Strategic Alliances, Joint Investments, and Market Structure

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Abstract

This paper examines strategic alliances (SAs) involving joint investments in and sharing of production capacity. We consider a situation where market entry is limited by the availability of an essential production capacity. New capacity becomes sequentially available, and the incumbent firms may form a strategic alliance in order to jointly invest in it. In this setting, SAs may influence competition in the product market by affecting market entry. We characterize the evolution of the market structure. We also show that SAs need not be anticompetitive. That is, banning SAs may lead to a more concentrated market structure than what would otherwise be the case.

Keywords: Strategic alliances; Oligopoly; Preemptive investment

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1 Introduction

Even firms that compete fiercely in the product market are often able to cooperate outside it through strategic alliances (SAs).[1] Important examples of strategic alliances are research joint ventures, joint investments in and sharing of plants and equipment, joint investments in exploration for natural resources, and sharing of licenses to produce or sell a new product.

The concern that has been raised in connection with strategic alliances is their possible influence on competition in the product market. For instance, in the airline industry, SAs involving sharing of terminal space or landing slots have been suspected to have anticompetitive effects. Many of these SAs have received attention from antitrust agencies.[2] The impact of SAs on competition in the product market has been theoretically analyzed in several papers. For instance, Cabral (2000) and Martin (1995) show that cooperation in R&D may facilitate collusive behavior in the product market and thereby reduce competition.[3] Chen and Ross (2000) show how strategic alliances involving capacity sharing may reduce competition by inducing an entrant to enter the market without investing in new production capacity. Morasch (2000) analyzes the influence of intermediate good production joint ventures on competition. In his model, SAs reduce competition in the product market unless several alliances are formed.

A common feature of this literature is that the number of firms in the market is taken as given.[4] However, if SAs influence profits of the incumbents they should also influence the incentives to enter the market. This may have a large impact on competition. In this paper, we analyze how SAs affect market structure in a dynamic setting where threat of entry leads incumbents to form SAs.

We build on the literature on preemptive investment. Within this literature, Lewis (1983), Krishna (1993, 1999), and Rodriguez (2002) are the most closely related to

[1] See for instance Chen and Ross (2000) and Morasch (2000). Following Morasch (2000), we define strategic alliances as arrangements that allow firms operating in the same product market to cooperate outside it in order to influence incentives in the future.

[2] For examples of policy responses that SAs in airline industry have induced, see Chen and Ross (2000) and references therein.

[3] A more general point was made by Bernheim and Whinston (1990) who show that multimarket contacts may facilitate cooperation among firms.

[4] In Chen and Ross (2000) there is a (single) potential entrant. However, the possibility to form a strategic alliance only affects its investment decision, not the entry decision itself.

our analysis. These papers consider a situation where market entry is limited by the availability of an essential production capacity. New capacity becomes sequentially available and is auctioned to an entrant or an incumbent. We use this framework to analyze strategic alliances. When new capacity becomes available the firms in the market may jointly acquire and share it while remaining otherwise independent. This is what we will call here a strategic alliance.[5]

We will first describe how the market structure and the price of new capacity evolve in the presence of SAs. When firms do not take future profits into account, the incumbents always buy new capacity units that become available. Thus in a static set-up SAs may only have anticompetitive effects. We then characterize the situation without SAs and show by means of a simple example that forbidding alliances may result in the final market structure being more concentrated than when SAs are allowed. In the absence of SAs a single incumbent may find it profitable to deter entry alone. But when alliances are allowed it may prefer to let some new units of capacity go to entrants and then buy the remaining units jointly with them. In other words, banning SAs may lead an incumbent to defend its market power more aggressively.

In the next section, we present the model and describe the equilibrium outcome. In section 3, we consider some examples with and without SAs. We conclude in section 4.

[5]Our main departure from this literature is that we consider the effects of cooperative behavior among the incumbents. However, the results in Rodriguez (2002) should be discussed in this connection. Rodriguez presents a thorough analysis of the case of non-cooperative behavior among incumbents with a symmetric market game. When each incumbent has an incentive to acquire a new capacity unit alone, given that the other firm doesn't buy it, multiple equilibria arise and Rodriguez uses a publicly observable correlation device to select a unique (symmetric) equilibrium. Two incumbent firms then share the expected cost of entry preemption by both buying new capacity with an equal probability. This is different from the type of coordination we attribute to SAs, since we see SAs as a way for the incumbents to jointly buy new capacity units even in a situation where a single incumbent would not have an incentive to do so. This has potentially much larger effects on the market structure.

