

The digital economy has been in the public interest limelight since the 1990s. As a consequence of the digitalization of written work, music, games, and movies, these information goods can be moved almost without cost from one party to another. This has given rise to new business models and strategies used by firms operating in these markets. The rise of the Internet (and more recently broadband access) has had a dramatic impact on how real markets work: since transaction costs have fallen for physical goods also, more and more trade now takes place online—think of the success of eBay and Amazon as intermediaries and of Dell as an online seller.

Rapid innovations in computing capacity and upgrades of telephone and cable networks and wireless transmission have made it possible to transmit larger files faster so that software products, recorded music, and movies can be distributed via the Internet. Product information (including in the form of digital images) is also immediately accessible, increasing the flow of information. Software programs and other information goods, as well as the information that is distributed over the Internet, constitute the software side of the digital economy.

In this new economy, many things happen that seem to contradict standard economic wisdom: Platforms for software (such as Microsoft) subsidize other software producers that need this platform to offer software running on that platform. A famous pop artist (Robbie Williams) publicly invites his audience to download his music for free, right at the music industry's annual trade fair where executives are discussing how to contain the prospect of falling record sales due to the spread of piracy.¹ New Internet journals provide the latest news worldwide without charging consumers. Famous journalists, known as fervent protectors of their own copyright, start to post their reports (blogs) on the Internet without any protection. Many clever young

software engineers seem to be addicted to publicly sharing the development of new software products. Is standard economic theory in conflict with the digital economy? Do we need a new paradigm for industrial organization of this economy? This book is an attempt to provide a better understanding of the software side of the digital economy.

1.1 Overview of the Book

The digital economy is evolving rapidly, leading to dramatic changes in the structure of many industrial sectors. To understand what is going on and where this process is heading, we first need a deep understanding of the facts of this rapid change. At the same time, we also need a sound theoretical base. This volume makes important contributions to both aspects of industrial organization (IO) in the digital economy.²

Theory should be guided by facts, and facts need theory for understanding. The book as a whole, as well as its individual chapters, tries to cross-fertilize facts and theory. Chapters 2 through 5 extensively present factual knowledge of the digital economy. The remaining chapters concentrate on the theoretical modeling of various IO aspects of the digital economy.

This book focuses on software and music as the two industries of information goods that have experienced the most significant recent change and so have dominated the public debate. Since the digital economy has given rise to electronic intermediation, the book also considers the impact of electronic commerce and intermediation on the markets for physical goods.³

Chapters 2 and 3 present stylized facts on the software industry. Chapter 2 provides an empirical analysis to measure the innovation value of software patents. Chapter 3 contains a number of case studies on the business models of software platforms. Chapters 4 and 5 concentrate on the music industry. Chapter 4 is a broad guide to music in the digital economy; chapter 5 discusses the evidence concerning the impact of file sharing on sales for recorded music. Chapters 6 through 8 present theoretical contributions to the understanding of firm strategies related to digital goods. Chapter 6 analyzes versioning strategies, chapter 7 product announcement strategies, and chapter 8 protection strategies. Finally, chapters 9 and 10 focus on electronic commerce. Chapter 9 contains a collection of facts and some theoretical analysis

on the adoption of electronic commerce. Chapter 10 provides new theoretical perspectives based on insights from the literature on two-sided markets.

1.2 The Industrial Organization of the Digital Economy

Does the industrial organization literature have anything new to say about the digital economy? Or is this all old wine in new bottles? The industrial organization literature provides a general framework; many of its important theoretical and empirical insights over the past thirty years are directly applicable to the digital economy. Nevertheless, the digital economy poses new challenges for the theory of industrial organization: industries of the digital economy work quite differently from old industries, so new questions arise. Some old insights must be revised and seen from a different angle. Key issues are the following:

1. Two-sided markets These markets are characterized by indirect network effects between the different sides of the markets. In a buyer-seller context the buyer side cares about the number and possibly the composition of sellers, and the seller side has the same concerns about buyers. If a single firm operates the platform, then this firm affects the interaction between buyers and sellers with its pricing decisions and has to take the indirect network effects into account.

