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Positive and negative feedback effects in competition for dominance of network business systems

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ABSTRACT

This paper extends the existing research on the interplay of positive and negative feedback dynamics in the competition for business system dominance. By building on an analysis of the digital television launch in the United Kingdom, we find that the expectation of network externalities intensifies competition causing strong negative feedback effects to emerge. Actions aimed at improving one's position are systematically imitated and pre-emptied. Pressure builds up in the business system, and only when the weakest firms exit, the positive feedback effects are unleashed in their full magnitude. Our findings contribute to an improved understanding of institutional dynamics in new technology introduction.

1. Introduction

The emergence of strategic networks in many industries makes it is increasingly important to understand their role in shaping competition and industry evolution (Gulati et al., 2000; Jacobides et al., 2006). Earlier research has recognized the importance of positive and negative feedback effects. Yet, the role of temporal and contextual factors in relation to these effects has not received much attention (Suarez, 2004). Understanding how multiple, overlapping networks interact and how their interaction is tied to the evolution of an industry is a major, but neglected area of study (Powell et al., 2005).

Research has witnessed how positive feedback and increasing returns shape network growth (e.g. Arthur, 1989), but the co-existence of competitive pressures and negative feedback have received less attention. While there is considerable amount of conceptual work that demonstrates the role of network effects in shaping technology adoption and industry evolution (Arthur, 1989; Church and Gandal, 1992; Katz and Shapiro, 1985, 1986, 1992; Oren and Smith, 1981; Suarez, 2004), research on networks has so far not addressed the simultaneous interaction of positive and negative feedback dynamics and their joint effects.

This paper examines the implications of multiple positive and negative feedback loops and the continuous managerial sense-making of the competitive situation (Weick, 1995). Our approach is consistent with the Suarez's (2004) integrative framework on technological dominance. Suarez divides the progress towards dominance to five phases: R&D build-up, technical feasibility, market creation, decisive battle, and post-dominance (Suarez, 2004). We focus on the three last phases. Our analyses also parallel and extend the recent research on the role of complementary relationships in the evolution of business systems (e.g. Teece, 2007; Venkatraman and Lee, 2004).

Since calls have been made in the network externality literature to provide an improved understanding of the relative importance of various determinants of competition (Suarez, 2004), the relationships among different types of participants (Gupta et al., 1999; Venkatraman and Lee, 2004), and the nature of their conduct (Majumdar and Venkataraman, 1998; Gallagher and Park, 2002), we perform a detailed empirical analysis of an intensive competitive episode in a networked business system. We focus on the introductory phase competitive dynamics of the digital television broadcasting business system in the United Kingdom.

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Our results support earlier findings that markets tend to act speculatively in a network externalities context (e.g. Besen and Farrell, 1994), but contrasts with the view of how the expected mechanisms actually work. We find that previous network externality modelling attempts have not fully captured how competitors' perceptions determine the "rules of the game" (Porac et al., 1995). It has been suggested that network externalities lead to rapid market "tipping" in which an early leader firm quickly gains an advantage, that is adoption rates increase significantly, because potential adopters strongly favour a firm which is seemingly winning the competition (e.g. Besen and Farrell, 1994).

In our analysis, we find that firms indeed anticipate others' actions and change their own behaviour, with significant implications for the competitive outcomes. Our analyses illustrate, however, that positive and negative feedback effects can have a mutually strengthening role. The feedback effects operate on both micro- and macro-levels supporting the view that the resulting industrial dynamics are not only an outcome of micro-level processes, but also of the system-level features, mainly the shared view of competition. This causes the micro-level processes of diffusion and adaptation interact with the macro-level processes of crowding and attrition.

Thus, we find that the observable dynamics are driven by the interplay of micro- and macro-level processes. In the short term, the shared expectations of positive feedback intensify competition, causing strong negative feedback. Actions aimed at improving one's own position are systematically pre-empted (e.g. Derfus et al., 2008). However, in the long run, as the weakest firms exit after a resource-draining competition, the positive feedback effects are fully unleashed.

