Preemptive mergers under spatial competition

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Abstract

Mergers for market power generally benefit outsider firms more than participating firms. Hence, outsiders should welcome such mergers between their competitors but, frequently, this is not the case. Under spatial competition some outsiders gain more than the participating firms but others might benefit less. Thus, if the number of admissible mergers is limited, firms may decide to merge to preempt rival mergers. This paper studies the incentives for preemptive merger by firms engaged in spatial competition.

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1 Introduction

Mergers for market power are frequently modelled as a reduction in the number of active firms: see especially the Cournot paradox paper of Salant, Switzer and Reynolds (1983). Their provocative result (contrary to common intuition) that mergers were likely to be unprofitable led the way to a new line of literature. Relaxing some of their assumptions, various authors showed that the effects of a merger were not necessarily negative for the participating firms (insiders) even in the absence of efficiency gains. For instance, Kwoka (1989) addressed the issue of profitability under non-Cournot behavior (using conjectural variations), establishing that mergers are more likely to be profitable in relatively competitive environments.[1] More recently, Ziss (2001) showed that merger profitability is increased if the output decision is delegated to an agent with appropriate incentives. Along a different line, Deneckere and Davidson (1985) analyzed mergers between firms competing in prices and selling symmetrically differentiated products. In this context the merger has implications other than changing the number of firms. Due to the fact that one owner controls the prices of several substitutes, firms are no longer symmetric after the merger takes place and this is sufficient to have profitable mergers.

A common factor to these models is that, as argued by Stigler (1950), non

[1] Along similar lines, Levin (1990) analyses the impact of a merger if insiders are not restricted to remain Cournot players.

participating firms (outsiders) benefit more from the merger than participating firms.[2] This is true both under Cournot and Bertrand competition and may be relevant when the decision to merge is endogenous: firms may find it more profitable to stay outside a merger (even if mergers are profitable) and just wait for other firms to merge, having therefore a higher payoff.[3] If all firms were symmetric and had the same kind of reasoning, then a possible outcome would be a hold-up situation, in which all firms decided to wait.

These results suggest that, in the presence of a merger for market power involving their competitors, outsider firms should react passively, behaving as free riders. However, outsiders frequently take action to prevent a given concentration operation from taking place as the following examples illustrate.

Following the announcement in February, 1999, of the friendly merger between Paribas and Société Générale, Banque Nationale de Paris (BNP), France's largest bank, decided to acquire both banks. This was interpreted as due to the fear of being outside the merger. Since cost synergies were not presented as the main driver of the merger, market power and market interaction must have been at the origin of this reaction.

Likewise, when Banco Santander Central Hispano (BSCH) announced

[2]This is a consequence of modelling mergers as a reduction in the number of symmetric firms but may also happen in other circumstances, as the Deneckere and Davidson (1985) case illustrates. The existence of efficiencies or synergies may invert this result as is shown, for instance, by Perry and Porter (1985). However, we are interested in mergers motivated by market power alone.

[3]The fact that outsiders have substantial gains resulting from a merger is responsible for the difficulties in monopolizing a given market described by Kamien and Zang (1990).

its intentions of acquiring a relevant stake at Mundial Confiança (MC) – an insurance company holding three Portuguese banks, Banco Pinto & Sotto Mayor (BPSM), Banco Totta & Açores (BTA) and Crédito Predial Português (CPP) – Banco Comercial Português (BCP) launched a public share exchange offer aimed at MC. This started as a dispute that involved the Portuguese authorities and, at a later stage, the European Commission. At the end of the day, a Solomonic division took place: BSCH got BTA and CPP while BCP was allowed to acquire BPSM.

Does this type of "rivaling to become an insider" behavior necessarily mean that the merger in question will generate substantial efficiencies, thus hurting outsiders while benefiting insiders? The purpose of this paper is to show that firms may still be interested in being insiders (as opposed to being witnesses to a merger) even when market power is the sole motivation for merger. This happens under two different configurations of post-merger payoffs. When insiders are the most benefitted firms, which is not a common feature in the literature unless efficiency gains are present, it is clear that there is an incentive to merge. However, even when some outsiders gain more (but others less) than the insiders, firms may still prefer to participate in the merger to avoid being in the place of the least benefitted outsider. This second type of merger may be called a preemptive merger. The firm's decision to merge is partially driven by some uncertainty about the rivals' post merger payoffs and, consequently, about their willingness to merge.

An example of mergers motivated by uncertainty about future events is the case of Tabacalera SA and Seita. These firms' announced intention to merge (in October 1999) was justified by the ever present cost reductions, hand in hand with the fear of being absorbed by the giant tobacco companies, Phillip Morris, British American Tobacco and Japan Tobacco.

To illustrate this point, spatial competition models will be used. The key feature of these models is that the impact of the merger on rival firms will depend on their location. In other words, the outsider group will not necessarily be homogeneous. If the number of mergers is limited, which is a reasonable assumption in concentrated markets, a given firm may prefer to be an insider even if this is not the best outcome, that is, even if some outsiders gain more. Part of the motivation for merging is thus the preemption of other mergers that, although profitable for the outsiders, are not as profitable as being an insider.

Preemptive mergers in the presence of cost reductions are exemplified by Nilssen and Sorgard (1998). Also, Fridolfsson and Stennek (2000) show that despite being unprofitable, a merger may increase the stock exchange value of the firm by eliminating the risk of being an outsider if this situation is even worse. The effects of mergers in spatial competition models were previously studied by Levy and Reitzes (1992), Rothschild (1998) and Braid (1999) and (2001). Nonetheless, the preemption motive for mergers is not highlighted in their contributions.

The paper is organized as follows. The following section presents the two-stage model used and is divided in two major subsections: the price competition stage is solved both before and after a merger in the first subsection while the decision to merge is endogenized in the second one. Finally, section 3 concludes.

