Extent of Network Effects and Social Interaction Effects

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INTRODUCTION

In economics and management science, there has been increasing interest in network effects and social interaction effects.

Network effects occur when to an economic agent (e.g., a consumer of a firm), the utility of using a product or technology becomes larger as its network of users grows in size (Farrell & Saloner, 1985; Katz & Shapiro, 1985). The network effect may set in motion a positive feedback loop that will cause a product or technology to become more prevalent in the market.

Social interaction effects occur when an economic agent's preference for a product or technology is dependent upon the opinions or expectations of other economic agents. The social interaction effect may set in motion a positive feedback loop that will cause agents to expect that a certain product or technology will become more prevalent in the market.

In markets, network effects and social interaction effects appear for example in the emergence of fashions and fads (e.g., Abrahamson & Rosenkopf, 1997; Bikhchandani, Hirschleifer, & Welch, 1992) and in technology adoption and standardization (e.g., Arthur, 1989; Katz et al., 1985). Theory and existing research suggest that the presence of network effects and social interaction effects in markets has important implications for market structure, for market outcomes and, as a consequence, for the behavior and the performance of firms that are active in those markets (e.g., Arthur, 1996; Schilling, 1998; Shapiro & Varian, 1999).

An important question is therefore under which conditions these network effects and social interaction effects occur in markets.

BACKGROUND

These conditions can be derived from the literature on increasing returns and from the lists of market conditions provided by Scherer and Ross (1990) and Carlton and Perloff (2000). The most important influencing conditions are (Den Hartigh, 2005):

- The *marginal economic gains of network size* (i.e., the additional economic utility of adding one extra adopter to the network).
- Kretschmer, Klimis, and Choi (1999) point out that actors in networks are characterized by (a) *conformity*, which means that there are positive marginal social gains of an increase in network size and (b) *individuality*, which causes negative marginal social gains in response to an increase in network size.
- Abrahamson et al. (1997) show that the *structure of the social network* (network density and network idiosyncrasies) is an important determinant of the extent of innovation diffusion.
- The *nature of the product* (i.e., consumer or industrial product, tangible or intangible product, durable or non-durable product, technology intensity of the product).
- Technology *complementarity* will further extend the possibilities for indirect network effects.
- *Substitution* means that products are competitive, so that a consumer will have either one product or the other. This means a limitation to the network effect.
- *Compatibility* one of the most important conditions for a technology network to materialize and therefore one of most important conditions for economic and social network effects to occur.

These conditions will be discussed next.

MAIN FOCUS OF THE ARTICLE

Marginal Gains of Network Size

The scope of network and social interaction effects is limited by the marginal economic gains of network size.

That is the additional economic utility of adding one extra adopter to the network. Usually, these marginal gains are assumed to be positive up to the point where the entire market is satisfied. Liebowitz and Margolis (1994) argue, however that we may very well conceive of a point at which the marginal economic benefits of increasing the number of adopters are exhausted (e.g., by crowding of the network or by customer preferences for more heterogeneity (Hellofs & Jacobson, 1999; Katz & Shapiro, 1994). Further, while many technologies require critical mass, they may not be helped by further participation beyond that level. Where marginal gains of network size are exhaustible at network sizes that are small relative to the market, there is no impediment to the coexistence of multiple networks (Liebowitz et al., 1994, p. 141).

Conformity and Individuality

Kretschmer et al. (1999) point out that networks are characterized by two competing psychological drives. The first is that of conformity, which means that there are positive marginal social gains of an increase in network size. This is also known as the bandwagon effect (Leibenstein, 1950). The second is that of individuality, which causes negative marginal social gains in response to an increase in network size. This is also known as the snob effect (Leibenstein, 1950).

The characteristics of the customer population may therefore be an important accelerator or limiter of social interaction effects. As most modern consumer markets are characterized by increasing heterogeneity of consumer behavior (Van Asseldonk, 1998), we would expect that customer individuality is a limiting factor to network size. If everybody wants to be different and unique, network size would be close to unity. Still, this is apparently not the case in many technology networks. The caveat lies in the distinction between the product and the technology. At the level of the technology, there is clearly a drive for conformity (i.e., we buy a "*Wintel*" computer because we want to be able to connect easily to others and to the market for complementary products). At the level of the product, however, there is clearly a drive for individuality (i.e., based on the "*Wintel*" standard, the choice of different computer models and features is larger than ever.

Degree and Structure of Economic and Social Interdependence

Another important aspect of the network and social interaction effect is the degree and the structure of economic and social interdependence between economic agents, customers, as well as suppliers. Abrahamson et al. (1997) show that the structure of the social network is an important determinant of the extent of innovation diffusion. They show first that a network with a higher density results in a higher extent of diffusion of an innovation (i.e., more agents within the network eventually adopt this innovation). Second, perhaps even more interesting, they show that network idiosyncrasies (i.e., the location of agents in the network who form a boundary between the fully connected network core and a not fully connected network periphery) can have a large influence on the extent of innovation diffusion.

Different forms of connections between economic agents can be distinguished in markets. First, there is the interaction between suppliers and customers. These interactions involve the buying or selling of products in exchange for money, the after-sales service trajectory, and communication in the sense of information provision, advertising, promotions, and signaling. Second, there are the mutual interactions between suppliers. These involve interactions between technology sponsors (e.g., head-on competition, coalition forming, R&D alliances, or joint ventures, interactions between sponsors and licensees (e.g., buying or selling of licenses), commitments to investing in technology, commitments to develop products or provide services based on this technology, and interactions between sponsors and firms that have not decided yet (e.g., signaling or manipulation of expectations). Third, there are the mutual interactions between consumers. These involve direct interactions through the products in the network (e.g., connecting computers, exchanging files, and communicating by phone, fax, e-mail, newsgroups, chat sessions or internet search, information exchange behavior (e.g., information search, opinion leadership, role models, or word of mouth), and finally, formation of expectations.

An important aspect of the structure of social and economic networks is whether they are local or global (Bikhchandani et al., 1992; Redmond, 1991). A global network effect means that consumers are in-

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