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# Network Effect

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In economics and business, the term “network effect” describes the phenomenon of a product or service becoming more valuable when more users or customers are owning or using it. Another term in use is “network externalities.” In many cases, these network externalities are embedded in the value of the goods or services and are designed to benefit from this effect through scaling. Classic examples of the network effect are the telephone or Internet services. The concept of the network effect in economics is closely related to network theory in sociology. Social network analysis provides a useful set of theoretical methods to deepen insights into network effects and assess the properties of networks and externality effects. Today, the network effect is increasingly discussed in relation to social networks, unintended consequences of big data, and effects witnessed in the field of blockchain technology and cryptocurrency.

Jeffrey Rohlfs (1974) of Bell Laboratories first formulated the idea that the utility of communication services increased as more users joined the system. This was further formulated in the 1980s by Robert Metcalfe in relation to the emergence of the ethernet. Metcalfe argued that the effect of a network is proportional to the square of the number of nodes in the network. This so-called Metcalfe’s law was subsequently applied to many other areas besides telecommunication networks. In 1985, Farrell and Saloner, in a working paper, and Katz and Shapiro (1985), in an article, hypothesized that standardization and compatibility of services and products would add to a positive network effect. “There may be a direct ‘network externality,’ in the sense that one consumer’s value for a good increases when another consumer has a compatible good, as in the case of telephones, or as when friends want to be able to exchange software for their personal computers” (Farrell and Saloner, 1985).

## Concepts

Direct network effects can be summarized as a direct relationship between the size of the user base and the value of the network. Indirect network effects can be witnessed when a product or service sparks additional compatible products or services, thereby indirectly increasing the value of the main commodity. At the microlevel, the network effect can lead to individual decisions to join the network. The macrolevel effect is that such individual decisions increase the value of the product or decrease the costs of service. Aside from these two main effects within the larger concept of network externalities, further effects are two-sided network effects and local network effects.

In sociology, social network analysis, advanced by Georg Simmel’s work on graph theory, offers intriguing parallels to network economics – and more specifically, the network effect. Such considerations and parallels lend themselves to investigating network effects of goods and services in more detail.

## Positive and Negative Network Effects

Network externalities can have positive as well as negative effects with regard to the value of the service or product. Many products or services that rely on connectivity experience an increase in value with an increasing density of the network and the increasing number of users. Such services might be affected by a negative network effect when the increased network density leads to congestion within the network.

Other positive effects are, among others, synergy effects resulting from actors converging around one service or product which can lead to economies of scale or demand-side economies of scale. Once a tipping point is reached, such networks can enter positive feedback loops in gaining advantages. On the negative side, products or services once gaining such a position can become too big to fail. Convergence on one such service or product can further lead

to reduced resilience of the network (for the lack of a plan B) when the service or good is affected by a critical disruption. Depending on the nature of networked services and goods, they can also be prone to cascading effects within their networks – for example, the spread of viruses in a computer network or the spread of viral messages in social networks.

A specific effect of network externalities is the tendency to lead to a lock-in of customers regarding services and goods. There is a relation between lock-in and the adoption of (open and closed) standards, compatibility and/or interoperability within a certain group of products or services. The QWERTY keyboard and the Unicode Standard – but also many software and hardware products such as mobile phones and operating systems – are ready examples of effects associated with standards and interoperability. The lack of compatibility or standards in a field can lead to reduced indirect network effects.

### Current Debates

The concept of network effect has also permeated other fields associated with digitalization. There is increasing research in the domains of cryptocurrency and blockchain technology that investigates whether network effects and Metcalfe's law also apply to digital commodities, such as Bitcoin. The nature of distributed ledgers also suggests

that the larger a blockchain service and the more users that authenticate transactions, the more useful, reliable, and tamper-proof the blockchain becomes (e.g., 51 percent attacks).

Accompanying the increasing connectivity among individuals and the increasing availability of data about them, there arise ethical concerns that are sometimes referred to as “network effects.” The discourse around big data has raised concerns about potential knock-on effects of actions within highly networked societies. Such knock-on effects are effects *within* a network rather than *of* a network. Associated terms are “network ethics” and “big data ethics.”

SEE ALSO: Actor-Network Theory; Economy, Networks and; Networks; Social Network Analysis

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