



Martin Bichler

The Future of e-Markets
Multidimensional Market Mechanisms

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Preface

Electronic markets are breaking new ground in old industries by providing them with a wealth of supply chain information via the Internet. The way that net market makers match buyers and sellers is key to the success of a marketplace and the design of electronic marketplaces has become a million-dollar business. This is a challenging field for both the business and the academic community.

This book introduces a framework of negotiation protocols for electronic markets. In particular, I will focus on multi-dimensional auction mechanisms which allow automated negotiation on multiple attributes and/or multiple units of a product. The findings and analyses should be useful to an audience of scholars as well as practitioners involved in the business of electronic market design. Through this book a reader should be able to understand the multitude of technical and economic issues involved in the design of electronic marketplaces. In contrast to purely economic treatments of this topic, the book combines aspects of both economics and computer science. The book provides a detailed description of the various negotiation protocols, which will be a valuable resource for systems engineers and designers. It also covers the relevant theoretical concepts in this multi-disciplinary field and should, therefore, be of interest to the wider academic community.

It is often difficult to write a book about a fast-moving subject. Describing the past is relatively easy. Predicting the future with reasonable accuracy is possible if the discussion is based on a good understanding of the fundamentals. I have tried to make the description of technical issues as robust as possible without tying it too closely to a particular product or development. Articles in magazines and newspapers can give an up-to-date picture of events. All web addresses (URL) cited in the text have been checked as at May 2000, but may have changed afterwards.

The book grew out of my research at the Vienna University of Economics and Business Administration and at the University of

California at Berkeley. Most of the technical expositions of electronic brokerage described in chapter 2 result from my work on the OFFER project in Berkeley. At that time I became fascinated by auction design and developed the first ideas about multi-attribute auctions. The laboratory experiments as well as the simulation studies described in chapters 6 and 7 were conducted in Vienna. The article upon which parts of chapter 6 are based was published in the *Decision Support Systems* journal. Some of the material from chapters 3 and 7 was published in the *Journal of End User Computing* and *Wirtschaftsinformatik*, respectively. I hope that having read this book you will share my fascination with this exciting research topic.

Acknowledgments

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Vienna, June 2000
Martin Bichler

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1 Electronic Commerce and Electronic Marketplaces

New information technologies like the Internet are allowing a much closer integration of adjacent steps in a value chain. This is affecting firm and market structures and the coordination mechanisms used.

(Davenport, 1993)

Information systems and their application play a major role in today's business. In addition to the introduction of new technologies which help to streamline processes within companies, electronic commerce has become the most recent trend. Electronic commerce has been described as "commercial transactions occurring over open networks, such as the Internet" (OECD, 1997). These new information technologies provide new opportunities and mechanisms to cooperate or to compete, taking advantage of computer power, the communication possibilities of the network, and the fact that millions of people and businesses are simultaneously online.

Though only a few years old, electronic commerce (e-commerce) has the potential to radically alter business-to-business, business-to-consumer as well as consumer-to-consumer transactions. For instance, electronic communication between businesses and suppliers via Electronic Data Interchange (EDI) has recently been enhanced by web-based front-ends for the placement of customer orders. Inter-organizational systems, efficient consumer response, and supply chain management are only a few of the challenges that future businesses will have to meet.

The current success of electronic commerce and the creation of billions in market capitalization and revenue is based on fundamental work done in the past in various disciplines. Computer networks, cryptography, databases, and distributed object technology form a mix of technologies and standards for the development of electronic commerce applications (Bichler, 2000b). In particular, the success of the Internet and Internet protocols as an "inter-lingua" between heterogeneous information systems has fueled the enormous growth rates. Network externalities are one way to

explain the fact that millions of users worldwide have agreed upon a single network standard, since the utility for every Internet user is increasing, more people are using the Internet.

While computer and engineering sciences have laid the foundation for electronic commerce, electronic commerce technologies are no longer simple efficiency tools that automate various types of transactions. By equipping economic agents with the tools to search, negotiate, and transact online and in real time, various electronic commerce applications promise an unprecedented opportunity to rethink fundamental assumptions about the economic efficacy of markets and open a whole range of new research questions. In particular, electronic commerce techniques are transforming the marketplace by changing firms' business models, and by enabling the implementation of new market institutions.

1.1 Market-Based Coordination

In recent years a particularly influential phenomenon has emerged with regard to electronic markets. Markets play a central role in the economy and facilitate the exchange of information, goods, services, and payments. They create value for buyers, sellers, and for society at large. Markets have three main functions: matching buyers to sellers; facilitating the exchange of information, goods, services, and payments associated with a market transaction; and providing an institutional infrastructure, such as a legal and regulatory framework which enables the efficient functioning of the market (Bakos, 1998). Internet-based electronic marketplaces leverage information technology to perform these functions with increased effectiveness and reduced transaction costs, resulting in more efficient, "friction-free" markets.

