

## Chapter 1

### Introduction and Overview

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The phenomenal growth of the Internet since the mid-1990s is an unprecedented event in the history of information and communications technology. The Internet, essentially a collection of computer networks linked by cable and satellite, which started off connecting four supercomputers, today links more than 300 million people in 170 countries. And the rate of Internet traffic continues to grow rapidly.

The Internet has already fundamentally changed the way many individuals and organizations think about and perform their work. Electronic commerce—the conduct of business activities electronically via digital media—is now part of everyday business. And despite the sharp falls in the share prices of many ‘dotcoms’ since early 2000, e-commerce is still likely to have a major and *lasting* effect on most forms of economic activities.

This is true for the interactions of businesses both with consumers and with other businesses. On the business-to-business (B2B) side, web-based procurement systems, online business auctions and electronic negotiations are already commonplace in the interactions of large to medium-sized businesses with their suppliers and clients.<sup>1</sup> On the consumer side, the Internet is emerging as a significant medium for buying and selling certain goods, such as books, computer software and hardware, music CDs and airline tickets.

Advances in web-based technologies further support the growth of e-commerce. In particular, automation and delega-

<sup>1</sup> On October 5, 2002, *The Economist* ran a story “Life after dotcom death”, which began with the sentence; “If you think B2B market places are dead, read on”.

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tion technologies—known variously as intelligent or smart ‘agents’, ‘shopping bots’ or ‘bidding elves’—are likely to have a considerable effect on the future of e-commerce. These software programs make it possible, for example, for consumers to conduct automated searches and price comparisons, and for online sellers to know the identity of visiting consumers, access background information on them in real-time and adjust their prices and offerings accordingly. The technologies can even make decisions on behalf of individuals, negotiate with other programs and participate in online markets.

Much of the economic value of e-commerce arises from this kind of automation. The opportunities to use the Internet for business and comparison shopping are increased significantly by technologies that can take the place of activities that were previously done manually, especially those that were most costly in terms of data and working hours. And e-commerce, particularly automated e-commerce, creates new economic value not only by making business processes easier, but also by opening up new possibilities for market interactions.

That is the issue at the heart of this book. The aim is to provide an understanding of the added economic value of e-commerce applications for readers searching for “e-commerce solutions”. These might include e-commerce strategists and business managers in corporations, designers of new applications—whether online retailers, B2B marketplaces, negotiation technologies, auction websites or electronic exchanges—and potential investors in these enterprises.

As the rise and fall in the valuations of the first wave of e-commerce companies show, promises of profits at some vague point in the future are no longer going to be sufficient. Only business models based on sound economic propositions will survive and flourish. And that is where economic analysis is essential. This book provides the reader with the tools to understand and evaluate the underlying economic propositions of the wide range of actual and potential e-commerce businesses. And it demonstrates how the tools can be used to assess a variety of existing applications.

The first part of the book investigates the economic value of both consumer and business e-commerce applications, using the tools of economic analysis to explore key questions about the variety of trading mechanisms on the Internet. For example, are electronic markets likely to be more or less competitive

than ‘bricks-and-mortar’ markets? And what are the pros and cons of dynamic pricing, where sellers price their offerings according to the identity of each individual consumer? The goal is to understand the advantages of online trading mechanisms and the choices of individuals and organizations over which mechanism to use and when.

*Chapter 2* lays out the basic tools of economic analysis that can be used to evaluate e-commerce applications, notably the assumption of rationality, game theory and the concept of equilibrium. The guiding principle is that, to understand the way electronic markets—indeed any markets—work, it is essential to have an overarching framework of analysis.

This demands, first, a basic intuition of what incentives determine economic behavior, and the only reasonable one to use is rationality, i.e. that people (and software programs operating on their behalf) act in their own best interests. Second, it requires a way of thinking about how economic interactions take place across the whole market place; game theory is a very effective tool. And finally, it needs a “solution”, some means of predicting and assessing the potential outcome or outcomes of all those interactions, and that comes from the concept of equilibrium.