We also depart from the previous literature in that we consider an infinite-horizon model with interim profits. Previous work has considered a two-stage setting, where first all capacity units are sold sequentially and then production takes place (Krishna 1993, also briefly considers the case with two production periods). Our set-up seems more natural in some cases, for instance, when the capacity units are interpreted as licenses to new innovations.

2 The model

2.1 The set-up

Time is discrete and runs forever. There is a market that each period yields profits to the firms operating in it. Future profits are discounted with $0 \leq \beta < 1$. There is a large number of firms considering entry to the market. Each firm needs at least one unit of capacity in order to operate in the market. In the beginning of each period t, starting from period $t = 1$, one new unit of capacity becomes available and is sold by means of a second prize auction to a firm or to a group of firms that offers the highest payment for it.

We assume, as in Rodriguez (2002), that one unit of capacity is sufficient for profit maximizing production given any number of firms in the market. Hence, for the incumbents the only reason to invest in new capacity is entry deterrence. This assumption implies that it is natural to consider a symmetric market game.[6]

Let m denote the number of incumbents in the market. The per period profit of each firm in the market is $\pi(m)$. Throughout the paper, we make the following assumption concerning overall profits in the market:

Assumption 1. *The market profit, $m\pi(m)$, is strictly decreasing in m for all $m \geq 1$. Furthermore, there exists $1 \leq \overline{m} < \infty$, such that $\pi(\overline{m}) > 0 \geq \pi(\overline{m} + 1)$.*

We will analyze two different cases, a case where firms may form a SA and thereby share the cost of capacity acquisition and a case where joint acquisition of capacity is not allowed. When SAs may be formed, we assume that an alliance always involves all incumbent firms and that investment costs are shared equally.[7] These assumptions are extreme, but they can only emphasize the anticompetitive nature of SAs. Thus, by forming a SA, the incumbents are always able to avoid inefficient equilibria where they fail to acquire new capacity although it is jointly profitable. In both cases, firms maximize the discounted sum of current and future profits net of investment costs.

[6] In Lewis (1983) and Krishna (1993) there is one dominant firm and all entrants are price takers. Assuming a symmetric market game comes closer to the most policy relevant cases since if all entrants necessarily act as price takers, industrial policy may only have a limited effect on the degree of competition.

[7] For endogenous alliance formation, see Morasch (2000) and references therein. Bernheim (1984) uses the same equilibrium refinement in a context somewhat similar to ours.

When a new capacity unit becomes available, the action of each firm consists of offering any non-negative bid for it. Without loss of generality we assume that when the incumbents and a potential entrant offer the same payment for a given unit it is sold to the incumbents. We focus on equilibria where firms bid their valuations. If SAs are allowed, the incumbents act as a single bidder. In this case, both the entrants' and the SA's valuations are uniquely determined. When incumbents do not form a SA, things are more complicated. Now the valuation of each incumbent need not be uniquely determined, but may depend on whether another incumbent or an entrant is expected to be the highest bidder. This is because of an incentive to free ride. Even if each incumbent finds it profitable to acquire the new unit alone, all of them prefer another incumbent to buy it. Therefore, we may have multiple equilibria characterized by one of the incumbents acquiring the new unit and others free riding.[8] As we will show in Proposition 2, we can rule out multiple equilibria of this type with the following assumption.

Assumption 2. *The profit function is such that*

$$\left[\sum_{t=1}^{\overline{m}-m} \beta^{t-1}\pi\left(m+t\right)+\frac{\beta^{\overline{m}-m}\pi\left(\overline{m}\right)}{1-\beta}\right]\left(2-\beta\right)>\pi\left(m\right)$$

for all $m \geq 2$.