2 The model

This section describes and characterizes the equilibria of the two-stage model used throughout the paper. In the first stage firms decide whether or not to participate in a merger. It is assumed that firms can protect themselves against hostile takeovers at no cost. Consequently, concentration operations may only take place with the agreement of those involved. For simplicity, only two-firm mergers will be considered and only one merger is assumed to be allowed by the antitrust authorities. Although a strong assumption, this feature is shared by most papers on mergers.[4] In the second stage, firms compete in prices, taking the ownership structure resulting from the previous stage as given. Two alternative spatial competition models will be used at this stage: the circular city model of Vickrey (1964) and (1999), also

[4] Note that with 10 or less symmetric firms the Herfindahl-Hirschman Index is always superior to 1000 and the increase in the index brought about by a two firm merger is always higher than 100. Consequently, assuming no post-merger entry or merger related efficiencies (and no failing firms either) it is possible that an antitrust authority following the thresholds presented in the US Merger Guidelines opposed a second (or even the first) merger as long as the number of firms was inferior to 10.

referred to as the model of Salop (1979), and, for comparison purposes, a simplified version of the pyramid model by Von Ungern-Sternberg (1991) as well as the symmetric differentiation model used in Deneckere and Davidson (1985). As the game is solved by backward induction, the price competition stage is solved first for every possible outcome of the merging stage.

2.1 The price competition stage

This subsection includes the solution of the price competition stage under four different scenarios: no mergers take place or one merger takes place in either the circular city model or the simplified pyramid model. The models differ essentially in the number of competitors that a given firm has. In the latter model, all firms compete with each other so that for an outsider it is irrelevant to know which merger took place. Thus competition is less localized in this model.

2.1.1 The circular city model

Let us assume that n profit maximizing firms are located around a circumference of length 1. Consumers are evenly distributed around this circumference and always purchase one unit of the good, so that each consumer will buy from the firm with the smaller acquisition cost (price plus transportation costs). Transport costs are assumed to be quadratic, so that it costs tx^2 to travel the distance x. Marginal production costs are assumed to be zero. Firms maximize their profits and compete in prices, setting them simultaneously. Although the results have previously been obtained by Levy and Reitzes (1992), these authors present post-merger equilibrium prices and profits recursively. In what follows, equilibrium prices and profits will be presented as a function of n and t.

Firms are assumed to be located symmetrically, with $d = 1/n$ being the distance between any two firms.[5] It is straightforward to show that before any merger takes place the Nash equilibrium price for any firm i is $P_i = t/n^2$ and the corresponding equilibrium profits are $\Pi_i = t/n^3$. Higher transportation costs result in higher prices because the demand facing a given firm will have a lower elasticity. More firms mean increased competition and a lower equilibrium price level.

We will now consider the post-merger equilibrium. Throughout the paper it will be assumed that firms are not able to relocate after a merger. This can be explained by the existence of a sufficiently high relocation cost and it means that mergers are not supposed to alter the product characteristics. Furthermore, it is possible to prove that closing one of the locations is not profitable.[6] If the outcome of the merging stage is such that insider firms are not consecutive (that is, they are not competing directly for the same consumers), their best response functions will be the same after the merger

[5] The effects of having a firm competing with all others (that is, a firm at the centre of the circumference) was the subject of the work of Bouckaert (1996).

[6] Proof available on request.

as well as their equilibrium prices. Thus, there is no market power motive for such merger due to the nature of localized competition in this model.

After a merger involving neighboring firms, both insiders will have an incentive to raise prices. By increasing i's price (respectively, $i+1$'s price), the merged firm is creating demand for firm $i+1$ (i). Some of the demand shifted away by the higher price will be directed to another product (another store or another brand) of the same firm. When such merger takes place, a symmetry argument cannot be applied to solve the pricing game. Firms closer to the merger will suffer a larger impact from the increase in prices. Without loss of generality, let the insiders be firm 1 and firm 2. The outsiders' best response to the increase in the insiders' prices will also be to increase their prices. Initially, only the immediate neighbors of the insider firms will raise their prices (by a smaller amount than the insiders did because of the slope of their reaction functions). These increases will set out a chain reaction of price increases which will include a further increase in insiders' prices until a new equilibrium is reached. Note that all these effects occur simultaneously: the reactions and counter reactions are mentioned with the purpose of a clearer exposition. As a result, at the post-merger equilibrium, outsiders will gain some consumers because their price will rise relatively less than the insiders'. The business stealing effect is present and one has to compare profits in order to check if it is sufficient for any outsider to gain more than insiders.

Insider and outsider equilibrium prices after the merger are given by (see Appendix A):

$$P_{1m} = P_{2m} = \frac{t}{n^2}\left(1+\frac{2\sqrt{3}-a^{n-2}+a^{2-n}}{\sqrt{3}\left(4-a^{2-n}-a^{n-2}\right)}\right), \tag{1}$$

$$P_{im} = \frac{t}{n^2}\left(1+\frac{a^{3-i}-a^{i-3}-a^{n-i}+a^{i-n}}{\sqrt{3}\left(4-a^{2-n}-a^{n-2}\right)}\right), i=3,...,n, \tag{2}$$

with $a = 2+\sqrt{3}$, where the subscript m denotes the post-merger equilibrium.

It is now possible to quantify the impact of the merger on profits in order to ultimately assess the incentives firms have to participate in it. In the appendix we show that

- A merger by any pair of neighboring firms is always profitable for the insider firms.

- The two outsiders located close to the merging firms gain more than the insiders do while those located further away are always worse off than the insiders.[7]

The two additional features that the circular city model brings into the analysis (capture of consumers located between the insider firms and asymmetry between outsiders) have some effect on the relative increase in profits. Some outsiders will still gain more from the merger than the participating

[7] This does not depend on the assumption that only one merger will be allowed. It is possible to have multi-merger cases where some distant outsiders will gain less than the insiders while others will gain more.

firms, but others will not. With symmetrically located firms, the increase in prices brought about by the merging firms shifts demand away to the closer firms, which also lose some customers to their other neighbors. Despite the fact that the merged firm maintains all the consumers located between both insiders and charges them a higher price, this situation is not as profitable as the increase in demand that the nearest rivals have, even while increasing their prices. For "distant" firms the increase in price is not very significant and neither is the increase in demand. These firms still gain from the merger but not as much as the insiders.

