same capital also have the same output and profits at equilibrium. Focusing on symmetric equilibria is standard when dealing with Cournot models. Even the standard Cournot duopoly model admits asymmetric equilibria where one firm produces such a large output that the rival's best response is simply to produce zero output, but it is customary to focus on the symmetric equilibrium where both firms share the market, probably the most reasonable outcome of the game.

In the merger game we have analysed, asymmetric equilibria arise - for certain parameter values - under many of the configurations analysed. For instance, under the initial market structure, $\left\{\frac{1}{4}, \frac{1}{4}, \frac{1}{4}, \frac{1}{4}\right\}$, apart from the benchmark symmetric equilibrium we have found, where four firms equally share the market, there might also be at least another equilibrium[31] where three firms sell a larger quantity and the fourth firm's best response is to sell zero;[32] and in a market configuration after two mergers have been realised, $\left\{\frac{2}{4}, \frac{2}{4}\right\}$, there is also an asymmetric equilibrium where one firm sells a larger quantity than at the symmetric duopoly equilibrium and the other produces zero.[33]

[31] To be more precise, there are four asymmetric equilibria of the same nature, and differing only in which firm (1, 2, 3, or 4) produces zero.

[32] Suppose that the fourth firm sells zero output. Each of the remaining firms will choose q_i so as to maximise $\Pi_i = (1 - q_i - \sum_{j \neq i} q_j - 4\alpha)q_i - f$. Taking FOCs and imposing symmetry among the three active firms, one obtains $q(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}) = \frac{1-4\alpha}{4}$, $p(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}) = \frac{1+12\alpha}{4}$, and $\Pi(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}) = \frac{(1-4\alpha)^2}{16} - f$. This solution is feasible if $\alpha < 1/4$ (which corresponds to our Assumption 1) and $f < \frac{(1-4\alpha)^2}{16}$. Now we have to check that when the three firms sell the output $\frac{1-4\alpha}{4}$, it is indeed optimal for the fourth firm to sell zero. If it decides to produce, given the output of the rivals, its profit is $\Pi_4(q_4) = (1 - q_4 - 3\frac{1-4\alpha}{4} - 4\alpha)q_4 - f$, from which one can check that the profit maximising output is $q_4 = \frac{1-4\alpha}{8}$, and associated profit is $\Pi_4 = \frac{(1-4\alpha)^2}{64} - f$. Therefore, this asymmetric equilibrium exists if $\frac{(1-4\alpha)^2}{64} < f < \frac{(1-4\alpha)^2}{16}$.

[33] Suppose that the rival firm sells zero output. Firm 1 will choose q_1 so as to maximise

In our paper, a complete treatment would require dealing with all possible asymmetric equilibria, but the reader can easily see that this would lead to a very complicated setting (just think that there are different possible initial market equilibria, and that for each one would have to analyse the merger game, with a multiplication of cases as one proceeds to a further stage of the game) without gaining any further insight.

Nevertheless, there is one asymmetric case which is probably worth considering, and to which this appendix is devoted. We have seen that when efficiency gains are large enough, the first merger will lead to the exit of *both* outsiders, unless they react by merging in their turn. The case where both outsiders leave after a merger corresponds to our restricting attention to a symmetric equilibrium: the outsiders have the same share of the industry's capital, and we focus on the equilibrium where they have the same output, which turns out to be zero for some parameter values. The reader might wonder whether the results of the paper hold good when, after the first merger, only one of the outsiders might be forced to leave the industry (unless a merger between them occurs). This appendix deals with this asymmetric case, and shows that indeed the qualitative results of the paper are fully confirmed. In particular, a forward-looking AA would not block a merger that under a static approach would not be authorised due to an efficiency offence argument.

A.1 A merger leading to exit of one outsider only

Let us consider the case where a merger has taken place, so that the distribution of the industry's capital is such that one firm holds one-half of it and the two outsiders hold one-quarter each of it. We look for an asymmetric equilibrium where one outsider sells positive output and the other sells zero output.

Suppose that an outsider sells zero output. The large firm will choose q_l so as to maximise $\Pi_l = (1-q_l-q_s-2\alpha)q_l - 2f$, and the active outsider will choose q_s so as to maximise $\Pi_s = (1-q_l-q_s-4\alpha)q_s - f$.

