2. World-wide-welfare: A micro-economic analysis of 'the new economy'*

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2.1 INTRODUCTION

Worldwide, there has been – and still is – a lot of interest in what is generally referred to as 'the new economy'. It concerns economics that relates to digital information and the hardware and software that deals with it. The new thing about that form of economics is that, as a result of the digitalization of information, its exchange and multiplication can take place at close to zero marginal costs. With that, comes that an increasingly large number of people have an ever better wall or wireless connection to the new infrastructure that is formed by the world-wide-web. This allows for very fast, inexpensive and extensive transportation of information.

The economic relevance of these developments is large and growing. An ever-expanding economy flourishes on the Internet, in which supply and demand meet in virtual markets. As a result, old physical markets are being substituted at a continuous and rapid rate. On the other hand, many new markets have emerged such as the one for Internet guidance and many new markets will certainly open in the years to come. With that, the Internet is increasingly responsible for added value, which is, despite the burst of an early bubble, reflected in the value of firms engaged in information trade on the stock exchanges around the world.

Two of the many things that are written about the new economy meet the eye. First, the approach taken to understand new economy issues is often a macro-economic one. That is, the effects on macro-economic magnitudes

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such as national product, price level or employment are considered. These treatments are typically quite optimistic. National products and employment will rise for long periods of time, and without any inflation to speak of. Sepsis, although heard, often concerns semantic issues – is the new economy new or not new – or earlier eulogies of a macro-economic nature.

Second, it is regularly concluded that understanding the new economy demands a reconsideration of economic theory. Old economic laws allegedly no longer apply, for new ones have replaced them. Demand no longer leads to falls in prices, whereas supply often does. Companies need no longer make profits, but instead should give away their products for nothing. And since traditional economic laws no longer apply, speaking of 'new economics' is justified.

In some sense these two visions are at odds. If one is of the opinion that old theory cannot comprehend new economics, then one cannot support optimism about the effects of the new economy on welfare on the basis of old theories and measurements. And the other way around: optimism on the basis of macro-economic statistics reveals a faith in the applicability of the underlying theory. It is therefore important to find a theoretical structure that can be used to consider the 'new economy's' blessings and plagues.

It is certainly the case that particular traditional insights, such as the existence of a trade-off between unemployment and inflation as represented in the Phillips curve, or measurement methods based on prices, such as inflation indices, are less solid and reliable in an economy in which information increasingly flows at decreasing average costs. The latter corresponds to the paradox on the national product in heaven and in hell. In heaven, there is no scarcity. All commodities are available in abundance. Consequently, all prices, and hence the national product, are equal to zero. In hell, on the other hand, there is a need for energy to keep the temperature sufficiently high. On top of that, everything is scarce and priced highly. As a result, the national product is substantial. Traditional macro-economics has to be careful, therefore, not to measure a preference for hell over heaven.

The questions we are concerned with here are more modest, however: isn't it possible to use the concepts developed in economic theory to consider how to efficiently allocate scarce means over alternative ends in an attempt to shed light on the new economy as well? The discipline in which the allocation issue led to the development of sophisticated models is micro-economics. On the basis of the structure of economies, and the behaviour of consumers and producers in it, micro-economics derives conclusions about social welfare. The latter is a consistently defined concept that is not open to the macro-economic measurement problems pointed at

above. Micro-economic theory seems, therefore, particularly suitable for making statements about the new economy. It can serve to give hands and feet to either widespread optimism, or a sceptical attitude.

Since its earliest development, the role of information in understanding societies has been central in micro-economics. Adam Smith's notion of 'the invisible hand' in competitive markets concerns in essence the spread of sufficient information via market prices to ensure that individually optimal decisions are socially optimal as well. Micro-economics seems well equipped to handle information issues, that is.

The applicability of micro-economic theory, however, falls or stands with the presence of scarcity in the new economy. After all, it is the use of scarce means for alternative ends on which the theory concludes, it is scarcity that determines the prices of commodities, and it is the prices of commodities that guide the invisible hand. Yet, digitalized information can be reproduced and transported without loss of quality and at close to zero marginal costs can be multiplied and transported. This seems to challenge the scarcity concept. However, an unbridled production of information leads to a new type of scarcity: the time it takes to select, personalize and consume information. Moreover, there is an artificial way to make information scarce: the granting of intellectual property rights. And a further potential source of scarcity lies in the carriers of information, the information infrastructure.

In this chapter we consider some of the consequences that large-scale traffic of digitalized information can have for the structure of supply and demand, as well as for competitive processes and social welfare. To that end, the following section contains a micro-economic treatment of information and markets that offers a handle for an analysis of the new economy. We introduce the distinction between commodity information and information commodities. Section 3 analyses the consequences of increased commodity information in the new economy. This concerns commodity information on traditional commodities as well as information commodities. Section 4 discusses the specific economic aspects of information commodities. Section 5 considers the carriers of information streams, the information infrastructure, and particularly several important consequences of the private production thereof. Section 6 concludes with concerns about new and specific restrictive tendencies in the new economy.