1.1.1 Markets vs. Hierarchies

Markets *clear* by matching demand and supply. Sellers are provided with information about demand which allows them to employ capital, technology, and labor, and develop products with attributes that match the needs of buyers. Buyers, on the other hand, select their purchases from the available product offerings after considering factors such as price and product attributes.

A key function of markets is discovering prices and conditions of a deal at which demand and supply clear and trade occurs. Markets are primarily an *information exchange* designed to lower the transaction costs for a deal. Markets can employ a number of mechanisms to match supply and demand. For instance, financial markets use one or more of the several

types of auctions to determine prices, such as the “call market” auction at the New York Stock Exchange (NYSE). Other markets, such as the traditional automobile dealership, employ bilateral negotiation between buyers and sellers until a price is agreed upon. In still other markets, such as the typical department store, merchants make firm offers which customers can either take or leave.

This matching establishes a contract between buyer and seller. After a deal is agreed upon, the product being sold must be transported to the buyer, and payment must be transferred. Logistics and settlement require a certain level of trust which protects buyers and sellers. Trust is often provided through the electronic market provider or a third party who issues a letter of credit or a rating of participants. The general institutional infrastructure specifies laws, rules and regulations that govern market transactions. Regulations such as contract law, dispute resolution, and intellectual property protection are typically the province of governments.

Institutional economics has classified different *governance structures*, i.e. ways to organize and conduct economic transactions (Williamson, 1975). These governance structures refer to different types of institutional arrangements within and between firms. One of these coordination forms is the market. “Hierarchies” are seen as an alternative to markets for coordinating the flow of materials and services through adjacent steps in the value chain. The decision between market or hierarchy can be rephrased in management terms as decision between make (= hierarchy) or buy (= procurement on the market) (Werthner and Klein, 1999, p. 143). Many economists have analyzed the advantages of hierarchical and market methods of coordinating economic activity in terms of various kinds of transaction costs (Coase, 1937; Williamson, 1981, 1975).

The price of a product can be seen as a combination of three elements: production costs, coordination costs, and profit margin. *Production costs* include the physical or other primary processes necessary to create and distribute the goods or services being produced. *Coordination costs* take into account the costs of gathering information, negotiating contracts, and protecting against the risks of “opportunistic” bargaining. Finally, the profit margin is what the producer earns. Williamson (1981) was the first to classify transactions into those that support coordination between multiple buyers and sellers (i.e. market transactions) and those supporting coordination within the company, as well as industry value chains (i.e. hierarchy transactions) (Wigand and Benjamin, 1993).

Various factors affect the relative desirability of markets and hierarchies. One of these factors is *coordination cost*, which seems likely to decrease through the use of information technology. Two other factors are *asset specificity* and *complexity of product description* (Malone, Yates and

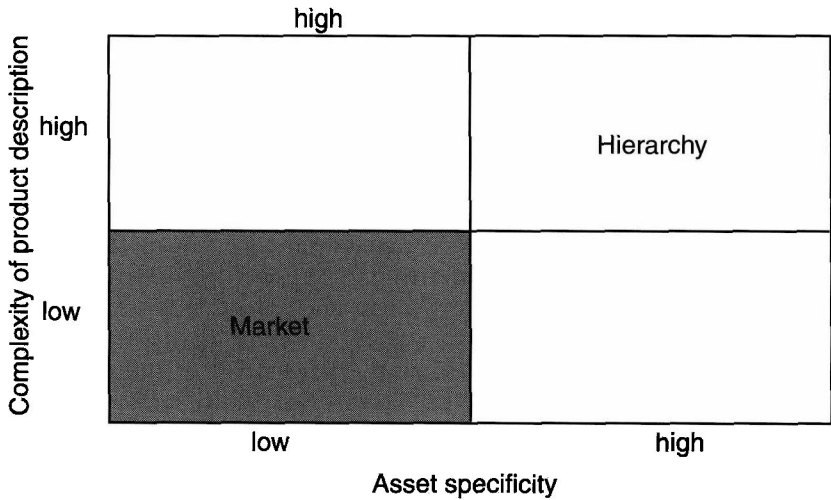


Figure 1.1 Product attributes and forms of coordination.

Benjamin, 1987). The input used by a company is highly asset-specific if it cannot readily be used by other firms because of site specificity, physical asset specificity, or human asset specificity. The term “complexity of product descriptions” refers to the amount of information needed to specify the attributes of a product in enough detail to allow potential buyers to make a selection. Stocks and commodities have simple descriptions, while those of automobiles or insurance companies are much more complex.

Highly specific assets are more likely to be acquired through hierarchical coordination than through market coordination because they often involve a long process of development and adjustment which allows the supplier to meet the needs of the procurer. Moreover, there are fewer alternative suppliers or buyers for a highly specific product. A highly complex product description often leads to hierarchical coordination, for reasons centring on the cost of communication about a product. Figure 1.1 shows that items that are both highly asset-specific and highly complex in product description are more likely to be obtained through a hierarchical relationship.

