

# Network Effects in the Mobile Communications Industry: An Overview

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## 1. Introduction

Information technology (IT) markets, in general, and mobile telecommunications, in particular, represent a large and growing portion of today's economy. They are one of the main sources of economic growth in modern economies (Greenspan 2000) and provide the basis for the development of a knowledge-centric world. The rapid development of these markets and the central role that they play in the economy have attracted the attention of a large number of researchers who have shifted their emphasis from traditional markets to the so-called New Economy. When dealing with these markets, however, it is important to understand that they are governed by a unique set of characteristics that may render well-established principles and managerial practices invalid (Shapiro and Varian 1998).

One of the most significant distinctive features of these markets is the central role played by the network of users. In IT markets, customers derive utility not only from the product/service itself, but also from the networks surrounding these products (Frels, Shervani, and Srivastava 2003). This is because the installed base of users offers benefits to existing and potential customers in the form of reduced uncertainty, compatibility, the transfer of technical and non-technical information between members of the network and the increased availability and quality of complements, among others (Farrell and Klemperer 2007). This feature explains why IT markets are frequently referred to as network markets (Shankar and Bayus, 2003; Tanriverdi and Lee, 2008). Mobile communications, video games and software are just three examples of businesses where network effects drive market competition and consumer behavior. The network of users becomes a central strategic asset for assessing the firm's current and future competitive position (Shankar and Bayus 2003; McIntyre and Subramaniam 2009) and, as a result, the understanding of network effects has become a top priority for researchers and practitioners alike.

The previous discussion can help explain why network effects have emerged as a trendy topic in recent years in economics and management literatures. This research stream focuses on understanding how network effects alter the way in which firms compete. This increasing interest is due to the evidence that network industries seem to challenge much of

the thinking derived from previous models and findings (Shapiro and Varian, 1998; Suárez, 2005). We can observe a trend toward examining value creation in IT markets on the basis of the interdependencies that exist within a market. This trend has intensified in recent years with the proliferation of social networks and other new media that have resulted in an increasingly networking society where individuals can easily interact with each other. In this new environment, a firm's success and survival critically depend on a proper understanding of how these networks operate.

In this chapter, our primary objective is to provide an overview of the current state of the networks effects literature highlighting their role in the mobile communications industry in order to gain a better understanding of one of the key forces that underlie the development of these markets. To do so, we will review the relevant works in the field of network effects and network markets, offer empirical support for the conceptual arguments and identify how network effects operate in mobile communications.

The second section of the chapter elaborates on the concept of network effects as well as on the different types of network effects that the literature has identified. Networks can be conceived as a whole – which we refer to as *direct* or *pure network effects* – in which each individual in the network contributes equally to creating value for the others. This implies that adding one customer to the market equally increases the utility of all users who are already in the network. Networks effects can also be *indirect* or *market-mediated*. In this case, the utility of each user is not directly influenced by other users consuming the good at the same time, but for the growth in the other side of the market. Recently, researchers have introduced a new category of network effects, *personal network effects*, which acknowledges that network effects may be localized (Birke and Swann, 2006; Farrell and Klemperer, 2007; Maicas, Polo and Sese, 2009a). For instance, a mobile phone user gains more when her friends join the mobile network than when a stranger does. In other words, there are different densities in the network (Ahuja, 2000) with different consequences on customer utility.

The third section of the chapter focuses on the telecommunications industry and discusses the different sources of network effects that can be identified therein. We distinguish between direct and localized network effects. Direct network effects emerge as a result of pricing strategies implemented by mobile phone carriers and based on the origin and destination of the calls (price discrimination between on-net and off-net calls). Personal network effects refer to those instances where mobile service providers offer special tariffs for calls to members of the social network (family, friends...).

Finally, we will discuss the managerial implications of network effects in mobile communications. The significant contribution of networks to the utility derived by individuals is important for firms and they have begun to strategically manage this market-based asset. For example, operators try, as mentioned, to increase the contribution of direct network effects to utility by charging different prices depending on whether the calls made by the user are directed to members of the same operator (low or on-net tariff) or to members outside the operator (high or off-net tariff). In this same context, firms aim to promote personal network effects by offering special tariffs to a group or social subset of users (e.g. customers can select five contacts to whom they can call with a reduced tariff). Overall, these strategies influence the value that users derive from the networks surrounding the product in an attempt to ultimately improve a firm's competitive position and gain competitive advantage.