A consequence of this result is that mergers can happen because firms are afraid of being the "most distant outsider". It is considered that firms (or managers) may "fear" gaining a smaller amount than their rivals. Although there is no loss from merger, this may be justified as a fear of moving down in the profitability ranking. If the other firms' performance is used as a benchmark, managers may prefer to see their firms well placed when compared to their rivals. In this model, the best thing that could happen to a firm was a merger located as near as possible and the worst outcome would be a merger between "distant" firms. Somewhere in between is the payoff of being an insider. By not trying to merge firms will restrict themselves to the outsider role. In the circular city model this is not necessarily better than being an insider. Thus we have identified a motive that leads firms to be interested in being insiders even when mergers do not generate any efficiencies and there is a positive externality to the outsiders. This motive is not present when all outsider firms are symmetric, as the following model illustrates.

2.1.2 The pyramid model

Alternatively, let us now assume that the n firms are located at the edges of a $n-1$ dimensional pyramid. Each edge is connected with any other one by a line bearing the same characteristics as Hotelling's "main street". The total length of the $n(n-1)/2$ connections is normalized to 1 (so that we can compare the results with the circular city approach).

The main difference from having Hotelling's street with n firms or from using the circular city model described above is that, in the pyramid, all firms compete with each other for some of the consumers while in the other cases each firm would compete with only its two closest neighbors. There is a similarity with Deneckere and Davidson's analysis: products are also symmetrically differentiated, but firms still keep their "turf" after merging.

Pre-merger equilibrium:

For any segment connecting firm i to any firm j the consumer that is indifferent between purchasing at firm i or at firm j is located at a distance x (from firm i) which is defined by

$$P_i + tx^2 = P_j + t\left(\frac{2}{n(n-1)} - x\right)^2. \tag{3}$$

The demand facing firm i when the alternative is firm j is thus given by

$$D_i^j(P_i, P_j) = \frac{1}{n(n-1)} - \frac{1}{4}n(n-1)\frac{P_i - P_j}{t}. \tag{4}$$

Assuming that marginal costs are constant and equal to zero, firm i will maximize the following profit function:

$$\Pi_i = P_i \sum_{j \neq i} \left(\frac{1}{n(n-1)} - \frac{1}{4}n(n-1)\frac{P_i - P_j}{t} \right). \tag{5}$$

Under symmetry of the corresponding first-order conditions we have $P_i = P_j = P$ given by

$$P = \frac{4}{(n-1)^2} \frac{t}{n^2} < \frac{t}{n^2} \text{ for } n \geq 4. \tag{6}$$

Equilibrium profits are equal for all firms:

$$\Pi_i = \frac{4}{(n-1)^2} \frac{t}{n^3} < \frac{t}{n^3} \text{ for } n \geq 4. \tag{7}$$

For $n > 3$, this model has more competition among firms, as each firm competes with all its rivals for some set of consumers. Therefore prices and profits are lower than in the circular city representation of the market. Note that for $n = 3$ the results are the same.

Post-merger equilibrium:

After a merger by any m firms belonging to a set I of insiders, profits for insiders and for outsiders are, respectively,

$$\Pi_I = \sum_{k\in I} P_k \sum_{j\neq k} \left(\frac{1}{n(n-1)} - \frac{1}{4} n(n-1) \frac{P_k - P_j}{t} \right), \tag{8}$$

$$\Pi_O = P_o \sum_{j\neq o} \left(\frac{1}{n(n-1)} - \frac{1}{4} n(n-1) \frac{P_o - P_j}{t} \right), \forall o \notin I. \tag{9}$$

The equilibrium prices can be shown to be

$$P_I = \frac{4(2n-1)}{(n-1)(2n-2+m)(n-m)} \frac{t}{n^2}, \tag{10}$$

$$P_O = \frac{4(2n-m)}{(n-1)(2n-2+m)(n-m)} \frac{t}{n^2}, \tag{11}$$

and the corresponding profits (for each firm),

$$\Pi_I = \frac{4(2n-1)^2}{(n-m)(n-1)(2n-2+m)^2} \frac{t}{n^3}, \tag{12}$$

$$\Pi_O = \frac{4(2n-m)^2}{(n-m)^2(2n-2+m)^2} \frac{t}{n^3}. \tag{13}$$

It is easy to check that

- Mergers are always profitable for the insiders.
- Any outsider always gains more than each insider.

The reasoning for this is the same as in the circular model: Insiders keep the consumers located in between and charge them a higher price. The increase in price shifts demand away to rivals in $2(n-2)$ line segments. This last effect is dominant in the sense that any outsider will be better off after the merger.

The main difference between the equilibrium outcomes in these models is that firms may prefer to be insiders rather than distant outsiders in the circular city model, whereas being an outsider is always the best outcome in the pyramid model. This happens because the insiders' increase in price equally benefits all outsiders when all firms compete with each other (pyramid model). In the circular model some firms are only indirectly affected by the merger and, consequently, do not benefit as much. Therefore, in the circular model there is an extra incentive for merging. To fully account for this argument, we need some sort of endogenous formation of mergers. This is taken up in the next section.

2.2 The merging stage

To find out which firms will be involved in the merger a simple game will be used. Each firm is assumed to decide whether it wants to participate in a merger. Firm i's set of admissible strategies is $S_i = \{in, out\}$, where *in* denotes the situation in which this firm is candidate to be an insider. If only two consecutive firms have chosen *in* then, a merger having these two firms as insiders will take place. However, it is possible that more than one pair of consecutive firms wish to participate in a merger. In that event, "nature" will choose with equal probability which merger will take place from the set of most profitable mergers involving candidate firms.[8] Note that a possible outcome of the merging stage is that no merger will take place, which happens when only one firm (or none) chose *in*. The fact that the merging stage is not repeated makes this outcome irreversible. However, if the game was repeated until a strictly profitable merger was proposed to the authorities the qualitative results would not change significantly.

After the identity of the insiders is known, firms compete in prices, taking location and ownership structure as given. For any outcome of the merging stage and any initial number of firms, equilibrium payoffs are those presented in the previous sections.

Preemption as a motive to merge arises when firms are uncertain about future events, namely about which merger will be the one taking place. It will be assumed that firms are somewhat uncertain about their rival's payoffs after merging. If this uncertainty is small enough, the mixed strategies equilibrium yields the same probability distribution on pure strategies as the incomplete information game. The use below of mixed strategies is thus justified by Harsanyi's (1973) "purification" argument of the mixed strategies equilibrium. This uncertainty about rivals' payoffs may be responsible for some firm's "fear" of being the most distant outsider, which may be one of the motives for mergers in the circular model.