2. Intellectual property rights The economics of patents and copyright must be reconsidered in the case of information goods that can be exchanged easily. In that context, end-user piracy is a phenomenon that applies only to information goods and has become more important in the presence of fast Internet connections and file-sharing technology.

3. Marketing and selling techniques New marketing and selling techniques arise for information goods and for goods that are sold over the Internet.

4. Electronic commerce and the power of consumers and intermediaries Electronic commerce involves more active consumers engaging in searches, and intermediaries pricing the buyer and seller side.

1.2.1 Two-Sided Markets

Industries trading products such as software and games operate quite differently from old industries: firms at multiple layers determine the

success of a software or game “system.” In contrast, products in the old industry, if consumed jointly, usually are sold jointly and thus more often controlled by one firm (for example, consider the automobile industry). Related to this is that consumers in the digital economy customize their system; for example, they buy a game platform and select their favorite games. Clearly, customization also plays a role in other parts of the old economy. But in the old economy, different components of a “platform” are often compatible—one can put clothes in any washing machine, dishes in any dishwasher, etc. Hence, in the latter examples, purchasing decisions can be separated.

In the case of game systems (similar to software and music systems), consumers must decide jointly on the platform and applications. Because of incompatibility, games, software, and songs cannot be moved from one system to the other, nor can they be sold easily in a second-hand market. This implies that consumers are locked into a certain standard, and this standard is in some cases proprietary (for example, iTunes and game platforms). Examples from the digital economy have led to an emerging literature on two-sided markets. Even though other examples for such two-sided markets may be found outside the digital economy, this literature is closely linked to phenomena observed in the digital economy. Note also that this includes electronic commerce, that is, markets with electronic intermediaries that often distribute physical products.

In this book, two chapters are devoted to such systems in the digital economy. In chapter 3, David S. Evans, Andrei Hagiu, and Richard Schmalensee provide a case-based analysis of the economic role of software platforms. They present case studies of personal computers, video games, personal digital assistants, smart mobile phones, and digital content devices and explain several aspects of these businesses including pricing structures and degrees of integration. These observations are of high relevance in the emerging literature of two-sided markets.⁴

In chapter 10, Bruno Jullien discusses electronic intermediation from the perspective of two-sided markets. He builds a simple model of intermediation, which requires the matching of trading partners—say buyers and sellers. In this framework he presents a survey of the insights that emerge in the two-sided market literature and discusses some new aspects. The first part of the chapter is dedicated to monopoly intermediation and contrasts efficient pricing to monopoly pricing. The second part is concerned with the nature of competition between

intermediaries. Jullien addresses important issues such as competitive cross-subsidies, multihoming, and tying.

1.2.2 Intellectual Property Rights

Intellectual property right issues have received renewed attention in the context of the digital economy. Here, one can distinguish between patents and copyright. Patents play an important role in the software industry. An important patent issue is the measurement of patent value, as analyzed in chapter 2. With respect to copyright, the current debate is dominated by the analysis of a particular industry, namely the music industry, because music industry representatives have made a big issue of the impact of electronic transfer of music files over file-sharing systems. However, lessons learned from that industry are likely to have a wider impact because other industries have similar characteristics. In this book chapters 4 and 5 deal directly with digital music and file sharing. Chapter 2 addresses intellectual property right issues from a broader, theoretical perspective.

For a long time, economists have been asking whether incentive schemes like the patent system provide proper incentives for firms to invest in research and development. Recently, the digital economy put new emphasis on this question. Such an analysis requires a good measure of the value of innovations and patents. This quantification is not an easy task, especially in the digital economy, which is characterized by knowledge industries such as computer software. Yet quantification is especially important in the digital economy, where technology has changed rapidly, the number of patents has grown exponentially, and patenting has become an important strategy of firms.

Economists have used primarily patent citation data as a proxy for the value of the underlying innovation and knowledge flows. In chapter 2, Chaim Fershtman and Neil Gandal propose a refined measure of patent citations for software patents that weighs citations by the importance of the citing patent in such a way that the resulting weights are both endogenous and consistent. They then compare this *consistent weighted ranking* system (CWR) to the traditional measure of patent counts. Their empirical analysis suggests that the CWR measure is better in measuring patent value for the data they consider than simply the number of citations considered by others. They also uncover that there may be strategic reasons for citing patents.