## 2. Network effects: Definition and types

### 2.1 Network effects: Concept and implications for markets

In recent years, network effects have received a great deal of attention in various disciplines including economics, management and marketing (Birke and Swann 2006; Farrell and Klemperer 2007; Srinivasan, Lilien, and Rangaswamy 2004; Wang, Chen, and Xie 2010). Drawing upon these recent research developments, network effects can be defined as follows. A good exhibits network effects when the utility of a user increases with the number of other users consuming the good (Katz and Shapiro, 1985; Farrell and Klemperer, 2007). That is, this definition acknowledges that the utility of the user is driven, not only by the product itself, but, even more importantly, by the network that surrounds that product so that the larger the network, the higher the utility derived from consuming the product.

It is clear from the definition offered that network effects have significant implications for the way markets operate and firms compete. For example, when the network of users is large and consumers can derive a high utility from it, customers' willingness to pay increases, with the subsequent potential impact on firm competitive performance (Shapiro and Varian, 1998; Shankar and Bayus, 2003). Network effects can also affect the distribution of the market (consumers) across the available alternatives (companies). By having a positive effect on customers' utility functions, firms or technologies with a high market share are able to obtain a higher level of profitability (Katz and Shapiro, 1985, 1994; Farrell and Saloner, 1985; Farrell and Klemperer, 2007). Taken to an extreme, network effects may create *winner-takes-all markets*, in which one company emerges as dominant and the other firms, which may have superior products or technologies, must abandon the market (Shapiro and Varian, 1998; Liebowitz, 2002).

The key implications of network effects for competition and strategy have resulted in an increasing interest among academics and practitioners in measuring and quantifying network effects in a variety of business. However, there is a clear mismatch between the development of the theoretical and empirical work in the network effects literature (Farrell and Klemperer, 2007). From a theoretical point of view, research on network effects has mainly aimed at analysing their impact on market competition using analytic and game-theory models. Overall, these studies provide support for the notion that, when network effects are present, the firm's installed customer base can be considered a key asset to gain abnormal returns (Shankar and Bayus, 2003; Shapiro and Varian, 1998). Moreover, as noted previously, network effects may create *winner-takes-all* outcomes (Arthur, 1996).

From an empirical perspective, most studies provide support for the theoretical postulates that (1) network effects are very important in information technology markets and (2) they significantly influence market competition. For instance, Gandal (1994) analyzes the spreadsheet market and concludes that network effects are very important and that there is a prize for compatibility with Lotus. In the same market, Brynjolfsson and Kemerer (1996) find that the price of the market leader in the late 1980s was much influenced by the size of its installed customer base. More recently, Dranove and Gandal (2003) study the battle between DVD and DIVX and show that the preannouncement of a competing technology (DIVX) delayed the adoption of DVD by many consumers. Srinivasan, Lilien and Rangaswamy (2004), using a sample of 63 different office products and consumer durables, show that, in technologically intense products, increases in network externalities

are associated with increased survival duration. Overall, these studies offer empirical evidence of the significant effect of network effects on individual user behavior which, aggregated across the entire population of the market, determine the level of competition in the market.

## 2.2 Types of network effects

The attention devoted to network effects in the literature has also resulted in an increasing interest in identifying different types of network effects as a prior step to understanding their different consequences on the marketplace. The literature has traditionally classified network effects into two types: (1) direct or pure network effects and (2) indirect or market-mediated network effects.

Direct network effects are present when “adoption by different users is complementary, so that each user's adoption payoff, and his incentive to adopt, increases as more others adopt” (Farrell and Klemperer, 2007: 1974). This type of network effects is easily understood when we think of examples such as the e-mail, fax or telecommunications. Here, the technology has no value in isolation. It can only produce utility to consumers when other users adopt the technology. More formally, each user's utility function increases with the number of additional users of the technology/product, so the larger the installed user network, the higher the utility derived from the product (Katz and Shapiro, 1985). This is because a large installed base allows the firm to offer more benefits to potential customers compared to companies with smaller customer bases (Farrell and Klemperer, 2007). These benefits can take the form of reduced uncertainty, compatibility, the transfer of technical and non-technical information between members of the network and the increased availability and quality of complements. The presence of these benefits encourages consumer adoption of the product (Gatignon and Robertson, 1985; Valente, 1995) and increases its utility over and above its stand-alone product performance.