Solving the FOCs gives the equilibrium quantities and price

$$q_l(\frac{2}{4},\frac{1}{4}) = \frac{1}{3}, \quad q_s(\frac{2}{4},\frac{1}{4}) = \frac{1-6\alpha}{3}, \quad p(\frac{2}{4},\frac{1}{4}) = \frac{1+6\alpha}{3} \tag{44}$$

and profits are

$$\Pi_l(\frac{2}{4},\frac{1}{4}) = \frac{1}{9} - 2f, \quad \Pi_s(\frac{2}{4},\frac{1}{4}) = \frac{(1-6\alpha)^2}{9} - f. \tag{45}$$

$\Pi_1(q_1) = (1-q_1-2\alpha)q_1 - 2f$, from which one obtains $q(\frac{2}{4}) = \frac{1-2\alpha}{2}$, and $\Pi(\frac{2}{4}) = \frac{(1-2\alpha)^2}{4} - 2f$. This solution is feasible if $f < \frac{(1-2\alpha)^2}{8}$. Now we have to check that when $q_1 = \frac{1-2\alpha}{2}$, it is optimal for the rival to sell zero. From $\Pi_2(q_2) = (1-q_2-\frac{1-2\alpha}{2}-2\alpha)q_2 - 2f$, one can find the profit maximising output as $q_2 = \frac{1-2\alpha}{4}$, and associated profit as $\Pi_2 = \frac{(1-2\alpha)^2}{16} - 2f$. Therefore, this asymmetric equilibrium exists if $\frac{(1-2\alpha)^2}{32} < f < \frac{(1-2\alpha)^2}{8}$.

This solution is feasible if $\alpha < 1/6$ and $f < \frac{(1-6\alpha)^2}{9}$ (in the area considered in the paper, $\Pi_l(\frac{2}{4}, \frac{1}{4})$ is always positive, since Assumption 1, which restricts attention to $f < \overline{f}$, ensures that $f < 1/18$).

Next, we have to check that given $q_l = \frac{1}{3}$ and $q_s = \frac{1-6\alpha}{3}$, it is optimal for the other small firm (say, firm 4) to leave the market. Its profit is $\Pi_4(q_4) = (1 - \frac{1}{3} - \frac{1-6\alpha}{3} - q_4 - 4\alpha)q_4 - f$, from which one can check that the profit maximising output is $q_4 = \frac{1-6\alpha}{6}$, resulting in profit $\Pi_4 = \frac{(1-6\alpha)^2}{36} - f$.

Therefore, this asymmetric equilibrium exists if:

$$\alpha < 1/6 \quad and \quad \frac{(1-6\alpha)^2}{36} < f < \frac{(1-6\alpha)^2}{9}. \tag{46}$$

It is on this region of the parameters' space that we focus here. Like in the rest of the paper, we now deal with the two cases of myopic and forward-looking AA in turn.

A.2 "Static analysis" (myopic AA)

If the AA is myopic, it decides whether to authorise a merger between two firms by comparing the consumer surplus arising under the initial market structure (we focus for simplicity on the symmetric equilibrium identified by expressions (4) to (6)) with that arising after the merger, where for the latter we focus on parameters such that the merger will lead to exit by one firm only (the remaining cases are already dealt with in the previous sections of the paper).

Consumer surplus is (weakly) higher under the merger if:

$$p(\frac{2}{4}, \frac{1}{4}) = \frac{1+6\alpha}{3} \leq p(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}, \frac{1}{4}) = \frac{1+16\alpha}{5}, \text{ or } \alpha \geq \frac{1}{9}, \tag{47}$$

therefore, the merger will be authorised if $\alpha \geq \frac{1}{9}$. For lower values of α, the merger will be blocked.

Figure 3 summarises the predicted market structure under a myopic AA.

A.3 Dynamic analysis (forward-looking AA)

The dynamic game is fully described in section 4. We solve it by backward induction, restricting attention to the region of parameter values described above, where an asymmetric equilibrium might arise after the first merger takes place.