In chapter 4, Martin Peitz and Patrick Waelbroeck present a fact-based guide to digital music. They contrast the traditional way of

selling recorded music to new ways with the Internet and compression technologies. As an alternative channel for disseminating music, file-sharing systems have played an important role recently. In their analysis of the music industry and file-sharing (or P2P) networks, they present industry and survey data, complemented by case studies of reactions to the rise of file-sharing networks. To understand these trends, they present survey evidence on consumer behavior in the digital world. They also provide some background on copyright issues and digital rights management.

In chapter 5, Stan J. Liebowitz gives a detailed account of the empirical evidence on the impact of file sharing on music sales. He reviews some of the theoretical analyses on end-user copying and concludes that there are few *a priori* reasons to expect that file sharing could increase or be neutral to music sales. According to his examination of recent empirical studies, the overall evidence supports the view that file sharing has hurt music sales. Liebowitz provides a critical reflection on methodological issues, implementation, and interpretation of the econometric estimations.

In chapter 8, Amit Gayer and Oz Shy provide a theoretical analysis of end-user copying and copyright enforcement. In particular, they question whether file sharing is inflicting significant harm on the recording industry. They argue that because of network effects an increase in end-user copying under certain conditions may actually make producers better off. They also point to a potential conflict between the creators of copyrighted works and the publishers because musicians or other creators often sell complementary products such as merchandise and concert tickets that strongly benefit from a wide distribution of recorded music, whereas the record companies typically benefit only from sales of recorded music.

1.2.3 Marketing and Selling Techniques

The digital economy has revived interest in sophisticated price discrimination, advertising, and protection techniques. In the case of digital goods, firms have the option to modify their products and offer them in different versions. They may want to preannounce their products in the case of network effects. In addition, firms can decide on protection of information goods through technological and legal measures.

In chapter 6, Paul Belleflamme provides a theoretical analysis of versioning practices (or second-degree price discrimination) for information goods. He presents simple and concise models that elaborate on

the strategic tools available to a firm with market power. In particular, he analyzes bundling, functional degradation, and conditioning prices on purchase history. These versioning tools are important strategic choices by firms operating in the digital economy.

In chapter 7, Jay Pil Choi, Eirik Gaard Kristiansen, and Jae Nahm give a theoretical analysis of a business practice prevalent among software developers: preannouncing new products. They give several explanations for the phenomenon. These preannouncements may be aimed at competitors or at consumers. The authors analyze in detail when such announcements are credible. In particular, software developers may acquire a reputation for being honest.

With chapter 8, Amit Gayer and Oz Shy also contribute to our understanding of the impact of copy protection on market outcomes. In particular, they show that in the presence of network effects a firm may not be interested in a severe punishment of copyright infringements.

1.2.4 Electronic Commerce and the Power of Consumers and Intermediaries

Not only firms use more sophisticated strategies; consumers may also change their behavior. An obvious example is that of search engines that allow consumers to find the lowest price for a certain product. Hence it is not at all clear whether firms or consumers will benefit more from the rise of exchanges for digital goods and more generally of electronic intermediaries for physical goods. In this context, electronic intermediaries must decide on their pricing strategies with respect to consumers and sellers. Two chapters of this book focus on electronic commerce and electronic intermediation.

In chapter 9, Emin M. Dinlersoz and Pedro Pereira discuss facts and develop theory about the adoption of electronic commerce by retailers. To explain these facts they construct a theoretical model focusing on market characteristics such as differences in firms' technologies, degrees of consumer loyalty, and preferences of consumers across the traditional versus the virtual market. The model generates results about the timing of decisions and the pricing in the market.

Chapter 10 by Bruno Jullien contributes to our understanding of electronic commerce from the angle of the two-sided market literature. In particular, he focuses on price-setting by electronic intermediaries. Electronic intermediaries control trade on the trading platforms and decide which prices to set for the different sides that participate on the platform.