Indirect network effects arise “through improved opportunities to trade with the other side of a market” (Farrell and Klemperer, 2007: 1974). They imply that customer utility from the primary product (i.e. the hardware) increases as more complements become available (i.e. software). In turn, this availability of complementary products depends on the installed user network of the primary product (Stremersch et al. 2007). Prior research has typically referred to the primary product, such as a television set, a mobile handset or a DVD player, as “hardware”, and to the product that complements the primary product, such as television programs, mobile phone applications and music or movies, as “software”. In the presence of indirect network effects, we can observe the “chicken-and-egg” paradox (Katz and Shapiro, 1994). This happens when consumers wait to adopt the primary product until enough complements are available. At the same time, manufacturers of complements delay releasing new complements until enough consumers have adopted the product. This effect can be dangerous for the diffusion of the technology as it may delay consumer adoption and reduce the interest of manufacturers in designing and releasing new complementary products. Stremersch et al. (2007) have recently carried out an empirical application in nine indirect network effects markets with the aim of resolving the paradox and they found that hardware sales lead to software availability, and not the other way around.

An important characteristic of this first classification of network effects into direct and indirect network effects is that it gives the same weight (importance) to all the customers in the utility function. This implies that adding one customer to the market equally increases

the utility of all the users who are already in the network. However, researchers have recently recognized that network effects may be localized (Birke and Swann, 2006; Farrell and Klemperer, 2007; Maicas, Polo and Sese, 2009a). For instance, a mobile phone user gains more when her friends adopt than when a stranger does. In other words, there are different densities in the network (Ahuja, 2000) which should be taken into account to analyze user behavior. Personal or local network effects, microexternalities and strong ties are the terms used by prior research to refer to this type of network effects (Swann, 2002; Suárez, 2005; Birke and Swann, 2006).

Personal network effects explicitly take into account the differences that exist in the contribution of each network member to the utility function (Birke and Swann 2006). They refer to the utility that an individual obtains from the adoption by a given individual. This utility may be positive, neutral or negative, depending on the person that joins the network. For example, a mobile user may derive a high utility when her boyfriend or her brother joins the network, while this utility becomes zero when a stranger does. Thus, network benefits are not homogeneous (Ahuja, 2000); consumers find more benefits from interacting with their social subset than with the rest of the installed base. This quotation from the Economist in 2007 perfectly illustrates this notion:

“Although mobile phones make it easier to keep in regular touch with a wide group of friends, for example, it turns out that a typical user spends 80% of his or her time communicating with just four other people”

Finally, recent research has introduced a new concept, marginal network effects (Farrell and Klemperer, 2007), which refers to the increase in the incentives of potential users to adopt the technology as network size grows. It means that a firm with a larger network will also have a better market position, not only because of its current market share, but also because the probability of future dominance is higher. Current users will have incentives to stay within the firm’s network and the incentives of potential users will also increase.

### **3. Network effects in the mobile telecommunications industry**

Mobile communications is a paradigmatic example of an industry where network effects drive market competition. Srinivasan, Lilien and Rangaswamy (2004) suggest that mobile communications present a high degree of network effects: they rate among the highest in a list of 45 goods/services that are believed to be intensive in network effects. Previous empirical evidence in mobile communications (Kim and Kwon 2003; Birke and Swann 2006) shows clear signs of network effects, even when the networks are perfectly compatible. This is the case of the European context in which the technological standard is the same for all the operators (Gandal 2002). Birke and Swann (2006) explore the role of network effects in users’ choice of mobile service providers in the UK. They find that (1) there are direct network effects even in the absence of price differences between on-net and off-net calls and that (2) individual choice is heavily influenced by the choices made in the individual’s social network. Doganoglu and Grzybowski (2007) analyze demand for mobile telecommunications in Germany and their results suggest that network effects play a significant role in the diffusion of mobile services. Grajek (2010) acknowledges that, in spite of being crucial to the understanding of mobile communications, the empirical literature has almost completely ignored the impact of network effects on the level of industry competition. The author estimates price elasticities in the Polish market and concludes that, if we do not consider network effects, the elasticity of demand could be substantially