Intuitively, this assumption guarantees that whenever there are at least two incumbents, none of them has an incentive to buy out a new capacity unit even when expecting that the highest bidder will be an entrant.[9]

To facilitate the analysis, we define $V\left(m\right)$ as the equilibrium payoff for an incumbent when the number of incumbents is m. Then

$$V\left(m\right)=\max\left[\pi\left(m\right)+\beta V\left(m\right)-d\left(m\right),\pi\left(m+1\right)+\beta V\left(m+1\right)\right] \tag{1}$$

where $d\left(m\right)$ is the equilibrium cost share of buying a unit of capacity for an incumbent. The equilibrium payoff for an incumbent when there are m incumbents in the market, is

[8] One way to select among the equilibria is to allow for a public correlation device that enables the incumbent firms to share the expected cost of entry preemption (as in Rodriguez 2002).

[9] A similar assumption (Assumption A_2^*) in Rodriguez (2002) guarantees that, provided that at least two firms are in the market, no single incumbent will buy out capacity units. Using Rodriguez' terminology, this means that externalities in capacity acquisition are 'insubstantial'.

thus the maximum of the following two elements: 1) Current profits and the discounted continuation payoff if a new firm does not enter the market less the cost of buying the current unit. 2) Current profits and the discounted continuation payoff if one new firm enters the market. Note that when the number of incumbents is $\overline{m}$, the price of a new capacity unit must be zero. It follows that $V(\overline{m}) = \frac{\pi(\overline{m})}{1-\beta}$.

2.2 Equilibrium with SAs

When there are $m-1$ incumbents in the market, the value of a new unit for a potential entrant is $\pi(m) + \beta V(m)$. With SAs, the equilibrium cost share of each incumbent is

$$d(m-1) = \frac{1}{m-1}\left[\pi(m) + \beta V(m)\right]. \quad (2)$$

The results on the evolution of the market structure and prices in the presence of SAs are summarized in the following proposition.

Proposition 1 *Assume that incumbent firms may form a SA. Then,*
i) In a static environment, i.e. when $\beta = 0$, no new firms enter the market.
ii) If the incumbents buy out a capacity unit in any given period, they continue to do so every consecutive period.
iii) The price of the new capacity units is weakly decreasing over time. The price is strictly decreasing as long as new units are bought by entrants and constant when new units are bought by incumbents.

Proof. In Appendix A. ■

Part i) of the proposition states that if $\beta = 0$, all new units are bought by the incumbents. If joint acquisition is not possible this may not be the case. To see this, consider the case of $m-1$ incumbents. When $\beta = 0$, the value of a new capacity unit for an entrant is $\pi(m)$. One of the incumbents will buy the unit if it is privately profitable, which requires that $\pi(m-1) - \pi(m) \geq \pi(m)$, a condition that may or may not hold. Thus, in a static setting, the possibility to jointly acquire new capacity may only have anticompetitive effects.

Part ii) of the proposition shows that if the initial incumbents let any units of capacity go to potential entrants these units are necessarily the first units that become available. By letting new firms to the market the initial incumbents are able to cut down on their own future entry deterrence costs for two reasons. First, the more firms there are in the market the less valuable the new units of capacity are for potential entrants and thus less costly for the incumbents to acquire. Second, letting more entrants to the market means that there are more firms to share any given investment cost.

Part iii) reflects the infinite-horizon framework. When the incumbents obtain the new units, the market conditions remain unchanged from one period to the next. This means that the value of the new units remains unchanged. In contrast, when an entrant obtains the new unit, the number of the firms competing in the market increases. This drives down the value of new units.

2.3 Equilibrium without SAs

Let us then, for comparison, consider the situation where firms are not allowed to form alliances for joint capacity acquisition. As in the case of SAs, equilibrium payoff of the incumbent firms is determined by equation (1) but now $d(m-1) = \pi(m) + \beta V(m)$, i.e. if an incumbent firm decides to buy a capacity unit it must bear the cost alone. We then have

Proposition 2 *Assume that the incumbent firms may not form SAs and Assumption 2 holds. Then,*
i) If

$$\pi(1) > (2-\beta)\left[\sum_{t=1}^{\overline{m}-1} \beta^{t-1}\pi(1+t) + \frac{\beta^{\overline{m}-1}\pi(\overline{m})}{1-\beta}\right],$$

a monopoly prevents all further entry and the price of the new capacity units is constant.
ii) Otherwise new firms enter the market and the price of the new capacity units is decreasing until $\overline{m}$ firms operate in the market.