1.3 Further Issues and Looking Ahead

This book connects with additional industrial organization aspects of the digital economy. Some of them are just beginning to be analyzed in economic research, and they certainly deserve further investigation. Here we discuss a few of them. The methods and industry studies presented in this book, in particular the analyses of two-sided markets, provide an especially promising starting point for this future research.

The open-source movement has provided an innovative solution to the allocation of property rights. People and firms involved in the movement contribute for free to the development of a digital product, for example, the software platform Linux. People contributing to a digital product such as Linux are providing a “community service.” Such community services are not restricted to programmers’ efforts for certain software products but include contributions to information goods such as online encyclopedias. It is interesting to note about these cases that the ascent of the Internet and the associated free community services lead to a substitution of nonmarket transactions for market transactions.

By contrast, other community services lead to new market transactions. For example, markets now operate that did not exist before the Internet and the business models that rely on community services. A good example is eBay, which provides a platform to buy and sell almost any kind of good and service.

The success of eBay rests in part on the trust trading partners have in each other, even though they are unlikely to ever trade with one another again. In particular, trading partners must trust the other side to carry out transactions as promised (that is, buyer makes payment and seller ships the good according to the agreed terms). This trust is achieved through a reputation system in which market participants voluntarily evaluate their trading partners. Market participants on each side try to build up and maintain their reputation because the other side of the market can condition its behavior based on the reputation. This is particularly relevant for sellers. Sellers with a good reputation command a higher price than sellers with a bad reputation, and so the reputation system works as a disciplining device. Note that because of high transaction costs some items would be traded in the absence of eBay; others would still be traded, but there would be a less efficient match of buyer and product.

The analysis of reputation on the Internet is a fascinating issue. It has the potential to provide a low-cost solution to an otherwise severe

asymmetric information problem. Overall, the Internet may make consumers more active and better informed. Lemons likely will be detected quickly and information spread rapidly. In this sense, electronic intermediaries become mainly certifying intermediaries where the intermediary simply aggregates the evaluation efforts of the market participants. To the extent that reputation cannot be moved between platforms, the reputation system is clearly an important source of network effects and is likely to lead to a highly concentrated industry (as in the case of eBay). The framework of two-sided markets as advanced in this book appears to be highly useful for the analysis of reputation effects in the digital economy.

Apart from solving asymmetric information problems, the easy accessibility of information on the Internet can lead to different selling strategies for information goods. In particular, rental and subscription services become attractive. Examples are digital music and video on demand. Note that buy-versus-rent decisions are also relevant for physical goods; however, such decisions likely will become more frequent in the digital economy. Similarly, the Internet allows for more sophisticated price and nonprice strategies, which are analyzed in various chapters of this book.

The increase of easily accessible information on the Internet and the reduction of transaction costs for trade have led to a substantial increase in the product variety that is available to average consumers, provided they have access to the Internet. Currently, we observe that new technological advances try to partly reverse this trend by introducing features that help to prevent information sharing and restrict the flexibility of use of information goods. Serious efforts toward an evaluation of the welfare effects of these changes are of critical importance for policy recommendations, including the evaluation of government interventions on the hardware side, such as the regulation of broadband.

In sum, this book improves our understanding of the microeconomics and industrial organization at work in the digital economy. We hope that it will stimulate further research in this promising field.

Notes

1. See *Economist*, Stepping up the war against piracy, January 30, 2003. Remarkably, Robbie Williams made this statement after he signed a deal in 2002 in which he gave his record label a share of money from touring, sponsorship, and DVD sales as well as from CDs, in return for big cash payments.

2. Preliminary versions of most of these contributions have been presented at a CESifo conference in Munich in summer 2004, published in *CESifo Economic Studies*.
3. A reader mainly interested in the software industry should definitely read chapters 2, 3, 6, 7, and 8. The music industry is analyzed in chapters 4, 5, 6, and 8. Chapters 9 and 10 cover electronic commerce and intermediation.
4. In chapter 4, Martin Peitz and Patrick Waelbroeck provide complementary information in the case of music platforms.