Economic Characteristics of Network Industries

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Network Industries react differently within the competitive marketplace and they affect the consumer in unique ways. This essay will examine the various structures of networks, how goods within these networks affect consumers and how the firm that provides network goods and services can compete and gain an economic advantage through mastering economies of scale and scope. Unlike the durable goods market that allows for a number of firms to participate selling similar or competing products, network industry markets tend toward concentration with only a select few firms and technologies able to compete in the market. There are a variety of terms used when analyzing network industries and this defining the terms used, and will discuss how these market effects interrelate and impacts a firm’s competitive strategy within the network economy. This essay will also discuss how the production of information and network goods/services and the demand for such services differ from traditional goods markets.

A network is a system of link and nodes (wires or channels) where goods, things and information travel from one spot to another. Networks are a boon for small entities allowing them to function (at least momentarily) as a large entity for the benefit of those connected to supply goods and services over long distance that they would not be able to surmount alone (Longstaff, 2000). Network structures can take one of three forms: one-way (used by the broadcast and paging industries), two-way (used by the telephone and airline industries) or distributed (like the Internet). In one-way industries, the network is structured to facilitate the delivery of goods and services in a one-way
direction through the network (the broadcast signal travels from the satellite to the users television set) and does not allow for the signal or good to travel in the reverse direction.

Two-way networks allow for information and goods to travel back and forth from one node to another often through a centralized switch or hub. This centralized switching function is only beneficial when there is very light point-to-point traffic and often results in structures that increase its susceptibility to network failures. Central switching structures require a network operator who not only controls access to the network but also gains an economic advantage for running and controlling the traffic over the network.

Distributed networks are not prone to network failure or bottlenecks at the hub like two-way networks, but two-way centralized networks are cheaper to establish than distributed networks (due to fewer links and nodes). Bottlenecks occur when one part of the network has a lower capacity than other parts of the network and to circumvent bottlenecks there often needs to be an investment in or cooperation of various parts of the network and often the government arbitrates such agreements. The term “bottleneck” is also often used in reference to the inability of the new competitors to transport services over existing infrastructure due to high access rates and the high cost of building a new infrastructure.
Interconnections are the cornerstone of network industries and in conjunction with the fluctuations of user expectations make the industry radically different from traditional goods industries. Some networks are even interconnected with each other and are developed in a layered fashion – one on top of another. This discussion runs together the ideas of interconnected networks and layered networks. They are very different ideas. AT&T’s long distance network interconnects with the local telephone exchanges, but it is not layered on top of it. The fax network simply is a protocol for sending and receiving information over telephone lines, so it is “layered” on top of the telephone lines. But it is not a separate physical network interconnecting with the telephone network. These networks are called open networks and they ride on top of an existing underlying network or a proprietary network. The most used example of a technology that uses this type of network is the fax machine. Fax machine technology was able to quickly agree on a universal standard, and the network runs on top of traditional phone network without a network operator. Another often used example of a layered network is the VISA system that runs on top of a proprietary network created on an internal corporate communication systems – a private organization with a private network operator.

The final type of network structure is called a virtual network. Virtual networks are systems where the products generate value only when they are combined with other products (for example audio playback equipment, hardware and software and these networks act like one-way physical networks. In virtual networks where is no network operator (no intermediary to regulate the traffic or create roadblocks) and the software
needed to join the virtual network is often delivered through normal retail outlets and therefore there is not an issue of limited access.

Network economies are heavily influenced by the powers of collective consumer action. Unlike durable good markets where an individual purchase does not directly affect the costs, price or availability of the product, network industry markets are largely affected by actions that are individually rational but lead to collective effects that are not affected by the consumer's best interest. This sometimes happens, and indeed there is a tendency for outcomes in network markets to be more influenced by network effects than by evaluation of the intrinsic benefits of a technology, but it is not an inherent logically necessary feature of network industries. Individual demand for network goods and services directly impacts the network itself and the value of the network and/or good as perceived by other users.

Network effects are created as more users join the network. Coined Metcalfe’s Law, the concept of the value of the network increasing exponentially as the network grows in size is the foundation for understanding the economies of networked industries.