[8]Recall that the most profitable merger will necessarily involve neighboring firms because mergers between firms that are not competing for the same consumers have no effect on equilibrium prices and profits.

2.2.1 The decision to merge in the circular city model

It is necessary that at least five firms are active to have some outsiders worse off than the insiders. In fact, the more firms exist, the larger the probability that an outsider will have lower profits than an insider. As mentioned above, only the two neighboring outsiders gain more than the insiders. As a consequence, the use of five firms can be considered as the scenario under which the incentives for preemptive mergers are the smallest. For the general n firm case, see Appendix B where we show that for $n \geq 6$ all firms choosing $s_i = in$ is a Nash equilibrium. Naturally, this is not the case when any outsider gains more than the insider firms as happens in some of the work mentioned above, namely when the impact of a merger is merely a reduction in the number of active firms or in the Deneckere and Davidson (1985) case.

The first point to note is that proposing a merger is not a dominant strategy. For example, if the neighboring firms to the left side of firm 1 have both decided to merge, then firm 1 should decide not to merge and get the best possible outcome (the nearby outsider payoff).[9]

With only five firms and normalizing $t = 1$, pre-merger equilibrium profit is $\Pi_i = \Pi = 8$, $i = 1, ..., 5$ (multiplied by 1000) whereas post-merger profits

[9]The set of pure strategy Nash equilibrium for the $n = 5$ case consists of all firms choosing $s_i = out$ and any other strategy profile such that no more than two neighboring firms are choosing $s_i = in$. However, for the reasons presented above, we will be looking for the mixed strategy equilibrium.

are the following:

$$\begin{aligned}
\Pi_I &= 10.028 = 1.2535\Pi_i \text{ (for each firm)} \\
\Pi_{3m} &= \Pi_{5m} = \Pi_O^+ = 10.889 = 1.3611\Pi_i \\
\Pi_{4m} &= \Pi_O^- = 9.389 = 1.1736\Pi_i
\end{aligned}$$

where Π_O^+ denotes the profit of the neighboring outsiders and Π_O^- the profit of the distant outsider.

Let p_i be the probability firm i assigns to deciding to participate in the merger. This is the probability of being interested in participating in any two-firm merger. Recall that as firms are symmetric there should not be any preference for the firm to the left or to the right side. Also by symmetry, in the mixed strategy equilibrium each firm assigns the same probability to each strategy, that is $p_i = p$.

The first two columns in Table 1 (under the title *CCM* – circular city model) present the probabilities $P(.)$ firm i has of getting the different payoffs when its strategy choice is $s_i = in$ or $s_i = out$, assuming other firms are playing their equilibrium strategies (that is, playing *in* with probability p). The last two columns will be explained below.

Table 1: Firm i's payoff probabilities under different strategies

	CCM		*CCM**	
	$s_i = in$	$s_i = out$	$s_i = in$	$s_i = out$
$P(\Pi_I)$	$2p - 2p^2 + \frac{2}{5}p^4$	0	$\frac{2p-2p^2+\frac{1}{3}p^3+\frac{1}{6}p^4}{1-p^2(1-p)^2}$	0
$P(\Pi_O^+)$	$p^2 - \frac{2}{3}p^3 + \frac{1}{15}p^4$	$2p^2 - p^3 - \frac{1}{3}p^4$	$\frac{p^2-\frac{1}{3}p^3-\frac{1}{6}p^4}{1-p^2(1-p)^2}$	$\frac{2p^2-p^4}{1-p^2(1-p)^2}$
$P(\Pi_O^-)$	$p^2 - \frac{4}{3}p^3 + \frac{8}{15}p^4$	$p^2 - p^3 + \frac{1}{3}p^4$	0	0
$P(\Pi)$	$1 - p^4 + 2p^3 - 2p$	$1 - 3p^2 + 2p^3$	$\frac{2p^3-2p-p^4+1}{1-p^2(1-p)^2}$	$\frac{1-3p^2+2p^3}{1-p^2(1-p)^2}$

To illustrate these probabilities, consider the case where $i = 1$ and assume that $s_1 = in$. In such a case, the merger between 3 and 4 is the one firm 1 is afraid of. This merger may happen under four different circumstances: (i) when firms 3 and 4 are the only competitors deciding to participate in a merger, (ii) when firms 2, 3, and 4 decide to participate in a merger thus leading to three equally likely mergers (iii) when all firms except firm 2 choose $s_i = in$ leading again to three alternative and equally probable mergers and, finally, (iv) when all firms are candidates to be insiders. In this last case we have five candidate mergers and the merger between 3 and 4 happens in 20% of the cases.

Therefore, the probability of firm 1 being a distant outsider (which is equal to the probability of firm 3 and 4 merging) is

$$P(\Pi_O^-) = p^2(1-p)^2 + \frac{1}{3}p^3(1-p) + \frac{1}{3}p^3(1-p) + \frac{1}{5}p^4 = p^2 - \frac{4}{3}p^3 + \frac{8}{15}p^4$$

Using the probabilities in the table as well as the payoffs referred above, one can plot the expected profits. These are represented in Figure 1, where the thick curve represents the expected profit when firm i chooses to participate and the thinner curve represents expected profits when the strategy choice is not to be an insider.

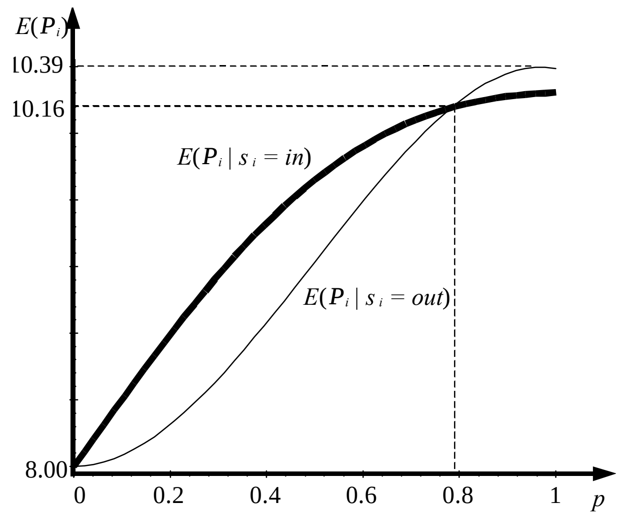

Figure 1: Firm 1's expected profits when choosing $s_1 = in$ (thick) or $s_1 = out$.