overestimated. Fuentelsaz, Maicas and Polo (2010) study market competition in the European mobile communications industry and find that the level of network effects shows significant differences among countries with respect to the level of competition. Maicas, Polo and Sese (2009a) investigate the role of local network effects in explaining customer choice in the Spanish mobile telecommunications industry. Their results reveal that local or personal network effects play a key role in determining mobile users' choice of supplier. In other words, the probability that a user selects a mobile service provider increases with the number of members of his social network already subscribed to that provider.

Following the classification of network effects suggested in the prior section, we can identify different types of network effects in mobile communications.

Direct network effects are present in the mobile communications industry even when the networks are perfectly compatible (Kim and Kwon, 2003; Birke and Swann, 2006). In this market, pure network effects mainly arise due to the differences between on-net and off-net tariffs (Laffont, Rey and Tirole, 1998). Operators charge different prices depending on whether the call made by the user is directed to a member of the same operator (low or on-net tariff) or is made to a member outside the operator (high or off-net tariff). These strategies aim to encourage existing customers to stay with the provider and to attract new customers because the larger the user network, the lower the average cost of the calls for their customers. At the same time, these strategies increase consumer switching costs (Maicas and Sese 2008) because leaving the company implies losing the benefits derived from making cheaper calls to the members of the same network, which reduces competition in the market and confers market power to the firms.

Indirect network effects are associated with the increase in utility derived from the availability of complements to the primary product or service (Stremersch et al. 2007). In mobile communications, as more and more individuals are interested in the technology, software manufacturers will also have higher incentives to design and release new applications, features or devices that will increase the utility of using the primary product. For example, as more and more individuals become mobile users, handset manufacturers were encouraged to introduce new devices with more complex features and with a wider range of options (front camera, GPS technology, Bluetooth technology) to increase the utility of the mobile experience.

Similar to pure network effects, in the mobile telecommunications industry, personal network effects also come mainly from pricing strategies implemented by mobile operators. In this case, the benefit for the user is not associated with the calls directed to the members of the same operator, but with the calls made to a particular group of users that constitutes her *social subset* (family, friends,...). The underlying logic is that, although all users in a network are a potential source of network effects, some users matter more than others (Birke and Swann, 2006). Thus, network benefits are not homogeneous (Ahuja, 2000) but consumers find more benefits from interacting with their *social subset* than with the rest of the installed base. Consequently, customer choice behavior will be more influenced by her *social subset* than by the rest of the users in the network. Maicas, Polo and Sese (2009a) studied the importance of personal network effects in customer choice of mobile carrier. Their results reveal that personal network effects play a key role in determining mobile users' choice: the probability that a customer selects a mobile phone company increases with the number of members of her social network already subscribed to that firm. In addition, they also acknowledge that the influence of personal network effects on choice of mobile supplier differs among consumers and, therefore, they investigate the drivers of each

customer's sensitivity to personal network effects. They find that relationship characteristics (e.g. relationship duration, service usage, cross-buying behavior) are important drivers of local network effects. Users with an intense service usage, who purchase few services from the firm and who have recently joined the company are more sensitive to local network effects. The results also show that more sophisticated users have a higher valuation of local network effects.

#### 4. Conclusion and managerial implications

In mobile communications, the user network is a critical strategic asset for assessing the firm's current and future competitive position. This is because there are strong interdependencies within the market and customers derive utility, not only from the product or service itself, but, even more importantly, from the network of users surrounding these products (Frels, Shervani, and Srivastava 2003). In today's competitive environment, one of the greatest challenges that practitioners face in mobile communications is to manage the user network optimally in order to maximize current and future profitability. In this section, based on prior research and the observation of best firm practices, we discuss some strategies that may help companies in leveraging the effect of network effects to increase firm profitability and value.

First, as we already noted, firms can implement strategies that both make existing consumers more willing to stay in the network and new customers more predisposed to join the network. This can be done, for example, by price discriminating against customers who call to other networks (off-net calls) as these calls are significantly more expensive than those made to members of the same network. Alternatively, firms can use additional incentives (e.g. promotions, rewards) to encourage customers to join the network. This increase in the size of the network will increase the probability that other users join the network in the future (marginal network effects).

