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Technological leadership and persistence of monopoly under endogenous entry: Static *versus* dynamic analysis ☆

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ABSTRACT

We build a dynamic oligopoly model with endogenous entry in which a particular firm (leader) invests in an innovation process, facing the subsequent entry of other firms (followers). We identify conditions that make it optimal for the leader in the initial oligopoly situation to undertake pre-emptive R&D investment (strategic predation) eventually resulting in the elimination of all followers. Compared to a static model, the dynamic one provides new insights into the leader's intertemporal investment choice, its optimal decision making, and the dynamics of the market structure over time. We also contrast the leader's investment decisions with those of the social planner.

1. Introduction

Is monopoly an environment conducive to innovation? Is there persistence of monopoly, or is there a change in the identity of the innovating firm (“leapfrogging”)? These questions are not new among economists, but recently they seem to have been rekindled. In an issue of The Economist (2004), the authors of the already-celebrated column “Economics Focus” in their provocatively-entitled article “Slackers or Pace-Setters: Monopolies may have more incentives to innovate than economists have thought” claimed that monopolies may have a far more prominent role in generating innovation than previously thought. The authors further expressed doubts about the prevailing economic theory according to which “a monopolist should have far less incentives to invest in creating innovations than a firm in a competitive environment.” Apparently, there is some controversy regarding the role of market power and monopolies in creating innovations, and the key to its resolution lies in the understanding of the underlying incentives to engage in innovation.

☆ Professor Vinogradov sadly passed away shortly after the final version of the paper has been completed. We respectfully dedicate this paper to his memory.

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Recent empirical evidence seems to support these Schumpeterian allegations from The Economist: There is a positive relationship between market power and the intensity of innovation (see, for instance, Blundell et al., 1999; Carlin et al., 2004; Aghion and Griffith, 2004). Commenting on this empirical evidence (Etro, 2004) stated that it "is consistent with pre-emptive R&D investment by the leaders" (p. 282). In other words, there will be only one firm at the end of the day, but this firm would display far more competitive behavior than the standard monopolist; it would generate a higher flow of R&D, charge a lower price, and produce more. As a consequence of such strategic behavior, the Chandlerian phenomenon of the persistence of monopoly can arise.[1]

There are many real-world examples of monopolistic or dominant firms that are technological leaders and that invest more in innovation and R&D than their rivals (see Etro, 2004), and that survive over a long period of time. AT&T, a giant American telecommunications company, is a good case in point. Founded in 1885, the company is one of the largest telephone companies and cable television operators in the world. AT&T provides voice, video, data, and Internet telecommunications services to businesses, consumers, and government agencies. After becoming the first long-distance telephone network in the US, AT&T made huge investments in research and development. As a result, the company obtained near-monopoly power on long-distance phone services. Heavy investments in R&D together with aggressive behavior on the market allowed AT&T to acquire crucial inventions and to spread its near monopoly power to other markets. The company both bought patents for significant innovations and undertook innovations itself.[2]

The above observations on the relations among innovation, technological leadership, and market power motivate our paper in that we aim to describe and analyze a particular setup in which a persistence of monopoly can arise in the long run. More specifically, we study the situation in which the technological leader facing endogenous entry may undertake pre-emptive R&D investment (or, in our words, may adopt strategic predation), that eventually leads to the exit of the follower firms and/or prevents or limits the entry of new firms. We contrast this situation with one in which the leader (within the same setup) accommodates the endogenous entry of followers, that is, co-exists with the followers in an oligopolistic market structure. This comparison will enable us to study both positive aspects of the two main strategies of accommodation and strategic predation (for instance, which strategy yields higher R&D intensity), and normative aspects (social welfare implications) of the two resulting market structures: oligopoly *versus* (constrained or unconstrained) monopoly and their respective performances *vis-à-vis* a social planner. The latter aspect, as we will see, carries important policy implications.

Our paper is related to a recent stream of industrial economics literature on endogenous entry (see, for instance, Etro, 2004, 2006, 2007; Erkal and Piccinin, 2007; Davidson and Mukherjee, 2008; Creane and Konishi, 2009). For instance, both Etro (2006, 2007) and Creane and Konishi (2009) examine, among other things, both positive and social welfare effects of strategic predation that a technological leader may exhibit when faced with endogenous entry and exit. In modelling those features they rely on a three- or two-stage version of the static Cournot oligopoly. The novel feature of our approach, however, is that we utilize an explicit dynamic model in tackling these issues and contrast it with its static (or quasi-dynamic) counterpart. This comparison can be considered as the topic *per se* of our paper. Since strategic innovations and entry are inherently dynamic phenomena, we argue that a suitable model aimed at capturing both accommodating and pre-emptive, or predatory, behavior of the dominant firm should be explicitly dynamic. Furthermore, to emphasize the role of the technological leader we assume that the leading firm is the only one that invests in innovation.

The concept of two-stage competition used to be a typical tool to tackle standard strategic interactions like the case when the incumbent firm undertakes a strategic investment in the first stage and then there is competition in quantities or prices in the last, second stage. This concept concentrates on identifying "strategic effects" that influence first-period behavior and aims to characterize the resulting strategic rivalry. It has proven successful in that the same strategic principles (e.g., overinvestment or underinvestment) apply in many economic environments, and the comparative static results from static oligopoly theory can be used to provide information about strategic behavior (see Fudenberg and Tirole, 1984; Tirole, 1988; Shapiro, 1989; Etro, 2004, 2006).[3]

Adding endogenous entry in the above two-stage framework, however, would require an in-between (second) stage of the game that allows the competitors to decide whether to enter the market or not after they observe the strategic move (R&D investment) on the side of incumbent (leader) firm in the first stage. Thus, our static benchmark game will be, in fact, a three-stage Cournot game in which one firm ("leader") has a strategic advantage in the form of a prior (first-stage) investment in R&D that leads to a unit cost decrease. In the last (third) stage the leader and followers compete in quantities.

The concept of a two-stage (or multi-stage) oligopoly game relies, however, on an artificial time structure and neglects potential intertemporal tradeoffs. From the perspective of a full-fledged dynamic model, it gives at best the steady state values of the true underlying dynamic game. Thus, it neglects the dynamic adjustment process and lacks the explicit motion of the strategic variables over time and their accompanying comparative dynamics. More importantly, the set of strategies available to firms may be richer than in the corresponding static model. In particular, the leader may go for early

[1] See Sutton (2007) for the theoretical and empirical issues concerning the measurement of the persistence of market leaders.

[2] For instance, during the early 1920s, AT&T bought Lee De Forest's patents on the "audion", the first triode vacuum tube, which let it enter the radio business. On the other hand, the first commercial communications satellite, Telstar I, was commissioned by AT&T in 1962.

[3] Etro (2006), however, demonstrated that allowing for endogenous entry dramatically simplifies the taxonomy of business strategies since all that matters is whether strategic investment hurts the incumbent.