Using numerical methods, it can be shown that for firm i to be willing to randomize it must be that $p = 78.4\%$. When all firms play their equilibrium strategies, relevant mergers happen with a probability of 95.8%.[10] Note that when choosing $s_1 = in$, firm i is decreasing the probability of being a nearby outsider (a negative factor because this is the best possible outcome) and of being a distant outsider (a positive factor because this is the lowest payoff for firm i given that a merger happens). Naturally, the probability of being an insider is increasing and that of no merger taking place is decreasing. One factor leading a firm to choose $s_i = in$ is therefore the reduction in the probability of being the least benefitted firm. To evaluate the importance of this factor let us consider the following alternative game: firm i believes that if the only consecutive firms willing to be insiders are firm $i+2$ and firm $i+3$ the merging game will be restarted, that is, firms will be allowed to choose again if they want to be insiders or not.[11] Otherwise, when there are more consecutive firms willing to merge, firm i believes that "Nature" will never choose the most distant merger. This eliminates the possibility of firm i believing it will be the most distant outsider. If all other firms are assumed to have analogous beliefs, the new probabilities assigned to each outcome are presented in the last two columns in Table 1, under CCM^*.

In this case, the expected payoffs when choosing $s_i = in$ or $s_i = out$ are

[10] The equilibrium values for p when $n = 3$ and $n = 4$ are, respectively, 75.0% and 77.8%. This means that mergers will occur with a probability of 84.4% in the case of three firms and 90.4% in the case of four firms. Despite the fact that there is no preemptive motive for merger when $n < 5$, the probabilities are not significantly lower because with such a small number of firms the probability of no merger taking place (the worst case scenario) depends crucially on the choice of each firm. Additionally, mergers are more profitable when the number of firms decreases.

[11] Note that with $n = 5$ the merger between these firms is what firm i is afraid of.

equal at $p = 69.9\%$. Hence, the fear of being the most distant outsider is responsible for an increase of nearly 8.5 percentage points in the probability of wanting to merge for the five firm case. To check whether these results would hold under different assumptions, the same game will be studied in the pyramid model as well as in the model used in Deneckere and Davidson (1985).

2.2.2 The decision to merge in the pyramid model

Holding the same assumptions of five firms, $t = 1$, and a total segment of length 1, payoffs (x1000) in the pyramid model are: $\Pi_i = 2, \Pi_I = 2.16 = 1.08\Pi_i$ and $\Pi_O = 2.2756 = 1.1378\Pi_i$. Due to post-merger symmetry, there is no need to identify the type of outsider in this case: the payoff of any outsider is always Π_O.

The probabilities for all possible outcomes, given that rivals are playing their equilibrium strategies, are given in Table 2.

Table 2: Firm i's payoff probabilities under different strategies

	$s_i = in$	$s_i = out$
$P(\Pi_I)$	$4p - 8p^2 + 6p^3 - \frac{8}{5}p^4$	0
$P(\Pi_O)$	$2p^2 - 2p^3 + \frac{3}{5}p^4$	$6p^2 - 8p^3 + 3p^4$
$P(\Pi)$	$(1-p)^4$	$1 - 6p^2 + 8p^3 - 3p^4$

Firm i is indifferent between its two pure strategies if $p = 47.4\%$. This equilibrium has profitable mergers happening with a probability of 77.9%.

Relevant mergers (those with some effects on prices and market shares) happen with a smaller probability in the pyramid model, despite the fact that the number of such possible mergers is higher (all mergers have effects and not only those concerning consecutive firms). Firms are not as interested in participating in a merger as in the circular city model for two reasons: (i) mergers are relatively less profitable and (ii) firms do not fear (but in fact welcome) any rival merger and consequently, there is no preemption motive for merging.

An interesting comparison refers to the widely used case of symmetrically differentiated products, studied by Deneckere and Davidson (1985), hereon *DD*. If the same merger game is played by five firms selling products related in this way, the probability of witnessing profitable mergers is even lower. The following Table 3 presents the equilibrium probability p for different values of γ, a parameter measuring product substitutability.[12] For comparison purposes, the equilibrium probabilities for the pyramid model (PM) and for the circular city model with (CCM) or without (CCM^*) the fear of being a distant outsider are also presented.

[12] The demand used by these authors is of type: $q_i = V - p_i - \gamma(p_i - \frac{1}{n}\sum_j p_j)$. Equilibrium relative prices and profits coincide with those of the pyramid model when $\gamma \to \infty$. The probabilities associated with each payoff are the same as in Table 2.

Table 3: Equilibrium probabilities

Model	DD	DD	DD	PM	CCM^*	CCM
γ	.25	1	5	-	-	-
p	27.9%	33.6%	42.5%	47.4%	69.9%	78.4%
P(merger)	42.9%	54.4%	70.4%	77.9%	90.2%	95.8%

Profitability rather than preemption is the main incentive for merging in the DD model. The fact that the probabilities p and P(merger) are growing with γ is explained by the fact that mergers are more profitable when insiders sell close substitutes (in the extreme case when $\gamma = 0$ mergers do not increase profits at all unless production costs are reduced).

Summing up, in spatial competition models, mergers are relatively more profitable because consumers located between insider firms have a very high cost of moving to another "location" to buy the product. This constitutes an incentive for firms to merge more actively, which is present in the two models considered. Under this last model's assumptions, mergers have an impact on relative profits similar to the one present in most of the literature, where outsiders' gains are the highest. Despite being profitable, mergers happen with a small probability when compared with the circular city model, where the fear of being the least benefitted outsider plays a relevant role.

The following alternative matching game can also be used to make the merger decision endogenous: each firm chooses another firm to merge with. If only one pair of firms have matching intentions, that merger takes place.

