

# A Brief Discussion On Demand-Side Network Externalities

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*Abstract:* Network externalities exist when some people bear costs that they are not paid or compensated for, or when they get benefits that they do not pay for. Externalities may be positive or negative, depending on the effects they produce. There are also supply-side and demand-side network externalities. The paper discusses some aspects of demand-side network externalities, particularly when related to the use of the Internet, extranets and virtual organizations or communities.

*Key-Words:* network externalities, demand-side externalities, Internet, extranet, virtual organization, virtual community

## 1 Introduction

There is more than one kind of economic good or service – *private* and *public* goods and services. An economic public or service does not necessarily imply something provided by a government; a private business or a non-profit organization may also provide it. A public good or service is nondepletable [1]. This means that when one person uses it, what is available to others is not depleted in quantity, power, strength or quality.

On the other hand, private goods or services are both depletable and excludable. For example, when one person takes a seat in a train, the number of seats available to other persons is reduced or depleted by one. All other persons are, consequently, excluded from using the seat and receiving its benefits.

But, there is a third class of economic goods or services that falls somewhere between pure public goods/services and pure private goods/service. An unintended “spillover” of any good or service is called an *externality* [1]. Economists define externalities and external costs and benefits as follows:

- When some people bear costs that they are not paid or compensated for, these costs are said to be *external costs*.
- When some people get benefits that they do not pay for, these benefits are said to be *external benefits*.

- In general, if there are either external benefits or external costs, we say there are *externalities*.

Externalities may be *positive* or *negative*, depending on the effects they produce. The idea is that the decision-maker, which does not pay for the costs not get paid for the benefits, does not take them into consideration in deciding how resources shall be allocated. He has no motive to produce benefits that he does not get, or to cut back costs that he does not pay. The benefits and costs are “external” to his maximization of his own net benefits.

Externalities are particularly important and interesting fact in information era. Namely, information processes done in, or by means of, computer and multimedia networks exhibit various and numerous positive consumption and production externalities. The first mentioned are also called *demand-side externalities*, while the latter can be referred as *supply-side externalities*. Both of them play a key role in network and, particularly, Internet economics.

## 2 The Nature of Network Externalities

Externalities in consumption exist when the level of consumption of some good or service by one consumer has a direct effect on the welfare of another consumer, as opposed to an indirect effect through the price mechanism [2].

Production externalities can be observed when the production activities of one firm directly affect the

production activities of another firm. The well-known Economy of Scale effect is a special case of production or supply-side externalities.

There are also some mixed consumption/production externalities, i.e. externalities that affect both demand and supply side of the value chain.

Generally, the essence of externalities, whether in production or consumption, is that their costs or benefits are not reflected in market prices, and so the decision of the consumer or business creating externalities on the scale of externality-creating activity does not take its effect into account. Hence, social welfare would be increased if the private consumption or production decisions were modified so as to take the external effect into account.

Externalities themselves are of two economic types [3]. Public good/service externalities are unintended spillovers that are neither depletable nor excludable. Their origins are public goods or services, but since they are not intentionally created, they may be viewed as *public good/service externalities*.

Unlike the case of public good/service externalities that differ from pure public goods/services only by the intent of their provider, *private good/service externalities* represent a totally different sort of economic good or service. They lay somewhere between pure public goods/services and pure private goods/services; they may be depleted, but not effectively excluded.

As mentioned earlier, networks exhibit positive or negative externalities. A positive consumption (demand-side) externality signifies the fact that the value of a unit of the good/service increases with the number of units sold. As it may seem quite counterintuitive, the nature of positive demand-side network externality should be interpreted as the fact that *the value of a unit of a good or service increases with the expected number of units to be sold*. Thus, the demand slopes downward but shifts upward with increases in the number of units expected to be sold.

The crucial reason for the emergence of network externalities is the complementarity between the components of a network [4]. Depending on the type of network, the externality may be *direct* or *indirect*. When customers are identified with components, the resulting externality is usually direct. On the other hand, in one-way networks externalities are typically indirect.

Let us illustrate this by some examples.

Consider, for example, a typical two-way network, such as paging systems or SMS services, shown in Fig. 1. In this  $n$ -component network, there are  $n(n-1)$  potential goods or services. An additional  $(n + 1)$ th customer provides direct externalities to all other members of the network by adding  $2n$  potential new

goods through the provision of a complimentary link to existing links.

