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On the effects of mergers on equilibrium outcomes in a common property renewable asset oligopoly

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ABSTRACT

This paper examines a dynamic game of exploitation of a common pool of some renewable asset by agents that sell the result of their exploitation on an oligopolistic market. A Markov Perfect Nash Equilibrium of the game is used to analyze the effects of a merger of a subset of the agents. We study the impact of the merger on the equilibrium production strategies, on the steady states, and on the profitability of the merger for its members. We show that there exists an interval of the asset's stock such that any merger is profitable if the stock at the time the merger is formed falls within that interval. That includes mergers that are known to be unprofitable in the corresponding static equilibrium framework.

1. Introduction

It is well known since Salant et al. (1983) that a merger of a subset of the players acting to maximize the joint profits of the subset in a static quantity-setting oligopoly is not necessarily profitable. In fact they show that in the case of linear demand and constant marginal cost no less than 80% of the players must be part of the merger if it is to be profitable. In particular, a merger of two players is never profitable unless it results in a monopoly. Subsequent generalizations have confirmed that the merger must always involve a significant share of the market in order to be profitable for its members.[1]

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[1] Such a generalization is provided, among others, by Gaudet and Salant (1991), who analyze in a very general framework the profitability of an exogenous reduction of production by a subset of the firms in an oligopoly, mergers being a particular case of this. Following the paper by Salant et al. (1983), a number of authors have used the same basic oligopoly theory framework to extend the analysis of mergers in various ways. To name a few, Perry and Porter (1985) allow for identical increasing marginal cost; Deneckere and Davidson (1985) assume price competition in an industry of firms producing symmetrically differentiated products; Farrell and Shapiro (1990) introduce general cost functions that differ amongst firms and allow for cost synergies; McAfee et al. (1992) assume that the firms produce a homogeneous product to serve spatially differentiated markets (and hence different "delivered" constant marginal costs) and engage in price discrimination; Kamien and Zhang (1990) develop a two-stage merger game to endogenize the merger

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The reason is that, in a situation of strategic substitutes, the firms outside the merger react to the joint reduction of output by the members of the merger by increasing their own output. The resulting aggregate effect on industry output will be positive, and hence the effect on price negative, unless the proportion of insiders is large enough for their reduction of output to compensate the increase of output by the outsiders.

The purpose of this paper is to reexamine the effect on the equilibrium strategies and on profit of a similar merger in the context of a dynamic common property resource oligopoly. In the pre-merger equilibrium a fixed number of firms are assumed to exploit a renewable resource stock under common property and sell their product on an oligopolistic output market. In such a dynamic context each firm benefits from two sources of rent: the rent due to its oligopolistic market power on the output market, as in the purely static framework of Salant et al. (1983), and the rent due to its access to the common resource stock. That stock is an asset which, if left unexploited, reproduces itself naturally at a rate which depends on the size of the stock. The marginal value attached to this asset by the firm varies inversely with the level of the stock and is taken into account when deciding on its rate of exploitation. In such a context, the profitability of a merger will depend on the level of the common stock at the time the merger is formed. It turns out that in the presence of the resource dynamics there always exists an initial interval of the stock inside of which any merger is profitable, even a merger of two firms.

The analysis is carried out in continuous time, using a non-cooperative differential game framework (see Dockner et al., 2000). We focus on closed-loop strategies, whereby the strategy of a firm is a production rule that depends on the current stock of the asset (i.e. Markovian strategies).[2] The equilibrium of the game is very closely related to that proposed in Benchekroun (2003, 2008). Contrary to many other analyses of the exploitation of a common pool of a renewable asset, in which each agent's net benefit function depends only on the consumption of its own production, there being no interaction in the output market (see for instance Levhari and Mirman, 1980; Plourde and Yeung, 1989; Benhabib and Radner, 1992; Dutta and Sundaram, 1993a,b; Dockner and Sorger, 1996), in our model, as in Benchekroun (2003, 2008), the agents interact in the output market as well as in the exploitation of the common resource pool.[3] This is of course essential in order to analyze the effect of a merger in a dynamic context that corresponds to the static-Cournot context of Salant et al. (1983). As in Salant et al. (1983) we do not model nor address the issue of the decision to enter a merger, but simply assume the merger to be exogenously determined. Contrary to the static framework, in a dynamic setting one could raise the issues of the timing of the merger, as well as of the possibility of the merger being disbanded after some time and maybe even reformed later. We will neglect those issues here and assume that the merger is formed at the outset and is irreversible, so as to better concentrate on illustrating the contrasts with the static game and the role played by the renewability of the resource. Before concluding, we nonetheless show, via a simple example, that a profitable merger formed at the outset may indeed remain profitable forever.

The rationale behind the result that any merger is profitable within some interval of the stock rests on the fact that, in this dynamic game, an action by one of the players that changes the level of the stock has an effect on the decision of all its rivals. Indeed, since each firm conditions its production decision on the size of the stock, when a firm (or a group of firms) changes its production the other firms' production decisions will now change for two reasons: the resulting change in the market price, as in the static context, and the resulting change in the stock of the resource, which is absent in the static equilibrium. As we will show, because of the presence of this stock effect on the rivals' production there is always an interval of stock such that overall equilibrium production falls following a merger of a subset of the firms. This explains why there is always some interval of the stock within which *any* merger is profitable, even one that is unprofitable in the static-Cournot equilibrium.

We will use the term “merger” throughout, but our analysis will apply just as well to some situations of collusive behavior other than actual mergers, where a subset of the players acts to maximize their joint profits. Production cooperatives are cases in point. As pointed out by Deacon (2012, pp. 263–264), “Fisheries cooperatives often perform the same management functions that a firm's manager performs: they control aspects of members' actions in order to achieve an outcome that is superior for the group.” They do this by designating a manager to “partially control each harvester's fishing effort and structuring payoffs to provide an incentive to maximize the group's profit.” In fact, as Deacon (p. 266), also notes, citing Adler (2004), “all horizontal agreements among commercial fishermen to restrain catches have been regarded as *per se* illegal” under US antitrust policy, as are in general horizontal mergers in conventional industries. Strict application of such a policy to fisheries of course neglects the dynamics of the common resource stock which our analysis will explicitly take into account.[4] Deacon documents a number of actual fisheries cooperatives in both developed and developing

(*footnote continued*)
decision (see also Gaudet and Salant, 1992b on this); Gaudet and Salant (1992a) consider the case of producers of perfect complements competing in price. Although those papers each propose some form of extension or generalization, the insight of Salant et al. (1983) generally reemerges in some way.

[2] Open-loop strategies, whereby the firms commit at the outset to a production path that depends only on time, are inappropriate for studying a game of exploitation of an asset under common property (see Eswaran and Lewis, 1984 or Clemhout and Wan, 1991).

[3] Some notable exceptions that take into account the competition in the output market are Karp (1992a,b), Mason and Polasky (1997) and, more recently, Fujiwara (2011) and Colombo and Labrecciosa (2013). However, they all put the emphasis on very different issues then the one that concerns us here. Colombo and Labrecciosa (2013) also make use of the same specification of the dynamics of the resource as in Benchekroun (2003, 2008).

[4] Deacon (2012) also emphasizes that antitrust policy and resource conservation work at cross purposes, since unrestricted competition for a common pool fish stock can threaten sustainability and thus harm consumers. In his very pertinent article, Adler (2004) explores the “tensions between antitrust principles and conservation of the marine commons” (p. 8) and discusses numerous cases where the conflict appears.