Analysis of Stage 6 If the game arrives at the *sixth stage*, the AA has to choose between the two alternative market structures $\left\{\frac{2}{4}, \frac{2}{4}\right\}$ and $\{1\}$. The analysis is the same as in section 4, where we found that the AA would allow the merger to monopoly only if $\alpha \geq 1/5$. In the area considered here, therefore, *the merger to monopoly will never be authorised.*

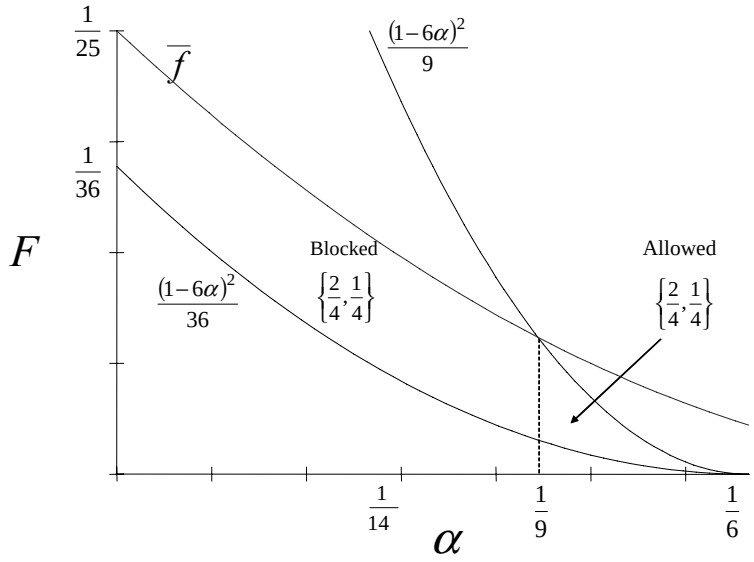

Figure 3: Equilibrium outcomes with a myopic AA

Analysis of Stage 5 In the *fifth* stage, if a duopolistic structure has emerged from the previous stages of the game, firms have to decide whether or not to seek a merger to monopoly. Again, the analysis here is as in section 4, where we found that the two duopolists will always have an incentive to propose the merger to monopoly.

Analysis of Stage 4 In the *fourth* stage, the AA decides whether to accept a merger between the outsiders to the first merger. In the area considered here, the AA anticipates that if it said no to the merger one of the two outsiders of the first merger would exit the industry, thus leading to the equilibrium market structure $\left\{\frac{2}{4}, \frac{1}{4}\right\}$. It also anticipates that even if the merger between outsiders were allowed, a further merger to monopoly will not be authorised. Therefore, the AA compares the consumer surplus under the two market structures $\left\{\frac{2}{4}, \frac{1}{4}\right\}$ and $\left\{\frac{2}{4}, \frac{2}{4}\right\}$.

Since $p(\frac{2}{4}, \frac{1}{4}) = \frac{1+6\alpha}{3} \geq p(\frac{2}{4}, \frac{2}{4}) = \frac{1+4\alpha}{3}$, *the AA will always authorise the defensive merger.*

Note that this was not always the case under the symmetric case dealt with in section 4. In particular, there was an area ($f < \widehat{f}$) where no outsider would leave the market after the merger, while here we restrict attention to the case where one outsider leaves the market after the merger. Of course, the former counterfactual calls for a tougher stance against the defensive merger (if the AA does not allow it, both outsiders will still operate in the market).

Analysis of Stage 3 In the *third* stage, we have to check whether the outsiders of the first merger (if it has been proposed in the first stage and approved in the second stage by the AA) will want to merge or not.

In the region considered, the outsiders know that if they do not merge, only one of them will survive. They also correctly anticipate that a further merger to monopoly will not be authorised, so that the final market outcome after the defensive merger will be a symmetric duopoly. Therefore, they will have an incentive to merge if:

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

which is satisfied if $f \leq \frac{8\alpha(1-4\alpha)}{9}$. Therefore:

- If $f \leq \frac{8\alpha(1-4\alpha)}{9}$, in the continuation game the equilibrium $\left\{\frac{2}{4},\frac{2}{4}\right\}$ will prevail (a defensive merger is proposed and allowed, a further merger is not allowed).
- If $f > \frac{8\alpha(1-4\alpha)}{9}$, in the continuation game the equilibrium $\left\{\frac{2}{4},\frac{1}{4}\right\}$ will prevail (a defensive merger will not be sought by the outsiders).

Analysis of Stage 2 In the *second* stage, if the two randomly selected firms at the first stage decide to submit a merger to the AA, the AA has to decide whether to allow it or not.

Two separate cases should be considered:

1. If $f \leq \frac{8\alpha(1-4\alpha)}{9}$, the AA anticipates that this first merger will be followed by a second merger that will give rise to a perfectly symmetric duopolistic structure. Therefore, a forward-looking AA will compare $CS(\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4})$ not with $CS(\frac{2}{4},\frac{1}{4})$, but rather with $CS(\frac{2}{4},\frac{2}{4})$. This has already been analysed in section 4, where we found that the first merger will be allowed if $\alpha \geq 1/14$.