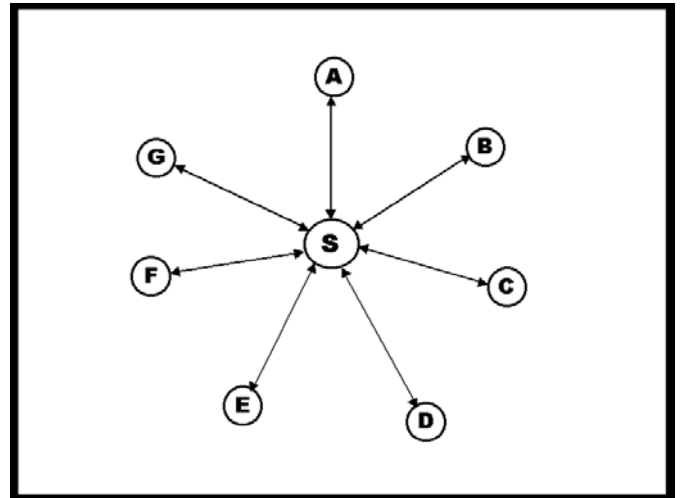


Fig. 1. – A typical two-way network

Indirect network externalities are typical to B2B e-commerce models (systems) and horizontal electronic marketplaces in which there are  $m$  varieties of component  $A$  and  $n$  varieties of component  $B$ , as shown in Fig. 2. If all  $A$ -type goods are compatible with  $B$ -type, i.e. if supplying businesses are offering goods or services required by demanding businesses, there are  $mn$  potential composite goods. An additional customer yields indirect externalities to others by increasing the demand for components of types  $A$  and  $B$  and thereby potentially increasing the number of varieties of each component that are available on the marketplace.

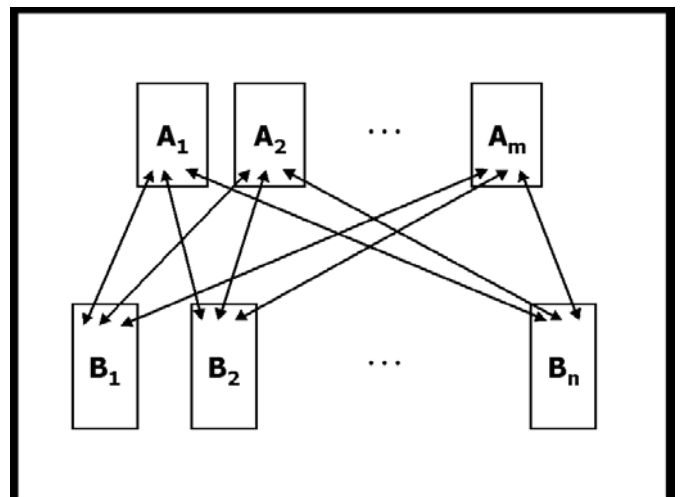


Fig. 2. – Indirect externalities in B2B e-commerce

Vertical electronic markets and exchanges also exhibit indirect network externalities. They may arise in

the array of vertically related services that compose a complex transaction or service. These include the services of a broker, of bringing offer to the floor, matching the offer, etc. The act of exchanging goods or assets brings together an e-trader that is willing to sell with an e-trader that is willing to buy. In other words, the e-exchange brings together two complementary goods: the *offer* that can be interpreted as “willingness to sell something at price  $p$ ” and the *counteroffer* that can be interpreted as “willingness to buy something at price  $p$ ”. These two complementary goods are brought together at the exchange in a composite good – *exchange transaction*. It should be noted that each of two original goods has no value without the another one.

### 3 Positive and Negative Consumption or Demand-side Network Externalities

The first researches on positive consumption or demand externalities from network service were done by J. Rohlfs [5] and S. Oren and S. Smith [6]. They found that a subscriber’s utility increases as others join the system. M. Katz and C. Shapiro [7] formally described the network externality phenomenon. N. Economides and Ch. Himmelberg [8] pinpointed startup and critical mass problems related to demand-side network externalities.

When the network market exhibits positive consumption externalities, the marginal private benefit from joining a network is less than the social benefit. It follows that the network size in equilibrium may be smaller than the social optimal size. Perfectly competitive market equilibrium will be inefficient due to these externalities.

Inefficiencies resulting from adoption externalities arise in different ways. For instance, public opinion regarding the network industries suggests that markets tend to be stranded in an inferior technology. This is an evidence of a kind of social inertia manifested as an excessive resistance to new superior technologies. J. Farrell and G. Saloner [9], in turn, suggest that the network effect may inhibit innovation.

Some authors are very suspicious as regards network externalities importance. So, for example, S. J. Liebowitz and S. E. Margolis write: “We argue that many ‘network externalities’ are not externalities in the modern sense...We conclude that the empirical importance of network externalities, as externalities, has been greatly overstated” [10].

This opinion will be discussed later in the paper.

### 4 Externalities Induced by the Internet

Externalities, as it was shown earlier, refer to the indirect effects that one user has on the other users of the same network. For example, if one user links up the Internet, he is indirectly increasing the value everyone else’s connection since they can send him e-mail messages promoting their own ideas or offer goods or services.

