Zero Entry Barriers in a Computationally Complex World: Transaction Streams and the Complexity of the Digital Trade of Intangible Goods

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In this paper we analyze how transactions related to the digital trade of intangible goods and services is being performed on the Internet. The adoption of electronic markets in an industry has a disintermediation potential because it can create a direct link between the producer and the consumer (without the need for the intermediation role of distributors). Electronic markets lower the search cost allowing customers to choose among more providers (which ultimately reduces both the costs for the customer and the profits for the producer). In this paper we contend that electronic markets on the Internet* have the opposite effect, resulting in the increase of intermediaries. We introduce transaction streams which model how transactions related to the digital trade of intangible goods are being conducted. Transaction streams help explain the types of new intermediaries that are appearing on the Internet and why entry barriers are close to zero. We also prove that in transaction stream-based electronic markets, searching for the best price of intangible goods is NP-complete.

The market value appreciation of Internet services IPOs YTD (1990-1997) is $4,773M (Meeker 1997). In only five years, the Internet may reach 150M users. The Internet is used in practically all industries, in ever more global and sophisticated manners. The convergence of industries such as telecom, office equipment, consumer electronics, computers, and media and publishing into emerging information industries is having profound effects on the everyday businesses we take for granted. It is no longer necessary to buy newspapers at the local news stand because they can be digitally distributed and read on-demand over the Internet. Encyclopedias no longer are mammoth books collecting dust on the shelf, rather, they are interactive on-demand on-line services to be enjoyed with a computer.

Understanding the current success stories on the Internet is an interesting endeavor for two reasons. First, it is an interactive environment with the full functionality of any other interactive environment (with some bandwidth limitations which restrict in some instances the exchange of real-time information such as video). This means that by understanding market dynamics on the Internet, one should be able to extrapolate and apply market behavior in other interactive environments. The next section explains the basic functionalities that make the Internet a generic interactive network. Second, it is based on open standards and is largely unregulated. Thus, it is in constant flux, adapting itself to the evolving characteristics of the demand. We could say that the Internet is a lead user interactive network similar to Von Hippel’s lead users concept (Von Hippel 1985, 1988).

Including this introduction, this paper has eight sections. In the second section (Internet Functional Properties) we outline the functional properties that characterize the Internet, concentrating on those which impact how transactions are being performed. In the third section (Electronic Markets) we review the existing literature on electronic markets. In the fourth section, Transaction Processes, we describe the five fundamental steps in performing a transaction. In the fifth section (Transaction Streams), we introduce the transaction stream model and provide diverse examples of real transaction streams. The sixth and seventh sections present a model of transaction streams and a proof that searching for the best price of an intangible good is an NP-complete problem. The final section discusses the implications of the findings presented.

Internet Functional Properties

The Internet is a special medium because it has six properties that facilitate economic activities. In this section we will review each of them. The first property is the possibility of using it anytime, practically from anywhere and by anybody. This is a very powerful paradigm. No matter where your customers are, you can reach them. This has enabled the
Internet to create communities of people with specific interests and low geographic density. An example is HotHotHot, a store devoted to spicy food. HotHotHot features an exhaustive selection of books and hot sauces. It includes a search engine and multiple delivery options. Operating a store like HotHotHot in every city around the world would probably not be profitable—however, the Internet enables the interaction between the centralized store owner and the scattered customers.

The Internet’s second property that facilitates economic activity is its capacity for enabling various forms of interactive communication between players (Nissen, 1996; Kosiur, 1997; Armstrong et al., 1996). The medium is extremely powerful as a communication vehicle. Through email (asynchronous one-to-one communication), chat (synchronous many-to-many communication), newsgroups (asynchronous many-to-many communication), even voice and video, it has demonstrated its potential for establishing close personal relations.

Third, the Internet can be used to provide services combining and selecting the offers of various providers. In this sense, it can be used to select the players that one wishes to invite to a given economic activity. This is important because sometimes, such selection can be done automatically by a program that helps you navigate through the Internet. For example, one can present the information related to a given sporting event by combining the information of different sources such as the weather report, the stock market, the player information and the event results all into a single page.

Fourth, a software robot can navigate on its own performing a sort of “personal butler” role (Negroponte, 1995). This is crucial because robots can be constructed to perform a myriad of relevant tasks such as to select vendors for a given product (Guttman et al., 1998, Beam et al., 1997). In other words, robots can lower the search costs to a simple time delay produced by the interval required by the robot to query the different stores.

Fifth, the Internet has developed tools such as Java that allow the customization of the offer so that Internet interaction can also be customized with a program running on the client machine. By customization we mean that the interaction between the company and the user is tailored to the user. For example, advertising networks are able to track how many times a user has seen a given advertising banner. This information is then used to customize subsequent banner placements. The issue of customization is becoming important beyond the advertising and interface levels (Noland and Galal, 1998).

Finally and most important, it is very inexpensive for both the user and the service provider. The entry barriers from a technical standpoint are very low. To start an Internet site, one can borrow space on an Internet Service Provider for a very low price. In fact, there are some services such as Tripod that offer free Web page hosting. Thus, everybody can afford a Web site. Because it is based on open standards, there are many competitive products covering most of the possible demand needs. This means that some new business concepts can be tested on a small scale at low cost relative to traditional testing arenas.

Electronic Markets

A transaction is the establishment of a contract between a set of agents (such as people and firms) to perform a given action. By “contract” we mean an agreement between a set of agents to perform a course of actions (usually with detailed implicit and explicit conditions and alternative paths). Electronic contracting focuses on negotiation of the terms and conditions of the contract, and the monitoring of contract performance (Lee, 1998). Here, “contract” should be understood in its broad sense as any commitment between parties to perform a given action. Examples are purchasing a cinema ticket, placing an add in a newspaper, purchasing a book, etc.

Previous work has stressed the roles of markets and hierarchies as distinct mechanisms for coordinating the transactions related to the flow of intangible goods, materials or services through adjacent steps in the value-added chain (Malone, Yates & Benjamin, 1987). Markets coordinate the flow through supply and demand forces between different individuals and firms. By reducing the costs of coordination, Malone et al. (1987) contend that the evolution of information technology is leading to a shift toward proportionately more use of markets compared to hierarchies to coordinate economic activity. They also argue that electronic markets are a more efficient form of coordination for certain classes of product transactions whose asset specificity is low and whose products are easy to describe.

According to their view, electronic markets will evolve from electronic single-source sales channels to biased markets where one of the providers uses the market transaction mechanisms in its favor, to unbiased markets, and finally to personalized markets. Personalized markets are those in which the customers can use customized aids in making their choices. For example, some airline reservation systems allow the user to set preferences such as departure time, seating assignment and rates which are then used in subsequent transactions. The airline market is therefore customized to the users—different users have different options depending on their preferences.

Bakos (1991, 1997, 1998) analyses the impact of electronic markets through the analysis of search costs. Buyers must, directly or indirectly, pay search costs to obtain information about prices and product offerings available in the market. Electronic markets have a vast impact on search costs because of the coordinating effect of information technology. Using economic theory, he shows that this reduction in search costs plays a major role in determining the implications of these systems for market efficiency and competitive behavior. This reduction results in direct efficiency gains from