The shortcomings of market relations to provide sufficient incentives for relationship-specific investments and safeguards against opportunism and quality faults of the participants provide the background for the rise of a third coordination form, namely “inter-organizational networks” (Werthner and Klein, 1999). Networks try to combine the best of both worlds.

The strategic network has been defined as a long-term, purposeful arrangement among formally independent but related for-profit organizations that primarily allow those firms which are part of it to gain or sustain a competitive advantage over competitors outside the network. Although a strategic network is a polycentric system it is, unlike regional networks, strategically led by one or several hub organizations. (Sydow, 1992)

1.1.2 *The Impact of Information Technology*

Based on the coordination forms introduced in the previous subsection, electronic forms of governance have been established. In a seminal paper, Malone, Yates and Benjamin (1987) described the concept of electronic hierarchies and electronic markets. Electronic hierarchies facilitate a technically enabled, close relationship between companies in a value chain. EDI links between suppliers and retailers in the food industry are an example of hierarchical relationships. These technically enabled relationships often lead to a high level of dependence in asymmetrical power relations. Electronic markets have been defined as institutions in which entire business transactions among multiple buyers and sellers are executed electronically. Online Auctions such as Onsale <<http://www.onsale.com>> are an example of electronic markets (see section 5.7 for a broader overview). From an economics perspective, electronic markets have fundamental differences from traditional markets:

- *Transparency*: Electronic markets can be completely transparent owing to marginal search costs (Picot, Bortenlänger and Heiner, 1995). “Market transparency” is defined as the ability of market participants to observe the information in the trading process. Information can be related to current or past prices, offers, volume, and the identities and motivations of market participants. This information in electronic markets is available through advanced search and comparison services.
- *Size*: An important characteristic of electronic markets is that they are in principle not limited to regional borders, enabling the easy matching of partners from all over the world. This significantly increases the number of potential trade partners compared to traditional markets. It must also be considered, however, that partners may be located in another country with a different culture, other trade customs, etc. which may heighten the complexity of the interaction.
- *Cost*: The transaction costs for advertising, searching for trade partners and subsequent coordination are generally low owing to a high degree of automation and the cheap connectivity to the Internet (Wigand and Benjamin, 1993). In the early days of electronic commerce (in particular with value added networks and EDI during the 1980s) switching costs

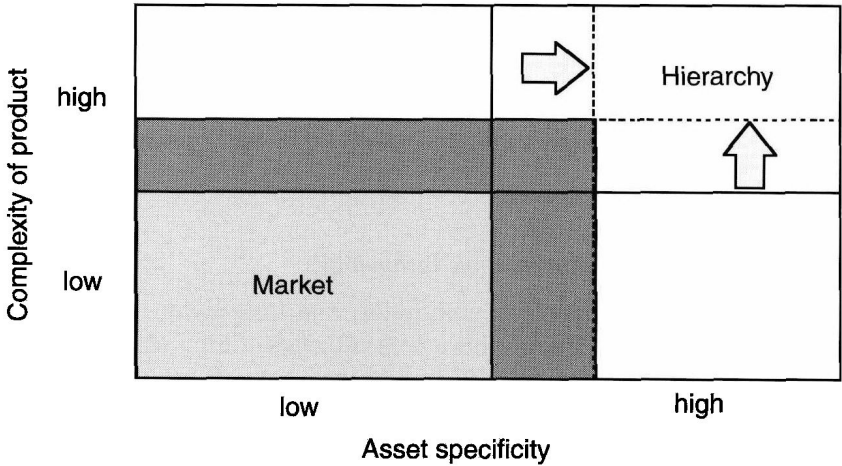


Figure 1.2 Move to electronic markets.
Source: Malone, Yates and Benjamin (1987).

for consumers were rather high owing to significant setup costs for electronic transactions. The costs have decreased as the Internet and its related standards homogenize the access channels.

Although the effects of information technology make both markets and hierarchies more efficient, Malone, Yates and Benjamin (1987) predicted an overall shift towards market coordination (see figure 1.2). The primary disadvantage of markets is the cost of conducting the market transactions themselves, which are generally higher in markets than in hierarchies. An overall reduction of coordination cost reduces the importance of the coordination cost dimension and, thus, leads to markets becoming more desirable. Moreover, low-cost computation favors electronic markets by simplifying complex product descriptions and asset specificity. For example, flexible manufacturing technology allows rapid changeover of production from one product to another. Besides, electronic marketplaces can be accessed by geographically separated buyers and sellers all over the world.

This “move to the market” hypothesis has been questioned by Clemons and Reddi (1994) who instead propose a “move to the middle” hypothesis. This means, on the one hand, a move away from the hierarchical vertically integrated organization to a higher degree of outsourcing, and, on the other hand, a move away from “faceless” market relations towards a situation where the firm relies on a few cooperative partners. These arguments are also based on transaction cost theorizing. The first part of the reasoning is