Proof. In Appendix A. ■

When Assumption 2 holds and the number of incumbents is at least two, an entrant will buy the new available unit each period until $\overline{m}$ firms operate in the market. As in Proposition 1, the price of new capacity units is weakly decreasing. This is in contrast with the results in Rodriguez (2002) and Krishna (1993), where the price of new units is constant as long as the units are bought by entrants and increasing when they are bought by incumbents. In these papers, the number of units to be sold is fixed and the market only becomes operational after all units have been sold.

3 Some examples

Consider a market where $\overline{m} = 3$ and $\pi(1) = 7$, $\pi(2) = 3$, and $\pi(3) = 1$. Assume first that the incumbent firms may form a SA in order to jointly acquire new available capacity units. In this case, $d(2) = \frac{1}{2}V(3) = \frac{1}{2}\frac{\pi(3)}{1-\beta}$. From equation (1) it then follows that a duopoly will acquire the new capacity unit in each period if

$$\pi(2) - \frac{1}{2}\frac{\pi(3)}{1-\beta} \geq \pi(3).$$

Hence, if $\beta \leq 3/4$, a duopoly will acquire new units and $V(2) = \frac{1}{1-\beta}(\pi(2) - d(2))$. If $\beta > \frac{3}{4}$, the new unit goes to an entrant and $V(2) = \frac{\pi(3)}{1-\beta}$.

Since $d(1) = \pi(2) + \beta V(2)$, a monopolist will acquire new capacity units if

$$\frac{\pi(1) - (\pi(2) + \beta V(2))}{1-\beta} \geq \pi(2) + \beta V(2). \tag{3}$$

Consider first the situation where $\beta \leq \frac{3}{4}$, that is, a duopoly would prevent all further entry. Then solving (3) for β shows that if $\beta \leq \frac{4}{7} - \frac{1}{7}\sqrt{2}$, the monopoly prevents all entry alone, but if $\beta \in (\frac{4}{7} - \frac{1}{7}\sqrt{2}, \frac{3}{4}]$, the monopoly lets the first unit go to an entrant. If $\beta > \frac{3}{4}$, a duopoly does not prevent entry. In that case, (3) is not satisfied and, as a result, the final market structure will consist of three firms.

Consider then the case when SAs are not allowed. Straightforward calculation verifies that if $\beta > \frac{1}{2}$, the profit function satisfies Assumption 2. By Proposition 2, no firm has an incentive to buy out new capacity units alone if the market is occupied by a duopoly. As a result, $V(2) = \frac{\pi(3)}{1-\beta}$ and $d(1) = \pi(2) + \frac{\beta\pi(3)}{1-\beta}$. Consider then the incentives of a monopolist to prevent entry. Using (3) gives that a monopolist will acquire the new capacity unit each period if

$$\pi(1) - \left(\pi(2) + \frac{\beta\pi(3)}{1-\beta}\right) \geq (1-\beta)\pi(2) + \beta\pi(3).$$

This inequality is satisfied if $\beta \leq 1/\sqrt{2}$. Consequently, if the market is initially occupied by a monopoly and $\beta \in (1/2, 1/\sqrt{2}]$, all entry is prevented by the monopolist. If $\beta > 1/\sqrt{2}$, neither the monopolist nor the firms in the duopoly market have an incentive to buy new capacity units and the final market structure will consist of three firms.

We are now able to compare the final market structure in the two cases when $\beta > 1/2$. First, if $\beta \in (1/2, 1/\sqrt{2}]$, a monopolist prevents all entry alone if SAs are not allowed but prefers to let one new firm to the market if SAs are allowed. This means that the market will be occupied by a monopoly when SAs are not allowed and by a duopoly when SAs are allowed. Second, if $\beta \in (1/\sqrt{2}, 3/4]$, it is not profitable for the monopoly to prevent all entry when SAs are not allowed. Allowing the firms to form a SA again leads to a duopoly but the final market structure will consist of three firms in the absence of SAs. Finally, if $\beta > \frac{3}{4}$, the final market structure will consist of three firms in both cases.

The possibility to form a strategic alliance may make it attractive for the initial incumbent to let a new firm to the market. It could preserve its market power alone, but prefers to let one entrant to the market because the negative effect of facing competition in the product market is offset by the positive effect of being able to share the costs of future entry deterrence. Clearly, SAs can never be anticompetitive if the market is initially occupied by a single incumbent who has an incentive to prevent all entry alone when SAs are not allowed. As our example shows, in that case they may well be procompetitive.