2. If $f > \frac{8\alpha(1-4\alpha)}{9}$, the AA anticipates that the first merger will not be followed by another, implying that the first merger will be authorised if $CS(\frac{2}{4},\frac{1}{4}) \geq CS(\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4})$. This inequality amounts to $p(\frac{2}{4},\frac{1}{4}) = \frac{1+6\alpha}{3} \leq p(\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4}) = \frac{1+16\alpha}{5}$, which (see eq. (47)) holds for $\alpha \geq \frac{1}{9}$.

   However, in the parameters' region such that $f > \frac{8\alpha(1-4\alpha)}{9}$ and $f < \overline{f}$ (the latter being our Assumption 1), α must take lower values than 1/9. Therefore, in this region the first merger will not be authorised.

Analysis of Stage 1 In the *first stage* of the game, two randomly selected firms in the status quo industry structure are given the opportunity to decide whether or not to merge. (Recall that there are no administrative costs of submitting a merger to the AA. Therefore, when firms anticipate that a merger will be blocked, they are indifferent between proposing or not the merger.)

Two cases are relevant here:

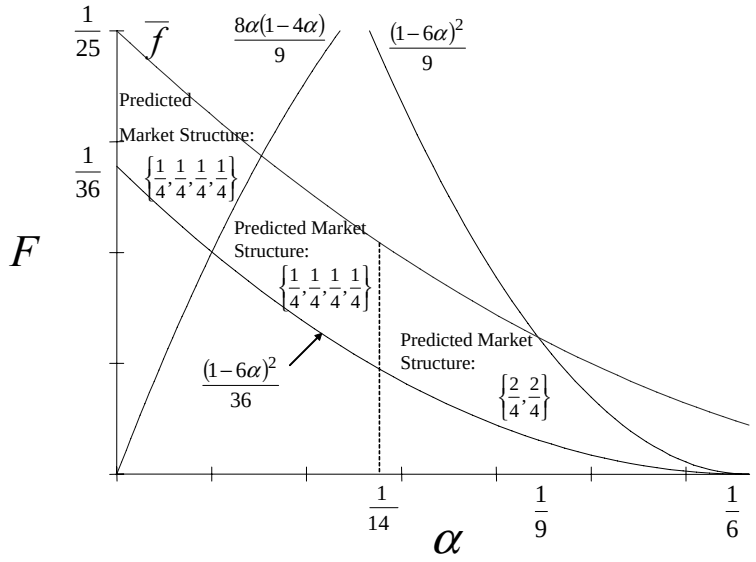

Figure 4: Equilibrium outcomes with a forward looking AA

1. If $f \leq \frac{8\alpha(1-4\alpha)}{9}$, a symmetric duopolistic structure will prevail in the continuation game, and firms will submit the merger if $\Pi(\frac{2}{4}, \frac{2}{4}) \geq 2\Pi(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}, \frac{1}{4})$. This has already been analysed in section 4, where we found that firms will always want to make the first merger proposal.

2. If $f > \frac{8\alpha(1-4\alpha)}{9}$, the first merger will not be followed by another, implying that it will be proposed if $\Pi_l(\frac{2}{4}, \frac{1}{4}) \geq 2\Pi(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}, \frac{1}{4})$. This amounts to the inequality $\frac{1}{9} - 2f \geq 2\frac{(1-4\alpha)^2}{25} - 2f$, which is satisfied for all values of $\alpha < 1/4 \equiv \overline{\alpha}$ (Assumption 1). Again, the first merger will be proposed (but in this area it will be rejected by the AA).

This completes the analysis of the whole game, which is summarised by Figure 4.

Notice that in the area where $1/14 < \alpha < 1/9$, at stage 2 the forward-looking AA would authorise the first merger submitted for its approval, whereas a myopic AA would not (since it considers that the merger will force one outsider to leave the market - a version of the efficiency offence argument - and does not take into account a defensive merger). This is because the forward-looking AA knows that along the equilibrium path, this merger will be followed by a defensive merger by the first merger outsiders. The defensive merger (but not a further merger which would lead to complete monopolisation of the industry) will also be authorised at stage 4, and consumer welfare will increase.

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