Otherwise nature chooses with equal probability which merger (if any) will occur. The use of this alternative model does not change the qualitative results above, in the sense that if price competition is modelled with the circular city model incentives to merge are higher. However, in the matching setup mergers happen with a very small probability due to the requirement of matching intentions. This means that even if all firms wish to merge it is not guaranteed that a merger will happen. In both spatial competition models firms have a very high incentive (in fact it is a dominant strategy) to propose merging because otherwise, the *status quo* (no merger) is very likely to be the final outcome. It is possible to show that if there exists a cost of making a proposition to a rival firm, firms may propose to merge in the circular city model but not in the pyramid model, illustrating that the former model creates more incentives to merge.

3 Conclusions

Mergers for market power generally benefit the outsider firms more than the insiders. This means that mergers may happen with a small probability if all firms expect other mergers will take place. It also means that firms should welcome rival mergers. However, real world decisions illustrate that firms react to the announcement of mergers in their market, trying to prevent these from happening or trying to become insiders in a number of ways. Part of this attitude may be explained by the merger related efficiency gains that benefit insiders and, eventually, consumers while hurting outsiders. We argue that firms may additionally have clear incentives to be insiders even when these efficiency gains do not exist and market power is the only reason the merger is profitable. When the number of mergers is limited, firms may decide to merge with the purpose of preempting other mergers. This behavior is based on the fact that some outsiders may gain less than the participating firms when products are not symmetrically differentiated.

To illustrate the preemption motive to merge, a two-stage game was considered in which firms initially decide whether they want to merge and then compete in the context of the circular city model, taking the ownership structure as given. For comparison purposes other models were also used, namely similar models where outsiders are a homogeneous group. Our main result is that in the circular model the hold up problem is mitigated. Even when some outsiders gain more than the insider firms, these firms are not necessarily gaining the least. If one allows for some uncertainty about the actions (or payoffs) of the rivals and if the number of admissible mergers is limited (as seems to be the case in concentrated markets) firms may decide to merge driven by the fear of another, damaging, merger taking place, where "damaging" means not as beneficial as a merger involving the firm itself. As opposed to other models, a situation in which all firms are willing to be insiders is a Nash equilibrium of the merging game.

The main contribution of this paper is the inclusion of the stage where firms decide to merge followed by a stage of price competition with differentiated products. The analysis of the first stage decision allows us to establish a new incentive for merging which leads to an equilibrium where all firms actively try to be insiders, rather than preferring to be free-riders on other mergers. This is in line with the commonly observed fact that firms react to rival merger announcements. We establish that such behavior may take place even in the absence of cost reductions.

The existence of preemptive mergers depends crucially on the asymmetric profile of post-merger payoffs and on the number of mergers being limited by the antitrust authorities. Therefore, such mergers are more likely to arise in concentrated markets where firms sell non-symmetrically differentiated products.

In light of these results, a more conservative approach towards mergers is recommended because market power may lead firms to be highly interested in being insiders, just like efficiency gains do.

Appendix A: Equilibria in the circular city model

In this appendix we will present the equilibrium prices and profits for the post-merger symmetric location case. Let x_i refer to firm i's position on the circumference so that $d_i \equiv x_{i+1} - x_i$. represents the distance between firm i and firm $i+1$ Firm i will face two direct competitors, firm $i-1$ to its left and firm $i+1$ to its right. Let P_i denote firm i's price.

The indifferent consumer between purchasing at firm i or at firm $i+1$ will be the one located at x_i^* with $x_i < x_i^* < x_{i+1}$ or $0 < x_i^* - x_i < d_i$ such that:

$$P_i + t(x_i^* - x_i)^2 = P_{i+1} + t(x_{i+1} - x_i^*)^2 \Leftrightarrow x_i^* = \frac{1}{2}\frac{P_{i+1} - P_i}{td_i} + \frac{1}{2}\left(x_{i+1} + x_i\right).$$

By analogy, the indifferent consumer between firm $i-1$ and firm i will be located at x_{i-1}^* with $0 < x_{i-1}^* - x_{i-1} < d_{i-1}$.

Firm i's demand can be divided in two parts: one concerning the consumers to the left of the firm and the other those to its right side. Total demand facing firm i will be:

$$D_i(P_{i-1}, P_i, P_{i+1}) = x_i^* - x_{i-1}^* = \frac{P_{i+1} - P_i}{2td_i} + \frac{P_{i-1} - P_i}{2td_{i-1}} + \frac{1}{2}\left(d_i + d_{i-1}\right).$$

Lemma 1 *If all firms are symmetrically located on the circumference, the* *merger involving firm 1 and firm 2 will lead to the following equilibrium prices*

$$P_{1m} = P_{2m} = \frac{t}{n^2}\left(1 + \frac{2\sqrt{3} - a^{n-2} + a^{2-n}}{\sqrt{3}\,(4 - a^{2-n} - a^{n-2})}\right)$$

provided that $n \geq 4$*. After that merger, outsiders equilibrium prices are:*

$$P_{im} = \frac{t}{n^2}\left(1 + \frac{a^{3-i} - a^{i-3} - a^{n-i} + a^{i-n}}{\sqrt{3}\,(4 - a^{2-n} - a^{n-2})}\right), i = 3, ..., n.$$

Proof. The insiders' profits are given by

$$\Pi_I = P_1\left(\frac{1}{n} + n\frac{P_n - P_1}{2t} + n\frac{P_2 - P_1}{2t}\right) + P_2\left(\frac{1}{n} + n\frac{P_1 - P_2}{2t} + n\frac{P_3 - P_2}{2t}\right).$$

After a merger by firms 1 and 2 the set of n first-order conditions can be simplified and written as:

$$\begin{bmatrix} -4 & 2 & 0 & ... & 0 & 1 \\ 2 & -4 & 1 & 0 & ... & 0 \\ 0 & 1 & -4 & 1 & 0... & 0 \\ : & & & & & : \\ 0 & ... & 0 & 1 & -4 & 1 \\ 1 & 0 & ... & 0 & 1 & -4 \end{bmatrix} \begin{bmatrix} P_1 \\ P_2 \\ P_3 \\ : \\ P_{n-1} \\ P_n \end{bmatrix} = \begin{bmatrix} -t2/n^2 \\ -t2/n^2 \\ -t2/n^2 \\ : \\ -t2/n^2 \\ -t2/n^2 \end{bmatrix}$$

Denoting the i^{th} row by l_i, the following operations over the rows

$$l_1 - \sum_{j=1}^{n-2} u_j l_{n-j} \text{ and } l_2 - \sum_{j=1}^{n-3} u_j l_{j+3} - u_{n-2} l_1, \tag{14}$$

result in the equations:

$$(2 + 4u_{n-2} - u_{n-3})P_1 - (4 + 2u_{n-2})P_2 = -t2/n^2 + \sum_{j=1}^{n-2} \left[u_j \left(t2/n^2\right)\right] \tag{15}$$

and

$$-(4 + 2u_{n-2})P_1 + (2 + 4u_{n-2} - u_{n-3})P_2 = -t2/n^2 - \sum_{j=1}^{n-2} \left[u_j \left(-t2/n^2\right)\right] \tag{16}$$

where $u_n = \left(a^n - a^{-n}\right)/2\sqrt{3}$.

