network externalities

John McGee and Tanya Sammut-Bonnici

An Economic Force for the Digital Economy

A previous entry (Competitive Market Theory) outlined the traditional economic model that was driven by economies of scale and scope. The digital world, characterized by information and communications technology, is governed by a different dynamic. Network externalities are the new drivers of the network economy. It is important to recognize that economies of scale/scope and network externalities represent the extreme ends of a spectrum of effects, and that the presence of one does not imply the exclusion of the other. Companies may experience the effects of both to varying degrees, with a tendency for network externalities to have more strategic relevance in the digitized network economy.

The concept of network externalities has attracted the attention of academics and practitioners alike. The extent to which network industries have proliferated in the economy is a recent phenomenon. The effects of network externalities, however, have been recognized for some time, with the development of the older network companies such as the railroads and the electricity systems. In 1804, Trevithick constructed the first practical locomotive in England. In 1882, the Edison Electric Lighting Company completed the first commercial generating station at Holborn Viaduct in London. The first commercial telephone line was installed in Boston, Massachusetts, in 1877.

Network externalities are defined as the increasing utility that a user derives from consumption of a product as the number of other users who consume the same product increases. For example, the more people there are in a telephone network, the more users can be reached on the network, thereby increasing its usability. Fax machines, broadcast industry services, credit card networks, and computer hardware and software are examples of products exhibiting network externalities.

The exponential adoption of a network service, which is subject to network externalities, is evident in the rapid rise of peer-to-peer networks in three main categories: social networks, e-marketplaces, and information services, such as Facebook, eBay, and Wikipedia.

Network Externalities and the Battle for Critical Mass

For normal goods, the demand curve slopes downward. As price decreases, more of the product is demanded. Other elements in the demand function, such as income or advertising, serve as "demand shifters" that elevate demand to a higher level. Figure 1 illustrates the traditional role of a demand shifter. Higher levels of consumption are derived from higher incomes (positive income elasticities) or from lower prices (negative price elasticities).

This fundamental relationship is greatly distorted in the presence of network externalities. In the presence of network externalities, we specify that sales rise as accumulated sales (the installed base) rise. However, there may be a chicken-and-egg problem. That is, customers may not be interested in purchasing because the installed base is small and/or not expected to grow. For example, imagine the purchase of complex software without internet support, help lines, and user groups. Alternatively, there may be confident expectations that the installed base will grow substantially and therefore consumers will confidently make purchases. The paradox is that consumers will not buy if the installed base is too low. But, the installed base is too low because customers will not buy. The crux of the paradox lies in the management of consumer expectations. In markets for normal goods, equilibrium is explained in terms of a balance between costs and demand, between marginal costs and marginal utility. In network markets, there is also equilibrium to be struck between actual demand and consumer expectations of total demand.

This gives rise to an economic paradox. Almost the first law of economics is that value comes from scarcity. However, in the digital economy, value comes from plenty: the more something is demanded and the more it is expected to be demanded, then the more valuable it becomes. Expectations are so important in driving demand that a point exists where the momentum is so overwhelming that success

Wiley Encyclopedia of Management, edited by Professor Sir Cary L Cooper.

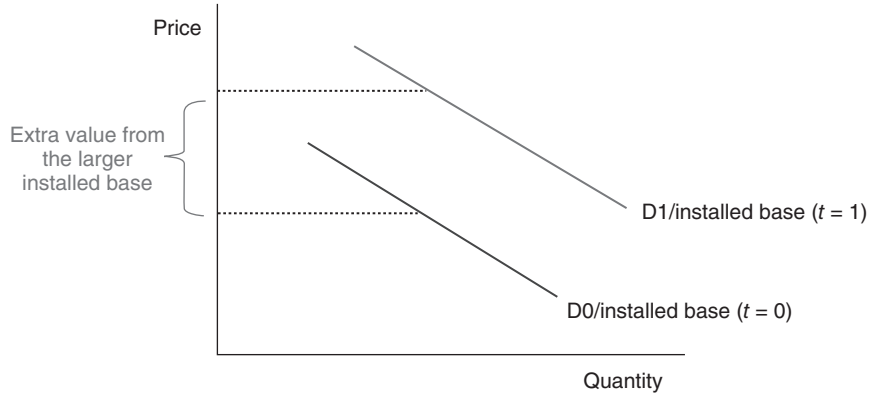

Figure 1 Demand shifts due to the installed base.