In addition to increasing pure network effects, firms should pay attention to the social networks, as customers' choice has been found to be mainly driven by the behavior of their social group. Thus, in addition to implementing general strategies to promote pure network effects, firms should also develop strategies to increase personal network effects in an attempt to build a big network that is the result of many smaller social networks. To achieve this goal, the firm may, for example, offer price discounts to groups of friends and family if they all belong to the same network. The importance of these strategies that promote the building of social networks inside the company's installed base comes from empirical evidence showing that, according to the Pareto principle (or the 80-20 rule), 80% of the calls are directed to less than 20% of the people that belong to the social network.

But firms should not only rely on their strategies to manage network effects in a way that increases firm profitability. Prior research has shown that customers are very heterogeneous and that they have different sensibilities to network effects (Maicas, Polo and Sese 2009a). Thus, firms should first understand customer behavior with respect to network effects before they can design an optimal strategy to leverage the impact of network effects on firm value. For example, customer relationship characteristics, such as the mobile plan selected – prepaid vs. postpaid, minutes of use, length of the relationship, purchase of additional services or products and mobile phone bills, are stored in firms' databases and can be used to identify the profile of customers who are more sensitive to network effects. Customer

demographics or attitudinal variables can also help the company better understand the responses of customers to network effects.

In addition to firm strategies and customer behavior, the degree of competition in a market is another force that can moderate the impact of network effects on firm performance. When competition is intense, gaining market share is critical for survival because the presence of network effects increases the probability that individuals will join the firm with the largest user network. This is why we see price wars and huge investments by firms directed at expanding the customer base. Once a firm has built a large market share, it becomes one of the most critical assets of the firm. In addition to the direct benefits that the company can obtain from the large number of users of its products, the company benefits from higher acquisition rates, higher barriers to entry (it is very difficult for competitors to enter a market with network effects dominated by companies with large market shares), lower price sensitivity and increased market power.

Finally, as a result of the consequences of network effects on marketing competition, we should also consider the role played by regulatory authorities. As we have already acknowledged, the presence of network effects confers market power on firms with high market shares, allowing them to charge higher prices, reduce product or service quality, create entry barriers and, as a consequence of all this, obtain abnormal returns (Klemperer, 1987, 1995; Farrell and Klemperer, 2007). In a context of low competition in mobile telecommunications, some national regulatory authorities have introduced measures directed at promoting competition, including Mobile Number Portability (Maicas, Polo and Sese 2009b). Although these policies are also motivated by the high level of switching costs in the market, regulatory authorities can alter the degree of network effects and their effectiveness in increasing firm performance.

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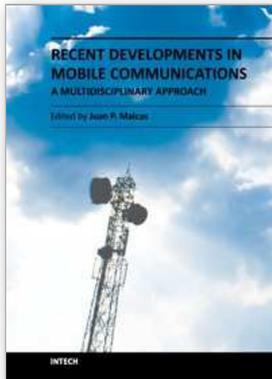
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Recent Developments in Mobile Communications - A Multidisciplinary Approach offers a multidisciplinary perspective on the mobile telecommunications industry. The aim of the chapters is to offer both comprehensive and up-to-date surveys of recent developments and the state-of-the-art of various economical and technical aspects of mobile telecommunications markets. The economy-oriented section offers a variety of chapters dealing with different topics within the field. An overview is given on the effects of privatization on mobile service providers' performance; application of the LAM model to market segmentation; the details of WAC; the current state of the telecommunication market; a potential framework for the analysis of the composition of both ecosystems and value networks using tussles and control points; the return of quality investments applied to the mobile telecommunications industry; the current state in the networks effects literature. The other section of the book approaches the field from the technical side. Some of the topics dealt with are antenna parameters for mobile communication systems; emerging wireless technologies that can be employed in RVC communication; ad hoc networks in mobile communications; DoA-based Switching (DoAS); Coordinated MultiPoint transmission and reception (CoMP); conventional and unconventional CACs; and water quality dynamic monitoring systems based on web-server-embedded technology.

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