\textit{Metcalf's law is one mathematical expression of the idea of network effects, but there is nothing inherent in the idea of network effects that makes it the only expression of network effects.} In fact, user participation in a network is heavily dependent upon that user’s expectations about the benefits derived from network participation or the size of the network rather than simply the technology itself (Besen & Farrell, 118). Purchasers of network industry goods are expecting that the quality and value of the system will stay the same or become more popular in the future. Therefore the decision to purchase
the good is determined more by expectations of future value than solely by the price of
the good or component.

There are two types of network effects that are created by demand-side economies of
scale (versus traditional economies which experience supply-side economies of scale),
those that are direct and those that are indirect. The direct network effects occur when
network users are linked directly in a two-way communication network. With direct
network effects, if there are more people then the network becomes more valuable if
of course the network itself is more valuable; it is bigger. The point though is that the
value of the network to each user, its average value, increases, and there is an increase
in communication capacities. (Shapiro & Varian, 179)

Indirect network effects occur in virtual networks and one-way physical networks. The
benefit derived from indirect network effects is a greater variety and number of
components for the user to buy for the system or platform. A good example of this type
of indirect network effect is the phenomenon created by the Windows operating system.
With a larger number of users participating in that network, there is a greater demand
(and therefore availability) of component pieces (software and compatible hardware) for
user of the Windows operating system versus users of other systems like Apple.

Some effects created by the demand for network goods affect more than just the initial
consumer. Called network externalities or spillover effects these impact users that are
not involved at all with the initial transactions, yet they benefit from the positive or
negative effect. [KAW1]Even though network effects are unique to network industries,
not all networks develop network effects. For instance, wireless and cell phone networks do not increase in value directly relational to the number of users that participate in that market. Therefore the existence of these externalities only represents a piece of what makes a network market differ from a traditional goods market.

Unlike traditional manufactured goods where there is a relatively stable cost of producing each good that is consumed, network industries do not have the same type of production behavior. Impacted by economies of scale, network industry firms discover that the more information goods you produce, the lower your average cost of production becomes. The costs of producing information goods many network industries produce information goods, but not all...are variable in such a way that the cost of producing an additional copy typically does not increase even if you produce a great number of copies. (Shapiro & Varian, 3) The “sunk cost” (the costs that are not recoverable if your production is halted), however, is much larger than what is required in a durable goods market. Information industries therefore have large fixed costs (often created by installing and creating the original infrastructure) and yet have low marginal (variable) costs (the cost of creating an individual product) that create increasing returns to scale. A good example of this phenomenon can be found by examining the telephone network where the average costs decreases as more people connect to the network and the highest fixed costs are created by establishing the infrastructure.

To survive in this type of a marketplace, firms need to become very large and often become vertically integrated. Vertical integration occurs when a firm operates at more than one level of the production and distribution chain. A good example of a vertically
integrated firm would be Disney who owns their own content plus broadcast channels, retail chains, and local distribution chains, etc. Or, during the early days of radio, the radio broadcasters were vertically integrated with their ownership of (the network) and their production of radios (the equipment) and the programming (the information good).

Firms are able to obtain these economies of scale and scope by reducing their average costs of production by increasing their sales volume and setting the price of their goods as high as possible without creating an incentive for other firms to invest the sunk costs necessary to enter and compete in your market (Shapiro & Varian[KAW2]). Network effects and economies of scale interact in a unique way and the resulting effect of the two occurrences can be large or small and can diminish as the network grows larger; neither is absolute or permanent, and what is important in the beginning of the development of the network is less important toward the end. This combination of these two effects, however, drives industries toward concentration.