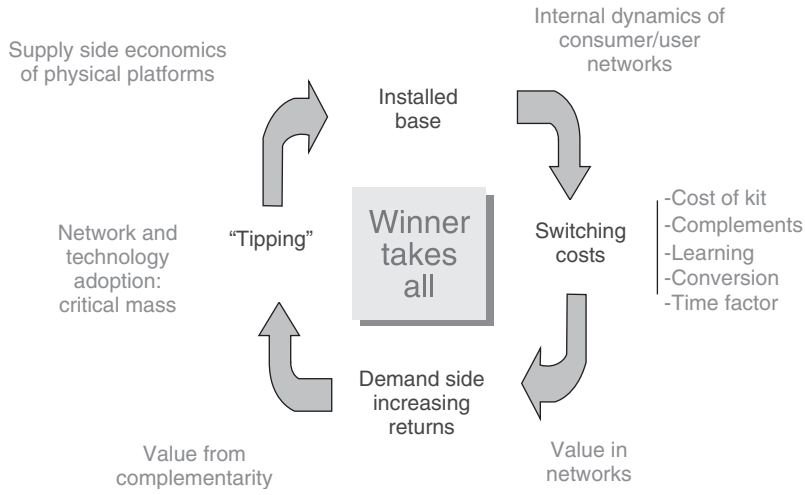

Figure 2 Winner takes all.

becomes a runaway event and we observe a "winner-takes-all" phenomenon (Figure 2).

The "tipping point" is when the installed base (i.e., the size of the network) tips expectations sharply toward one player (or one network) and away from its rival. We observed this effect when the market moved toward Windows as the prevailing computer operating system, rather than OS2. Another example of tipping would be IBM-compatibles versus Apple, as shown in Figure 3. The tipping point comes somewhere in 1984–5 when IBM system sales overtake those of Apple.

The tipping point mechanism in the computer industry had the effect of determining the pattern of market shares for a long time to come. Apple computer sales continued to remain at a constant level, showing a market share of 7.8% at the end of 2008. The market is showing signs of shifting upward slightly in 2009 and beyond as Apple's popularity increased with the success of its iPod product. Apple has clearly shifted its focus from the PC industry to competing in the market for network devices.

Another example is the tipping of the digital video disk (DVD) market toward Blu-ray and away from HD-DVD in 2008. The development of Blu-ray was initiated in 2002 by MIT and nine technology corporations: Hitachi, LG, Panasonic, Philips, Pioneer, Sony, Sharp, Samsung,

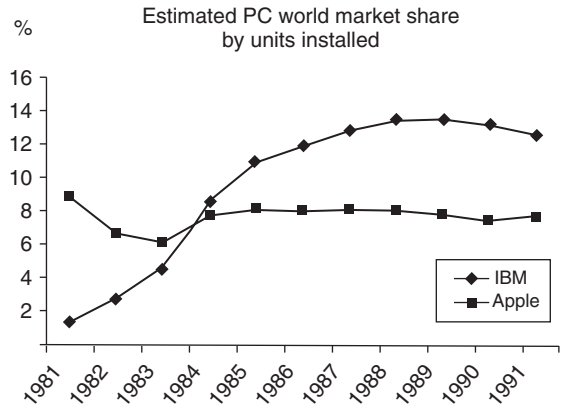

Figure 3 Market shares of Apple and IBM in the nascent phase of the computer industry.

and Thomson Electronics. HD-DVD was supported principally by Toshiba. In the 6 years that followed, Toshiba and Sony spent heavily on public relations campaigns to proclaim the benefits of their respective technologies. The markets were used to try out new ideas through product announcements as well the video players in test markets. The process led to conflicting media messages and confusion in consumers' minds as to which standard was technologically superior. Marketing efforts were not sufficient to tip market shares in favor of one side or the other, nor was the mechanism of free choice in a competitive market. Consumer expectations as to which technology will win the standards war became unclear. Revenues of video players declined as consumers waited for the market to settle before investing in new equipment.