*Chapter 3* surveys e-commerce for consumers, focusing in particular on the economic implications of Internet technologies for prices and product offerings, and for competition between firms. There are two key questions: what are the incentives for consumers and retailers to trade online; and is it buyers or sellers who benefit the most? Relatively simple economic analysis can clarify the economic proposition underlying many consumer e-commerce technologies, notably “ShopBots”, i.e. virtual robots that scan the web for price and product information on behalf of consumers and retailers, and ‘personalization technologies’, which provide retailers and marketing companies with an enormous amount of consumer-specific data.

Shopping bots, for example, reduce the search costs of consumers virtually to zero since the software program does all the searching. At first sight, this might suggest that markets will become more competitive and prices will fall, at least those for homogeneous goods like books, CDs and software. But economic analysis casts some doubt on this view, and there is evidence that, although the prices of some goods are cheaper on the Internet, loyalty and branding still play a major role in the electronic retailing industry.

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Economics sheds light on the real relationship between consumer search power and the pricing strategies of online sellers, especially the new opportunities the latter have, using personalization technologies, to tailor both prices and products to individual consumers. Sellers can now take advantage of the vast array of data on their customers to treat them as individuals, employing such practices as price discrimination, product differentiation, 'one-to-one' marketing and mass customization. Chapter 3 addresses the incentives for both sellers and consumers to engage with each other using these technologies and marketing strategies.

*Chapter 4* provides an overview of B2B e-commerce, focusing in particular on the economic advantages of trading through e-commerce and comparing the pros and cons of the three main forms of electronic markets. In broad terms, firms can trade online via 'one-to-one' or direct negotiations; by participating in 'one-to-many' auctions; or through 'many-to-many' exchanges, where there are many potential buyers and sellers at any given time.

The volume of business e-commerce is estimated to be nearly ten times as large as that of consumer e-commerce. Most companies now use the Internet in one way or another to trade with their suppliers and corporate customers. Large parts of the supply chain are automated using e-commerce. And auctions are commonplace, as are web-based markets for many commodities, like steel and metal.

Chapter 4 provides a framework with which to understand the economic value of these business electronic markets. There are two key questions: what is the added economic value from switching to trading with other businesses from offline to online; and what is the preferable online trading mechanism; that is, how do firms choose the most profitable way to trade online? Economic analysis reveals how web-based markets—online auctions and electronic exchanges—can overcome the inefficiencies often associated with direct negotiations.

If part I of this book is about evaluating existing e-commerce applications, part II is about how to make things better. Economic engineering—the design of market mechanisms that encourage desirable economic outcomes—is certainly not a new invention, but the opportunities for practicing it have increased dramatically with the growth of e-commerce. The public seems to have acquired an appetite for trying out new

ways of buying and selling. Managers understand that proper economic engineering can make all the difference to their businesses. And the pressure toward trading electronically and further automation of the supply chain increases, because no one wants to be left out. It is no longer acceptable for managers not to know the advantages and disadvantages of auctions, say, or price discrimination.

The second part of the book is therefore a reference guide to the principles of economic engineering in the context of e-commerce: how economic analysis—and game theory in particular—can be used to help design efficient e-commerce applications.

It has been said that economists are forever theorizing about how they could make the world more efficient if only they were given a chance. Over the last ten years or so, they have finally had that chance. For example, the U.S. Federal Communications Commission invited a number of game theorists to design its telecommunications auctions. These turned out to be a huge success, bringing in revenues far greater than originally expected. Other countries, including the U.K., followed suit, employing game theorists to design large-scale auctions in order to maximize the government's revenue from licencing state-owned and natural resources.