In the above example, starting with a single incumbent, the final market structure is a monotone function of the discount factor. However, this is not a general result. For instance, if $\pi(1) = 12$, $\pi(2) = 4$, and $\pi(3) = 1$, and SAs are formed, the final market structure will be a monopoly for $0 \leq \beta \leq 2/3$, duopoly for $2/3 < \beta < 4/5$, a monopoly for $4/5 \leq \beta \lessapprox 0.87$, and three firms for $0.87 \lessapprox \beta < 1$.[10] In addition to affecting the discounted sum of interim profits, β affects the cost of entry deterrence. When $m = \overline{m} - 1$, an increase in β always implies that entry deterrence becomes more costly for the incumbents. But when $m < \overline{m} - 1$, an increase in β may also reduce the price of new units as it increases the cost of entry deterrence for future incumbents and hence reduces the value of new units for potential entrants. As a result, the final market structure can change non-monotonically and abruptly as the discount factor increases.

4 Conclusions

We have analyzed strategic alliances involving joint capacity acquisition. An often expressed concern is that SAs may have anticompetitive effects. While the previous

[10] Solving this example without SAs reveals that in this case SAs are procompetitive for $2/3 < \beta < 4/5$. See Appendix B for details.

literature has considered how SAs may influence competition among existing firms in a given product market, our focus has been on how SAs may influence competition by affecting the number of firms in the market. As our examples show, SAs may indeed affect the market structure this way. Furthermore, although in our model the sole purpose of SAs is to facilitate entry deterrence, in some cases banning SAs results to a more concentrated market structure than what would otherwise be the case. This result suggests that to determine whether a particular SA is anticompetitive, dynamic entry considerations should be taken into account. Consequently, it seems important to incorporate entry decisions into otherwise more elaborate analysis of strategic alliances.

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Appendix A

Proof of Proposition 1.
i) Let $\beta = 0$. Then the incumbents buy a new unit if $\pi(m) - \frac{1}{m}\pi(m+1) \geq \pi(m+1)$. By Assumption 1

$$m\pi(m) > (m+1)\pi(m+1) \Leftrightarrow \pi(m) - \frac{1}{m}\pi(m+1) > \pi(m+1).$$

ii) If the SA obtains a unit in any given period, the number of incumbents remains unchanged. Hence, the incumbents' and the entrants' valuations remain the same in the following period.
iii) The price of a unit equals its equilibrium value to an entrant. Consider a situation where up to period $t-1$ new capacity units go to entrants and from period t onwards the m incumbents always obtain the unit that becomes available. Then the continuation payoff in each period from t onwards is the same, say V^*. The value of a unit for an entrant in period $t-s$, with $1 \leq s < t$, is

$$F_{t-s} = \pi(m-s+1) + \beta\pi(m-s+2) + ... + \beta^{s-1}\pi(m) + \beta^s V^*.$$

The value of a unit for an entrant in the following period is

$$F_{t-s+1} = \pi(m-s+2) + \beta\pi(m-s+3) + ... + \beta^{s-1}(\pi(m) - d(m)) + \beta^s V^*.$$

Since

$$\begin{aligned} F_{t-s} - F_{t-s+1} &= [\pi(m-s+1) - \pi(m-s+2)] + \beta[\pi(m-s+2) - \pi(m-s+3)] \\ &\quad + ... + \beta^{s-1}d(m) > 0 \end{aligned}$$

it follows that the price is decreasing for all $1 \leq s < t$. ■

Proof of Proposition 2. Let the number of incumbents, m, be $\overline{m} - s$. The first claim is that if Assumption 2 is satisfied each new unit goes to an entrant for all $1 \leq s \leq \overline{m} - 2$. The proof is by induction. Assume first that $s = 1$. Assumption 2 implies

$$\pi(\overline{m}) > \pi(\overline{m} - 1) - \frac{\pi(\overline{m})}{1-\beta}.$$

A new firm will enter the market if none of the incumbents has an incentive to prevent entry alone. This happens if

$$\frac{\pi(\overline{m})}{1-\beta} > \frac{\pi(\overline{m}-1) - \frac{\pi(\overline{m})}{1-\beta}}{1-\beta}.$$