In February 2008, after a drawn-out standards battle between Blu-ray and HD-DVD, Toshiba announced that it had ceased to develop and manufacture the HD-DVD players or drives. In the same period, Warner Brothers Entertainment, which made part of the Blu-ray camp, announced that it would not release films on the HD-DVD format. Warner Brothers Entertainment's intervention was intended to dislodge the stalemate caused by the battle of DVD standards. Both Toshiba and Warner Brothers showed market sensitivity to consumer expectations and acted in the interest of allowing the market to move forward.

The exception to the winner-takes-all phenomenon would be a regulated network market with strong interconnections between competing platforms. The mobile telephone industry is a classic example. The standards are harmonized across the network providers, at least by continental region. The platforms are interlinked and the sales curves of the regulated network providers follow the pattern of the overall subscription curve for the industry.

Traditional economic thinking is based on negative feedback systems in which the strong get weaker at the margin and the weak get stronger, thus providing a drive toward a competitive equilibrium. This is captured in economics by the concept of diminishing marginal utility as consumption grows. In the New World of networks, feedback rules. In this world, the valuation of a product increases the more that others consume the product. Strictly speaking, it arises from the interdependence of consumer decisions, whereas diminishing marginal utility dominates when consumer decisions are independent – the normal assumption in economics.

The price–quantity relationship is normally held to be downward sloping, but the demand curve for a network product should be drawn differently (Figure 4). The value to the consumer of a network product is reflected in the price he is willing to pay – the vertical axis. The principal driver of value is the size of the network, also referred to as *the installed base*,

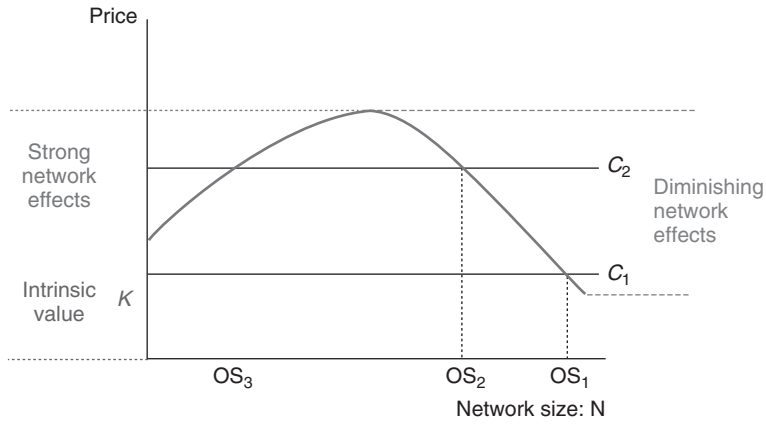

Figure 4 The network demand curve: the idea of optimal size.

and is shown on the horizontal axis. Quantity demanded does still have an effect on price, but for these products this is secondary to the network effect.

The initial upward slope of the curve reflects a rising valuation at the margin, as consumers perceive that they gain value by virtue of other consumers having the product. Being on the Wintel standard gives value to new users. However, as the network grows, the extra consumers at the margin are less valuable – that is, this shape assumes that those users with higher potential valuation of the network will join first. As the network gets very large, further growth has less value for future customers. The intercept on the vertical axis represents the value the network product has as a stand-alone product. Thus a Wintel computer has some standalone value, but a telephone has no value on its own and is a pure network good.

There is a notion of an optimal size of a network. This can be seen from the interaction of demand and cost so that, as less and less valuable customers join the network, there may come a time when the costs of acquiring and servicing new customers begin to exceed the price those customers are willing to pay. This determines the optimal size and has significant implications for competition.