Firms develop economies of scope when they are able to produce two products or services more efficiently and cheaper than the same service being provided by 2 firms (or networks). Often when a single firm can supply entire network in a way that no one else can match they develop into a natural monopoly. In contrast, a competitive market structure is able to support a large number of small firms due to the market's inability to set price, the ease of entering and exiting the market, the marginal costs involved and the marginal network effects that exist and impact the consumer.
Within this type of market structure a dominant firm often emerges who has significant economies of scope and scale that creates a cost advantage over its smaller rivals. Dominant firm technologies often develop by creating path dependent technology cycles for their users. Path dependence occurs when; during the early stages of development a small historical event gives one firm’s technology an advantage over the other. That one technology develops a lead in the market and becomes more improved due to the learning effects that occur as more people use the technology and find ways to improve it. “The claim for path dependence is that a minor or fleeting advantage or a seemingly inconsequential lead for some technology, product or standard can have important and irreversible influences on the ultimate market allocation of resources, even in a world characterized by voluntary decision and individually maximizing behavior.” (Liebowitz & Margolis)

The technology that becomes popular and attractive to a larger and larger number of users creates a positive feedback loop. A positive feedback loop occurs when an increasing return leads to a change in the value of the system. Feedback loops feed upon themselves and winners tend to continue winning, making it difficult for new firms to enter the market. “Because of strong positive feedback elements (in relation to the natural tendency in network industries toward de facto standardization), system markets are especially prone to ‘tipping’, which is the tendency of one system to pull away from its rivals in popularity once it has gained an initial edge” (Lemley & McGowan, 26). If the economics of a network market make it inevitable that there be one standard (rather than competing systems) in order to be efficient, then ‘tipping’ to that standard is likely. The firm that owns these standards or the property rights in relation to the technology
develops an economic advantage. Property rights and the ability to exclude others from a network play a crucial role in network markets and creates an economic advantage for the dominant firm (Lemley & McGowan).

Negative feedback loops represent the opposite of the positive feedback loops and occur when changes in the system variables tend to reverse the trend and the value of the system tends to move and continue to feed a negative pattern of returns. Whether the path dependent technology path dependence is connected to positive feedback is impacted by positive or negative feedback loops, often the technology that is adopted is not the most efficient or, at the very least, it is argued that it would not have been chosen by an individually rational decision weighing the costs and benefits of both technologies. Breaking out of path dependencies often requires government action is needed in the form of subsidies, restraints on the introduction of new technologies, etc. Path dependencies that are not monitored by government action will lead to technology lock-in where the consumer is so financially invested in the new technology and its complimentary components that the cost of changing (called the switching costs) are too high to transition to a more effective technology. (Shapiro & Varian, 12)

Switching costs are separate and independent of other network effects and their impact is relative to the benefits offered by the alternative technology. A user experiences switching costs related to the purchase of the primary product when the user has made investments in durable goods that are complimentary and matched to the brand of the primary product. The complimentary products have no value without the original product (which represents the user’s sunk cost). When the switching costs are
prohibitively high people don’t switch products or networks and system lock-in occurs. Switching costs decrease competition this is true when a large number of people are locked in, but companies compete vigorously to get locked in customers, and therefore all dominant network industry firms want to create and maintain a large base of locked in customers.

Lock-in can also be created through the establishment of standards. Network industries are often called “cooperative constructs” where products and services provided via (or as a part of) a network are deeply reliant on cooperation between the various nodes in order to operate and remain competitive. Often this cooperation is developed through the establishment of standards and agreements that maintain interoperable between the nodes. Standards are increasingly important for more than one firm to compete directly or provide complimentary products for an information or network technology. “Network markets by definition offer potentially lucrative returns to firm that can establish their own products as standards on which competition in the market, or in after markets for complimentary goods, will be based.” (Lemley & McGowan, 24)

This analysis has examined the various terms used to analyze network industries and has examined how network markets differ from traditional markets in how they are impacted by consumer demand and cost advantages that are unique to the production of information goods. Network economies are reliant upon some form of system and software interoperability in order to function, and controlling the standards and intellectual property rights related to the interoperability and/or the structures that connect the nodes or hubs of the network can warrant a firm significant economic
advantage. Network technologies are also highly influenced by historical events and often it is a historical event that will spur a chain reaction of customer preference that constitutes the distinction between a dominant and successful technology and a technology that is not. So while successful network firms are those who are able to significantly harness the powers of economies of scale and scope and are able to influence customer preference toward their technology over the competitors, the secret to market success might lie more in historical luck than in well-developed strategy.

What about open versus closed standards? standards wars?
Bibliography


-Path Dependence, Lock-In and History. North Carolina State University.


A: Good job. You’ve got a good grasp of the basic concepts.