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Network effects, market structure and industry performance ☆

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Abstract

This paper analyzes oligopolistic markets with network externalities. Exploiting a minimal complementarity structure on the model primitives that allows for pure network goods, we prove existence of non-trivial fulfilled-expectations equilibrium. We formalize the concept of industry viability, investigate its determinants, and show that it improves with more firms in the market and/or by technological progress. These results enlighten some well-known conclusions from case studies in the management strategy literature. We also characterize the effects of market structure on industry performance, which depart substantially from ordinary markets. The approach relies on lattice-theoretic methods, supplemented with basic insights from nonsmooth analysis.

JEL classification: C72; D43; L13; L14

Keywords: Network goods; Demand-side externalities; Industry viability; Industry start up; Supermodularity

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1. Introduction

It has often been observed that the nature of competition is qualitatively different in network industries. The presence of interlinkages in consumers' purchasing decisions induces demand-side economies of scale that may strongly affect market behavior and performance. When such effects prevail, be they of the snob or bandwagon type, purchase decisions are influenced by buyers' expectations, leading to behavior not encompassed by traditional demand theory (Veblen [38], Leibenstein [22]). From an industrial organization perspective, these distinctive features raise new questions and impose some methodological challenges. In their pioneering work on markets with network effects, Katz and Shapiro [19] proposed the concept of fulfilled expectations Cournot equilibrium (FECE), which was adopted by some of the early literature. This has led to a number of results that distinguish network markets from ordinary ones.[1]

The purpose of the present paper is to provide a thorough theoretical investigation of markets with homogeneous goods and network externalities. We consider oligopolistic competition amongst firms in a market characterized by positive (direct) network effects when the products of the firms are perfectly compatible, so that the relevant network is industry-wide. This is motivated by both positive and normative considerations. In terms of the former, several important industries fit the perfect compatibility framework, in particular those in the telecommunications sector, such as fax, telephone, the Internet, but also many classical industries such as compact discs, fashion and entertainment.[2] More important are the normative grounds, which stem mainly from the critical problem of industry take-off that new network goods are confronted with. A single (industry-wide) network is a crucial element in surmounting the take-off hurdle, or at least in avoiding potentially long delays before achieving success (Shapiro and Varian [31]). Indeed, the business strategy literature has concluded, through a number of detailed case studies dealing with the emergence of particular industries in the last thirty years, that interconnection amongst all the firms in a network industry (i.e., a single network) is probably the most important ingredient for success in launching a new network product (Rohlfs [29]). Thus a good understanding of the single network case will shed quite some light on the incentives for compatibility faced by firms and consumers in the case of firm-specific networks. We shall return to this key point several times below.

In contrast to the extant literature, this paper considers general demand functions with non-separable network effects, a critical feature if one wishes to capture pure network goods (those with no stand-alone value, such as most telecommunication products), and the so-called feature of demand-side increasing returns (see assumption ($A5$)). With pure network goods, the trivial outcome of zero output is always a self-fulfilling equilibrium, since there will be no actual demand if the market expectation is that there will be no eventual sales (in other words, nobody wishes to be the only person around owning a phone, say). In view of this, the industry will fail to take off at all if this is the only equilibrium, but might also end up coordinating on this worst possible outcome when other equilibria are present. In a nutshell, this is the so-called industry viability problem, a general treatment of which is the central concern of this paper. To this end, an important pre-requisite is a good understanding of the issues of existence and multiplicity of

[1] See Economides and Himmelberg [14], Economides [13], Shy [33], and Kwon [21]. In contrast, the earlier literature in management science relied on dynamic models with no expectations, e.g., Oren and Smith [27] and Dhebar and Oren [11]. See also Bensaid and Lesne [6] and Chen et al. [10], among others.

[2] In some industries, each customer may have in mind his own social network only, not the overall network, when making a purchase decision, but we follow the literature in industrial organization in ignoring this distinction.