Assume then that the claim is true for $s = k$. Then

$$V(\overline{m} - k) = \sum_{t=1}^{k} \beta^{t-1} \pi(\overline{m} - k + t) + \frac{\beta^k \pi(\overline{m})}{1-\beta}. \tag{A1}$$

Consider then $s = k + 1$. Assumption 2 implies

$$(2-\beta)\left[\sum_{t=1}^{k+1} \beta^{t-1} \pi(\overline{m} - (k+1) + t) + \frac{\beta^{k+1} \pi(\overline{m})}{1-\beta}\right] > \pi(\overline{m} - (k+1)). \tag{A2}$$

An entrant obtains the available unit if

$$\pi(\overline{m} - k) + \beta V(\overline{m} - k) > \frac{\pi(\overline{m} - k - 1) - (\pi(\overline{m} - k) + \beta V(\overline{m} - k))}{1-\beta},$$

which upon rearranging becomes

$$(2-\beta)\left[\pi(\overline{m} - k) + \beta V(\overline{m} - k)\right] > \pi(\overline{m} - k - 1).$$

Taking into account (A1) and rearranging this becomes (A2).

Consider then the monopolist. No new firms enter the market if

$$\frac{\pi(1) - (\pi(2) + \beta V(2))}{1-\beta} \geq \pi(2) + \beta V(2). \tag{A3}$$

Given the result above,

$$\pi(2) + \beta V(2) = \sum_{t=1}^{\overline{m}-1} \beta^{t-1} \pi(1+t) + \frac{\beta^{\overline{m}-1} \pi(\overline{m})}{1-\beta}.$$

Rearranging terms in (A3) gives

$$\pi(1) \geq (2-\beta)\left[\sum_{t=1}^{\overline{m}-1} \beta^{t-1} \pi(1+t) + \frac{\beta^{\overline{m}-1} \pi(\overline{m})}{1-\beta}\right].$$

The statements about the price sequences follow directly from the evolution of the market structure in the two cases. ■

Appendix B

Consider a market where $\overline{m} = 3$ and $\pi(1) = 12$, $\pi(2) = 4$, and $\pi(3) = 1$. If the incumbent firms may form a SA in order to jointly acquire new available capacity units, $d(2) = \frac{1}{2}V(3) = \frac{1}{2}\frac{\pi(3)}{1-\beta}$. A duopoly will acquire the new capacity unit in each period if

$$\pi(2) - \frac{1}{2}\frac{\pi(3)}{1-\beta} \geq \pi(3).$$

Hence, if $\beta \leq 5/6$, a duopoly will acquire new units and $V(2) = \frac{1}{1-\beta}(\pi(2) - d(2))$. If $\beta > 5/6$, the new unit goes to an entrant and $V(2) = \frac{\pi(3)}{1-\beta}$.

A monopolist will prevent entry if inequality (3) in Section 3 is satisfied. Now we have two different cases. If $\beta \leq 5/6$, a duopoly will prevent further entry. In this case, solving (3) for β shows that a monopoly will prevent entry if $\beta \leq 2/3$ or if $\beta \geq 4/5$. If $\beta > 5/6$, a duopoly does not prevent entry. Then (3) becomes

$$\pi(1) \geq (2-\beta)\left(\pi(2) + \frac{\beta\pi(3)}{1-\beta}\right).$$

This condition is satisfied if $\beta \lessapprox 0.87$. Hence, for $\beta \gtrapprox 0.87$, the final market structure consists of three firms.

Consider then the case when SAs are not allowed. Straightforward calculation verifies that if $\beta > 2/3$, the profit function satisfies Assumption 2. Then, if the market is occupied by a duopoly no firm has an incentive to buy out new capacity units alone. For a monopolist this situation is identical to the one where SAs are allowed and $\beta > 5/6$. Consequently, if $\frac{2}{3} < \beta \lessapprox 0.87$, all entry is prevented by a monopoly. If $\beta \gtrapprox 0.87$, neither a monopolist nor the firms in a duopoly have an incentive to buy new capacity units and the final market structure will consist of three firms.

The following table presents the final market structure in all the cases analyzed above.

Table 1: Final market structure as a function of the discount rate.

β	$0-2/3$	$2/3-4/5$	$4/5-5/6$	$5/6-0.87$	$0.87-1$
SAs	1	2	1	1	3
No SAs	-	1	1	1	3