Economic engineering is of course much more general than auction design. It is a set of tools for designing the rules that govern any interactions between individuals and firms. Over the last three decades, rapid progress in game theory has brought the subject to an engineering-like state, where a large number of well understood mechanisms can be prescribed for given sets of circumstances. Electronic markets are a particularly good place to apply this theory, because the interactions between participants are already regulated by the communication protocols of the software. They may as well be regulated by a well designed protocol, which, by setting the 'rules of the game' appropriately, provides participants with the right incentives leading to efficient outcomes.

*Chapter 5* sets out the basic principles of market engineering and its uses for e-commerce. Game theory can be used to consider the possible implications of various sets of rules, such as auctions and exchange, on the behavior of self-interested participants. On the basis of these conclusions, it is then possible to select mechanisms that ensure the efficiency of many types of e-commerce application.

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*Chapter 6* describes how ideas from the theory of negotiation can be used to resolve potential conflicts between participants in e-commerce applications. Negotiations lie at the heart of almost all e-commerce scenarios: buyers and sellers bargain for a price, companies negotiate the terms of agreement, and so on. In fact, a certain degree of conflict of interest is inevitable in most e-commerce applications (because of the nature of interactions between self-interested economic actors), and the parties involved must use some form of negotiation to resolve it.

Economic analysis takes the view that the choice of protocol (or the “rules of the game”) will typically affect the behavior of participants. For example, someone (or a software program acting on a person’s behalf) who is capable of making a credible “take-it-or-leave-it” offer is typically in a good bargaining position (*paradoxically* because they refuse to bargain). The designers of e-commerce systems must therefore take account of the strategic considerations of participants, especially in one-to-one bargaining situations, where these considerations are particularly significant. Chapter 6 reviews the theory and applications, and describes a number of new technologies designed specifically for e-commerce applications that involve one-to-one bargaining.

*Chapter 7* deals with auctions, clear winners of the e-commerce phenomena. Consumer web-based auction houses like eBay.com involve trade worth millions of dollars every day. Businesses in large numbers are incorporating online auctions into their transactions. And Microsoft’s release of an auction component in its e-commerce server will probably cause an increasing number of website developers to consider online auctions as part of their e-commerce solutions. By using an auction—instead of committing in advance to a fixed price—the seller is able to charge prices that reflect what buyers are willing to pay. This practice can, in many cases, increase the profits of the seller considerably.

Auctions are also an effective way of resolving the ‘one-to-many’ bargaining problem so that the seller does not need to negotiate with each of the potential buyers separately. This is particularly true for e-commerce, since the Internet can support only a limited amount of communication at any given time. Chapter 7 reviews the basic principles behind auction theory and describes a number of common auction types. It also describes a number of e-commerce auction technologies.

*Chapter 8* explores ‘many-to-many’ negotiations. This is a common set-up for trading in most commodities, where at any given stage there are many buyers and sellers.

The chapter explains how exchanges operate, how they are created and the incentives of participants to join them. It also provides designers of e-commerce exchanges with the basic theoretical tools to create and maintain such markets.

The chapter begins by discussing how goods and services can be standardized and describes the experience of a number of exchanges that struggle to standardize their offerings. It then discusses how exchanges work. Specifically, we examine what it means to set clearing prices and what affects this is likely to have on the market.

A key factor in determining the success of the exchange is its ability to provide liquidity. The chapter explains what exactly liquidity is and who provides it. It shows that industry consortiums are most likely to succeed in the long run because of their ability to bring enough liquidity to the market.

Finally, the chapter discusses the possibility of automating trading, by providing traders with software agents. Agents reduce the cost of trading, and increase its speed. These affects can increase trading volume, market efficiency and the profits made by the exchange. But traders need to trust their agents. The chapter describes Hewlett-Packard’s “Jester” experiments on the human-agent interface in exchange trading, and draws conclusions for the future use of such a technology.

The book ends with a case study of electronic communications networks (ECNs) and the affect they had on security trading in the United States in the second part of the 1990s.

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