Solving equations (15) and (16) yields the following result:

$$P_{1m} = P_{2m} = \frac{2t}{n^2} \frac{1 - \sum_{j=1}^{n-2} u_j}{2 - 2u_{n-2} + u_{n-3}} = \frac{t}{n^2} \left(1 + \frac{2\sqrt{3} - a^{n-2} + a^{2-n}}{\sqrt{3}\left(4 - a^{2-n} - a^{n-2}\right)}\right). \tag{17}$$

The corresponding result concerning outsider's prices is obtained solving the first-order condition for firm i in order to get P_{i+1}. For firm 3, equilibrium price is given by:

$$P_{3m} = -2t/n^2 + 2P_{2m}. \tag{18}$$

For the i^{th} firm one gets

$$P_{im} = -(2t/n^2) + 4P_{i-1m} - P_{i-2m}, i = 4, ..., n. \tag{19}$$

Solving the difference equation and simplifying yields the prices mentioned above. ■

The non-negativity constraints on demand were not considered so far. It is necessary to show that each firm will have positive demand both from its left and from its right side, that is, there is always an indifferent consumer between any pair of firms. This proof is available from the author upon request as well as the proof that equilibrium profits are given by $\Pi_i = nP_i^2/t$ for the outsiders and $\Pi_I = nP_{1m}^2/t$ for both insiders. These results will be used below.

Lemma 2 *A merger by any pair of neighboring firms is always profitable for the insider firms.*

Proof. Mergers are profitable if

$$\Pi_I - 2\Pi_i = \frac{t}{n^3}q(n) > 0, \tag{20}$$

where

$$q(n) \equiv \left(\frac{1}{3}\frac{18 + (5\sqrt{3} - 9)a^n - (5\sqrt{3} + 9)a^{-n}}{4 - a^{2-n} - a^{n-2}}\right)^2 - 2. \tag{21}$$

But $q(n) > 0$ is equivalent to $r(n) < 0$ with

$$r(n) \equiv 18 - 12\sqrt{2} + \left(21\sqrt{2} - 9\right)\left(a^n + a^{-n}\right) + \left(5\sqrt{3} - 12\sqrt{6}\right)\left(a^n - a^{-n}\right). \tag{22}$$

As $\frac{\partial r(n)}{\partial n} < 0$ and $r(3) = 0$ one gets $\Pi_{1+2a} - 2\Pi_i > 0$, meaning that mergers are always profitable for insider firms. ■

As for the outsider firms, the merger has the following consequences:

Lemma 3 *Outsiders to the merger located close to the merging firms gain more than insiders. Outsiders located far away from the merging firm are always worse off than insiders, provided that* $n \geq 5$.

Proof. It is easy to check that $P_{3+jm} = P_{n-jm}, \forall j = 0, ..., \frac{n-3}{2}$ if n is odd or $j = 0, ..., \frac{n-4}{2}$ if n is even, that is, outsiders' prices depend only on their distance to the merger location. We will start by showing that outsiders set higher prices the closer they are to the merger location and that the difference in consecutive outsiders' prices is smaller the further away firms are from the merger location.

The price of firm i at a distance j from the merger is (the distance is measured by the smallest number of firms between firm i and the nearest insider)

$$P_{im}(j) = \frac{t}{n^2}\left(1 + \frac{a^{-j} - a^j - a^{n-3-j} + a^{3+j-n}}{\sqrt{3}\left(4 - a^{2-n} - a^{n-2}\right)}\right). \tag{23}$$

Let

$$f(n)=\sqrt{3}\left(4-a^{2-n}-a^{n-2}\right). \tag{24}$$

This function has the following characteristics:

$\frac{\partial f(n)}{\partial n}=-\sqrt{3}\ln a\left(a^{n-2}-a^{2-n}\right)<0$ for $n>2$ and $f(3)=0$. Therefore, $f(n)<0$ for $n>3$.

The distance from the merger location affects price in the following way:

$$\frac{\partial P_{im}(j)}{\partial j}=\frac{-t\ln a}{n^2 f(n)}\left(g(j)-g(n-3-j)\right), \tag{25}$$

with $g(x)\equiv a^{-x}+a^{x}$. It is straightforward to show that $\frac{\partial g(x)}{\partial x}>0$ for $x>0$ and, with $j<(n-3)/2$, one has that $n-3-j>j$. Therefore $g(j)-g(n-3-j)<0$. This shows that price is smaller the further away a firm is from the merger location.

Note also that

$$\frac{\partial^2 P_{im}(j)}{\partial j^2}=\frac{t\left(\ln a\right)^2}{n^2 f(n)}\left(h(j)+h(n-3-j)\right), \tag{26}$$

with $h(x)\equiv a^{-x}-a^{x}$. Again, it is easy to show that $h(x)<0$ for $x>0$. Therefore $h(j)+h(n-3-j)<0$. This shows that price differences among firms are smaller the further away firms are from the merger location. Let $\Delta(n,j)$ be the difference in profits between an insider and an outsider located at distance j. By definition,

$$\Delta(n,j) \equiv \frac{1}{2}\Pi_I - \Pi_{im}(j) = \frac{1}{2}n(P_{1m})^2/t - n(P_{im}(j))^2/t, \tag{27}$$

where $\Pi_{im}(j)$ the post merger profit of a firm located at distance j from the merger.