The three configurations shown in Figure 5 indicate the range of possibilities. The first is a pure network good, such as a telephone system, in which the optimal size of network is a very high proportion of the available market. This implies that there is little or no room for rival networks. The second is a product with a significant intrinsic value that attracts a modest size group of users. For example, this could be a corporate software package (e.g., enterprise solutions) that attracts dedicated user support from the supplier through the Web. Alternative networks could coexist. The third case is one of very high intrinsic demand, but extensive consumer interactions (small in size but several in number) provide a substantial total network value. The obvious example is word processing software where the value from standardizing on MS Word is very high with the result that alternative standards (such as WordPerfect) are being frozen out of the market even though the intrinsic value of any word processing package is high.

Networks were originally analyzed on the assumption that each network was owned by a single firm, and research concentrated on the efficient use of the network structure and on the appropriate allocation of costs. With the antitrust cases against AT&T and its later breakup, attention shifted toward economies of scope, the efficiency gains from joint operation of complementary components of networks. This led to issues of interconnection and compatibility in parallel with the reduced role of IBM in the 1980s and 1990s in the setting of technical standards in computer hardware and software. As technology has advanced, there have been

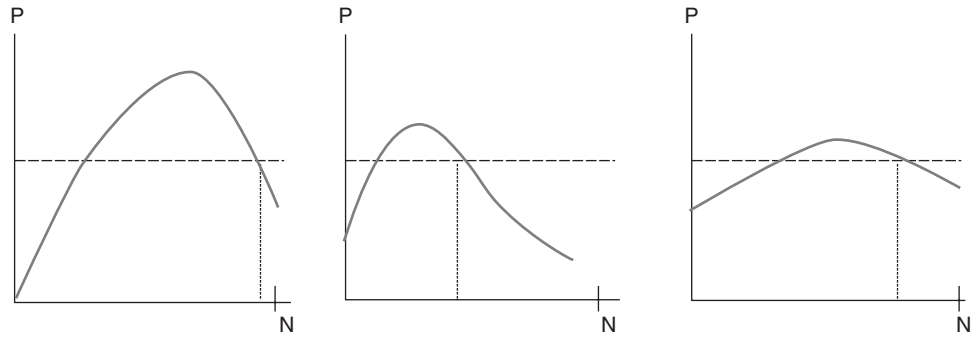

Figure 5 Alternative network demand configurations.

significant reductions in telecommunications costs and a shift toward fragmented ownership of telecommunications networks. Market structure has shifted from natural monopoly to oligopoly. Similar trends are evident in other IT-intensive industries. Thus, the focus of interest in network economics has shifted from the analysis of natural monopoly toward issues of interconnection, compatibility, interoperability, and coordination of quality.

See also *competitive market theory*; *critical mass*; *network industry strategies*; *networks*

Bibliography

Economides, N. (2007) *The Economics of the Internet*, The New Palgrave Dictionary of Economics.

Fitzek, F.H. and Katz, M.D. (eds) (2006) *Cooperation in Wireless Networks: Principles and Applications: Real Egoistic Behavior is to Cooperate!*, Springer.

McGee, J. and Sammut-Bonnici, T. (2002) Network industries in the new economy. *European Business Journal*, **14**, 116–32.

McGee, J. and Thomas, H. (2007) Knowledge as a lens on the jigsaw puzzle of strategy: reflections and conjectures on the contribution of a knowledge-based view to analytic models of strategic management. *Management Decision*, **45** (3), 539–563.

McGee, J., Thomas, H. and Wilson, D.C. (2010) *Strategy: Analysis and Practice*, McGraw-Hill.

Sammut-Bonnici, T. and McGee, J. (2002) Network strategies for the new economy. *European Business Journal*, **14**, 174–185.

Sammut-Bonnici, T. and Paroutis, S. (2013) Developing a dominant logic of strategic innovation. *Management Research Review*, **36** (10), 924–938.

Varian, H.R., Farrell, J. and Shapiro, C. (2004) *The Economics of Information Technology: An Introduction*, Cambridge University Press.