This conception is also tied to a related idea typically called *path dependence*. If the value of some product grows with usage, then it pays to be big. If a product, for any reason, gets enough users early on, it may be favored over others of higher “generic” quality just because it was there first and has an established user base.

Examples for this effect are numerous among Internet tools, like, for instance, search engines. As *Yahoo!* initially gained majority of users, it become more valuable good simply because others used it. More users induced the increasing interest of content creators to post their information exactly to this engine, and this, in turn, attracted more investors to support the company. Path dependence is then the idea that the current dominance of *Yahoo!*, over other, maybe technologically superior search engines, is a result of a simple historical accident. If some other search engine had an initial lead, it also could have taken over the market.

Similar examples could be made with other Internet tools like, for instance, browsers or cryptographic security systems. The popularity and value of Microsoft’s Internet Explorer may be explained by path dependence, too. Similar is PGP cryptographic algorithm. The best players in the market know that whoever gets biggest will probably end up dominating the market

The important question is whether or not the Internet-based economy is producing relatively more positive externalities than economic systems in the past. Casual observation suggests that it is true, since high-tech industries often display some of the characteristics needed to generate positive demand-side network externalities.

As the global economy shifts to the production of network-related products and services, questions must be asked what this implies about the working of the economy and what kind of policy the government should pursue.

The first important issue to consider is market structure. If positive demand-side network externalities imply that bigger is better, then more and more “objective monopolies” will be born. The flagrant example is the actual *Microsoft’s* market position. As Microsoft Internet Explorer took over the Netscape

Navigator's market, in part due to the presence of network externalities, Microsoft became virtually a monopoly producer of web browsers.

Monopolies are traditionally understood as a "bad thing" – since they have the ability to raise prices and extract monopoly rents from consumers, which may then lead to inefficient levels of production. However, in the case of "objective" monopoly, we would like to have only one producer since this is the best way to efficiently produce the product or particular service. An obvious example is *AOL Time Warner* conglomerate, which is able to provide major Internet services at the highest level of quality.

One way to deal with this challenge is to have the heavy government regulation. But, this was the case with telephone and cable industries in the pre-deregulation era, and this certainly was not very favorable experience. And, if government regulation is not a practical option, what is the one? This is maybe the heaviest question generally related to Internet-based economy and particularly to positive demand-side externalities generated by electronic business.

## 5 Externalities Induced by Extranets

### 5.1 The Role and Characteristics of Extranets

Extranets extend an organizational internal network, usually designed as an intranet, to include strategic business partners in order to facilitate work collaboration and information sharing. An extranet application can provide links to other related sites, thus providing its users with additional information and services. For example, banks develop extranets to engage in transactions with various consumers. Similarly, they deploy extranets to collaborate with the businesses they serve and share information with other banks. Manufacturing organizations deploy similar extranets to streamline their supply and demand chain processes and activities.

The concept of extranets surfaced based on the premise that an internal network, i.e. intranet, is freely accessible to an enterprise's employees, and access to the internal resources by external users requires regulated access controls. An extranet, therefore, referred to the appropriate physical and virtual segmentation of the intranet (at a network and application level) required to achieve that objective (grant controlled access to external users while leaving free access to internal employees).

However, as enterprises migrated great quantities of data and applications through and over their intranets, they sensed an equal need for implementing such

security controls for their internal employees as well. For example, the R&D department wanted to limit access to their findings, for easily understandable reasons, solely to the engineers working on the project. Those engineers could access that data locally (when physically present within the confines of the enterprise), or remotely – for instance, from their homes. Providing such access requires implementation of extranet technologies similar to what is required for granting such access to authorized external customers and partners.

Extranets are primarily enablers behind the success of business-to-business (B2B) e-commerce. The following summarizes some of the advantages of deploying extranets:

- *Streamline operations and thus reduce cycle times.* Extranets streamline organization's supply and demand chain processes. For example, suppliers can access a manufacturing organization's databases to get appropriate insights into the inventory levels, thus enabling them to deliver appropriate parts and supplies in due time. On the other side, representatives or distributors can access to information about manufacturer's work-in-progress, what enables them to plan their marketing campaigns and contracting.
- *Reduction of costs.* Extranets facilitate reduction of costs for all parties. For example, certain suppliers spend enormous amounts of money to publish paper-based catalogs of their products. In many cases, these catalogs require frequent updates and thus incur huge publication and distribution expenses for the supplier. By developing appropriate extranets and publishing information on their extranets, suppliers reduce such overheads. By further extending the extranet services to include ordering and bill payment, both suppliers and manufacturers can reap the benefits of reduced operational and publication costs.
- *The establishment of global markets.* Extranets facilitate the establishment of electronic marketplaces where organizations can meet electronically for various business activities such as selecting suppliers, exploring product prices, procuring goods, negotiating additional services, etc.
- *Information sharing.* Extranets facilitate information exchange between various businesses. For example, businesses can publish valuable information on their extranets – such as

user manuals and research reports – for access by business partners. Similarly, suppliers can publish their catalogs for immediate review by buyers. These extranets enable external partners to access an organization's systems for activities like checking shipment status, product prices, and other information. The *Industry Data Exchange Association (IDEA)*, for example, provides extranet services for organizations in the electrical industry. Using this extranet, manufacturers can update product and pricing information in an extranet that becomes immediately available to the various distributors that are the part of the extranet membership [11].