The function $\Delta(n,j)$ has the same sign of $P_{1m} - \sqrt{2}P_{im}(j) = \frac{t}{n^2 f(n)} s(n,j)$ with

$$s(n,j) = 6\sqrt{3} - 4\sqrt{6} + \left(7\sqrt{6} - 3\sqrt{3}\right) g(n) + \\ + \left(12\sqrt{2} - 5\right) h(n) - \sqrt{2}\left(h(j) + h(n-3-j)\right). \tag{28}$$

In particular, for $j = 0$, this expression simplifies to

$$s(n,0) = 6\sqrt{3} - 4\sqrt{6} - \left(8\sqrt{2} + 3\right)\sqrt{3}g(n) - \left(14\sqrt{2} + 5\right) h(n) \tag{29}$$

which is always positive if $n > 3$. For $j = 1$ the same function can be written as

$$s(n,1) = 6\sqrt{3} - 2\sqrt{6} - \left(49\sqrt{2} + 3\right)\sqrt{3}g(n) - 5\left(17\sqrt{2} + 1\right) h(n) \tag{30}$$

which is always negative as long as $n > \bar{n} \approx 4.4917$. As

$$\frac{\partial s(n,j)}{\partial j} = \sqrt{2}\,(\ln a)\,(g(j) - g(n-3-j)) < 0, \tag{31}$$

more distant outsiders will have lower profits than insiders. Therefore we can conclude that neighboring firms gain more than insiders ($\Delta(n,0) < 0$). The other outsiders, however, despite having an increase in their profits do not gain as much as the merging firms. ■

Appendix B: The merging game with more than five firms

Let us now consider a firm's decision to merge when $n > 5$ and firms operate in the context of the circular city model

Proposition 4 *The strategies $s_i = in, \forall i = 1, ..., n$ are a Nash equilibrium provided that $n \geq 6$*

Proof. If n (assumed even) firms are choosing $s_i = in$ then firm 1's probability of getting the insider or outsider profits are given in the following Table 4:

Table 4: Firm 1's payoff probabilities under different strategies

	Insider	Outsider at distance i, $i = 0, ..., n/2 - 2$
$s_1 = in$	$2/n$	$2/n$
$s_1 = out$	0	$2/(n-2)$

Firm 1's expected profit when it decides to be an insider is

$$E\left[\Pi_1 | s_1 = in\right] = \frac{2}{n}\frac{1}{2}\frac{n}{t}\left(\frac{t}{n^2}\left(1 + \frac{2\sqrt{3} - a^{n-2} + a^{2-n}}{\sqrt{3}\left(4 - a^{2-n} - a^{n-2}\right)}\right)\right)^2 + \\ + \sum_{j=0}^{n/2-2}\left[\frac{2}{n}\frac{n}{t}\left(\frac{t}{n^2}\left(1 + \frac{a^{-j} - a^j - a^{n-3-j} + a^{3+j-n}}{\sqrt{3}\left(4 - a^{2-n} - a^{n-2}\right)}\right)\right)^2\right].$$

If this firm chooses to be an outsider, then its expected profit is

$$E\left[\Pi_1 | s_1 = out\right] = \sum_{j=0}^{n/2-2}\left[\frac{2}{n-2}\frac{n}{t}\left(\frac{t}{n^2}\left(1 + \frac{a^{-j} - a^j - a^{n-3-j} + a^{3+j-n}}{\sqrt{3}\left(4 - a^{2-n} - a^{n-2}\right)}\right)\right)^2\right]. \tag{32}$$

Given that all rivals are choosing to be insiders, any firm's best response is also to be an insider if

$$\sum_{j=0}^{n/2-2}\left(f(n) + d_j(n)\right)^2 - \frac{n-2}{4}\left(f(n) + c(n)\right)^2 < 0, \tag{33}$$

where $f(n)$ is defined as above, $d_j(n) = (1 - a^{n-3})a^{-j} - (1 - a^{3-n})a^j$ and $c(n) = 2\sqrt{3} - a^{n-2} + a^{2-n}$.

Simplifying and making $x = x(n) \equiv a^{n-2}$, (33) is equivalent to

$$k(x)\left(l(x) - m(x)\right) < 0, \tag{34}$$

where

$$
\begin{aligned}
k(x) &\equiv \left(1-\sqrt{3}\right)\frac{\left(-2-\sqrt{3}+x\right)^2}{276x^2}<0, && (35)\\
l(x) &\equiv 138\,(x+1)\left(x+\sqrt{3}-2\right)\frac{\ln(x)+2\ln(a)}{\ln(a)}>0, && (36)\\
m(x) &\equiv \left(11\sqrt{3}+15\right)\left(23x-31+12\sqrt{3}\right)\left(x-7+4\sqrt{3}\right)>0. && (37)
\end{aligned}
$$

Note that $l(x) > m(x)$ is a condition equivalent to condition (34). It is verified at $n = 6$ (or $x = \left(2+\sqrt{3}\right)^4$). In order to prove that being an insider is a Nash equilibrium for $n \geq 6$, it is sufficient to show that for any $x > a^4$

$$\frac{\partial l(x)}{\partial x} > \frac{\partial m(x)}{\partial x}. \tag{38}$$

But

$$
\begin{aligned}
\frac{\partial l(x)}{\partial x} = {} & \frac{138}{\ln(a)x}x\left(\ln x+2\ln(a)\right)\left(2x+\sqrt{3}-1\right)\\
& + \frac{138}{\ln(a)x}\left(x+\sqrt{3}-2\right)(x+1) \qquad (39)
\end{aligned}
$$

and

$$\frac{\partial m(x)}{\partial x} = 2\left(11\sqrt{3}+15\right)\left(23x-96+52\sqrt{3}\right). \tag{40}$$

Given that $n \geq 6$ we have $\ln x \geq \ln(a^4) \approx 5.2678 > 5$. Therefore,

$$\frac{\partial l(x)}{\partial x} > u(x) \equiv \frac{138}{\ln(a)x}\left(x\left(5+2\ln\left(a\right)\right)\left(2x+\sqrt{3}-1\right)+\left(x+\sqrt{3}-2\right)\left(x+1\right)\right) \tag{41}$$

But $u(x) > \frac{\partial m(x)}{\partial x} \Leftrightarrow x < -7.7404 \vee x > 0.02624$ meaning that $\frac{\partial l(x)}{\partial x} > u(x) > \frac{\partial m(x)}{\partial x}$. ■

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