In our analysis of the digital television launch, the intense, resource-draining competition resulted in high aggregate adoption rates that further increased the attractiveness of the market. Yet, as the attractiveness of the market increased, the loss-generating competition amongst the major firms posed a dilemma for managers when they tried to weigh the negative aspects of the competitive pressures and the positive aspects of the fast-growing business. Each of them had to construct an external image of themselves as the winner of the "winner-takes-it-all" market, but in order to stay in the game they also had to believe in that external image, because otherwise the optimal strategy would have been to exit the market early in order limit losses. Thus, the reasons for selecting ex-post inappropriate competitive strategies can be understood in terms of the different firms' cognitive construction of the market and their own capabilities (Derfus et al., 2008; Rindova and Fombrun, 1999). The competitive process and the outcome were unintended results of collective actions of competitive, even antagonistic rivalries (Hargrave and Van de Ven, 2006).

The paper proceeds as follows. In the next section, we review the related research on the topic. Section 3 discusses the choice of research method and the reasoning for the choice of our case study. Section 4 provides a longitudinal analysis of the digital business system competition. Finally, Section 5 provides a discussion of our results and directions for further research.

2. Theory review

We review research on the determinants of competitive actions and success in a networked business system. We start by addressing the positive feedback effects, commonly examined in evolutionary theory, institutional theory, diffusion theory, and the network externalities research. Subsequently, we address negative feedback effects, commonly examined in the economics, population ecology, and competitive dynamics research streams.

2.1. Positive feedback

Evolutionary theories investigate how variation, selection and retention shape firms and their routines (Aldrich, 1999; Nelson and Winter, 1982). Non-successful routines, and even whole firms, may disappear because of an evolutionary selection process and the successful ones are carried forward. Routines are often idiosyncratic, and imitation from one firm to another may be difficult (Nelson and Winter, 1982).

Evolutionary theories and the concept of routines are quite closely related to the resource-based view and the concept of resources (Barney, 1991; Helfat, 2000; Helfat and Peteraf, 2003; Peteraf, 1993; Teece et al., 1997; Winter, 2000). According to the resource-based view of the firm, firms can be seen as bundles of idiosyncratic resources (Barney, 1991; Penrose, 1959). Learning processes recombine existing resources to create new knowledge that forms a basis for future growth (Penrose, 1959). The processes of recombination often make learning take place in a path-dependent manner (Kogut and Zander, 1992), which may be further reinforced by different kinds of positive feedback dynamics (Prahalad and Hamel, 1990).

Research on the evolution of institutions (Nielsen, 2001; Powell, 1998) has similarly investigated how the patterns of behaviour, social rules and conventions, "habits", and "social technologies" evolve in a path-dependent manner, and diffuse from one organization to another (DiMaggio and Powell, 1983; Hodgson, 2003; Meyer and Rowan, 1977; Nelson, 2002; Nelson and Sampat, 2001; Powell and DiMaggio, 1991). Diffusion is a social process that often incorporates some form of path dependency and positive feedback (Rogers, 1995). Also, the research stream focusing on network externalities (or network effects) can be seen as part of diffusion research as it focuses on the dynamics of adoption in the specific context of networks.

Network externalities were first introduced by Rohlfs (1974) in an article on the demand for communications services. Network externalities are commonly divided to direct and indirect network externalities. Direct externality occurs when the number of users *directly* influences a product's utility as, for example, the number of telephone owners in a telecommunications network (Katz and Shapiro, 1985). For a potential adopter, the utility distribution depends on network externalities. Thus, evaluation of the state of the network leads either to adoption or rejection (Farrell and Saloner, 1986). Indirect externalities are present when the demand for a product is *indirectly* affected by the availability of complementary products (Katz and Shapiro, 1985). Industries where indirect network externalities have been identified include the personal computer, music, and television and broadcasting industries (Gandal et al., 2000; Gupta et al., 1999; Katz and Shapiro, 1992, 1994; Le Nagard-Assayag and Manceau, 2001).

Positive feedback effects may end up magnifying small historical events occurring by change in the development of an industry (Arthur, 1989; David, 1985). Path-dependence, network interdependency, and high adoption rates after the critical mass has been reached may create strong incentives to dominate the market and use first-mover strategies with the expectation of a "winner-takes-it-all" situation (Besen and Farrell, 1994; Dickson et al., 2001; Katz and Shapiro, 1986; Lieberman and Montgomery, 1998; Shapiro and Varian, 1999a). Network externalities may also create expectations for a dominant design, for example, the emergence of a standardized product architecture (Tegarden et al., 1999). Expectation of a "winner-takes-it-all" situation increases the incentives to manage, or even manipulate, the expectations of the participants by product announcements and other public statements providing favourable information on the future state of the firm and its products (Besen and Farrell, 1994; Dickson et al., 2001; Katz and Shapiro, 1986;