- *Collaboration.* Beyond information sharing, extranets also enable organizations to collaborate on specific business issues. For example, competing networking organizations who need to collaborate in order to work on industry standards can set up extranets to share standards information, track project progress, and monitor industry events related to those subjects. In this context, extranets serve as private bulletin boards and enable secure collaboration between its members.
- *Global acceptance.* Extranets for B2B e-commerce are continuously on the rise, with numerous standards bodies defining open standards and protocols for e-commerce through extranets. *CommerceNet*, for instance, is a nonprofit organization whose membership includes businesses and users that contribute to the resolution of e-commerce and extranet-related issues.

Extranets often serve as an information/communication infrastructure to virtual organizations and communities.

## 5.2 Extranet-Based Virtual Organizations and Communities

A transformation from the traditional, centralized hierarchical organization to networked, decentralized and extranet-based structure is underway. Globalized organizations must be agile, flexible, and boundaryless [12], which is possible under a network or, more specifically, extranet-based organizational model.

An even more popular model of this kind is a model of virtual organization, which creates its own virtual community. The strategic reason for forming a virtual organization may be summarized as follows (Palmer, 1998):

- Sharing infrastructure, as well as research and development risks and costs.
- Linking complementary core competencies of several organizations.
- Reducing the time from concept to profit through sharing.
- Increasing the facilities available and the apparent size of the organization.
- Gaining market access, speeding time-to-market and increasing partners and customers loyalty.

Advantages and disadvantages for combinations of small to medium sized companies forming a kind of virtual community (alliance) are shown in Table 1.

## 5.3. Extranet Demand-Side Externalities

The fact that externalities in consumption exist when the level of consumption of some good or service by one consumer has a direct effect on the welfare of another consumer can be attributed also to extranets. Each new member of virtual community or alliance contributes to the welfare of another member(s) since they share some common interests.

For example, each new member has knowledge, experience and expertise he wants to share with other members if they are interested to use them. He also often owns or can acquire some operational information that may help others in the virtual community to improve their market positions, competitive advantages, internal efficiency, and business management. The trust and respect inevitable in virtual communities are intangibles that might be turned into business success and contribute to members of these communities.

Moreover, members of the virtual community often create their common internal electronic marketplaces or exchanges at which fair-play rules are practiced, as opposed to external markets at which deviations from these rules are not rare. They can help each other in facilitating a smooth performance of their supply and demand chains, as well as in creating virtual value networks in which several value chains are interwoven to produce new types of synergies.

But, certainly, the most valuable network externalities induced by extranets can be derived from collaboration in research and development area. Ideas, information and knowledge shared among member organizations' experts may be multiplied resulting in unexpected valuable new solutions, products and services. These externalities are, of course, very hard to express in financial terms, but, intuitively, they may be well understood and appreciated.

Table 1.  
Advantages and Disadvantages of Virtual Organizations

<b>Advantages</b>	
Increased competitive capability and flexibility	Partners can pool core competencies and add new ones as needed. They can respond more quickly to changes in the marketplace.
Improved customer service	Virtual organizations have greater customer focus and market response. Linking with clients in design reduces errors and improves service.
Lower costs	Reduced rent, shorter cycle time for design, development, and production
Better communication and internal control	By working in teams rather than a hierarchy, intra-organizational communication improves
Trust and respect	The whole concept is based upon trust and respect as new business values
<b>Disadvantages</b>	
Relatively high investment and operational costs	Lower cost (above) are counterbalanced by increased investment in infrastructure, coordination costs, training, and maintenance
Legal problems	Ownership rights for copyrights, designs, and products
Culture clash	Partners coming from different businesses and national cultures must learn and get used to work together

## 6 Conclusion

Network externalities are benefits driven by new information/communication technologies, attracting more and more attention. They are defined as an unintended “spillover” of any good or service, and may be positive or negative. Also, supply-side and demand-side network externalities may be identified.

In our opinion, network externalities still have not been examined thoroughly enough, what relates especially to demand-side externalities. It is rather surprising, since the externality phenomenon has been recognized still about a quarter of a century ago.

Having this in mind, we tried to investigate some aspects of this kind of network externalities, particularly those relating to implementation of extranets and

creating virtual organizations and communities. Of course, these issues require much more research to be done in future.

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