2.2 INFORMATION AND COMMODITIES

The central aspect of the new economy is its feature that information is reproduced and distributed at extraordinary low marginal costs, with no loss

of quality to speak of. The latter is possible because of the form information takes and the rise of new telecommunications networks, with the Internet as a prominent example. We use the term 'information' for everything that can be digitalized; that is, all that can be put in a series of zeros and ones. It is the digitalization of information that facilitates its wide and rapid spread. And even though digitalization is not always fully feasible – after all, a digital signal is only a discrete approximation of an analogue signal – the cut off peaks only really bother the hardened LP record or celluloid film enthusiast. All information – be it newspaper articles, medical records, train schedules or rock songs – can be digitized for practical purposes.

2.2.1 A Classification of Information

In order to unravel the influence of information on the way decisions are made, it is useful to make a categorization. The first and most elementary distinction is that between pure and instrumental information.[1] Pure information – that should be considered distinct from its carrier – is information that is a direct source of utility, or information that is directly used as an input factor in a production process. An example of information as a consumption good is a movie, but then without the cinema. An example of information as a production factor is a word processor, but without the CD-ROM on which it comes. Pure information is a commodity and is therefore characterized just like other commodities, by content, time and place of availability, and state of the world at the time of availability.[2] We refer to pure information as 'information commodity'.

Instrumental information, on the contrary, is information about things that provide direct utility or serve in production. It is commodity information, such as the information that a certain movie plays at a certain time in a certain theatre, or information about the availability of certain types of production factors. Commodity information is in the micro-economic literature generally represented by a probability distribution over the set of possible states of the world. In the case of complete commodity information, there is no uncertainty and the distribution over possible states of the world is degenerated. In the case of incomplete commodity information, however, individuals base their decisions on a non-degenerated distribution. New commodity information generally leads to an update of this distribution.[3]

Where information commodities are a direct source of utility in themselves, commodity information specifies individuals' choice problems over all sorts of commodities that provide utility. It has little value in itself, but derives value from the possibility to make better choices. Commodity information serves to enable one, for example, to better enjoy the information commodity movie by being in time for the show, or to make lemonade more

efficiently out of lemons – which in essence is the same. Also, information that producers obtain about the buying behaviour and preferences of their customers features in this categorization under commodity information. Commodity information is information about the elements of the commodity vector, including information commodities. Information is very often available in both forms simultaneously. A film review, for example, is both an information commodity – as it often is amusing reading – and commodity information, since it leads to better choices in the matter of theatre visits. An element of commodity information that attracts a lot of attention in the economic literature is the price of a commodity – whether an information commodity or otherwise.

It is important in this context to note the difference between the interpretation of one piece of commodity information by different individuals. Confronted with a large amount of identical information, different individuals may form similar expectations.[4] Yet, on the basis of the same signals from the outside world, different individuals may also form different expectations. This has to do with both the structure of the view of the world that someone has and the initial probabilities that are assigned to possible developments within that structure. In Section 3 we come back to this.

The indirect value of information may cause commodity information to be traded as if it were a commodity. The information regarding what movie plays when could be offered for sale – generally it is of course offered free. Another, and perhaps better, example of tradable commodity information is the information necessary for the sellers and potential buyers of houses to find each other. The trade in this commodity, which consists of commodity information, earns real-estate brokers their daily bread. Their well-being, however, depends on the latter only.

Although information can therefore be analysed separately from its carrier, to be useful it has to be stored, for example on a DVD, paper, or in human minds. Traditional carriers add characteristics to the combination of information and carrier that make the total product a standard commodity in the economic sense. An example is again the information commodity movie shown in a movie theatre. Since the number of seats in the cinema is limited, a positive price can be charged for this commodity. Also the information printed in the consumers' magazine is tied to a paper carrier that needs to be acquired. Tradable commodity information obtains the characteristics of a traditional commodity, and is characterized by content, time and place of availability, as well as state of the world.

Developments around the information infrastructure, such as wireless Internet, are interesting because they make the tie between information and carrier less rigid. As a result of decreasing scarcity in carriers such as digital

memory, the special characteristics of information as a commodity – information commodity and tradable commodity information – play a larger role. The cheaper transportation of information makes the information's location of availability of ever lesser concern. For producers, this implies that a traditionally important element on which to build monopoly power disappears. Apart from that, the technological progress leads to new applications of information, applications that before were simply not feasible or were too expensive.

2.2.2 Specific Characteristics of Information

Both the production and the distribution of information are significantly different from those of physical commodities. This was already recognized by Arrow in the early 1960s, who observed that the production of new information generally requires high fixed costs, which are largely sunk once made. Writing a book, for example, demands a special effort of the writer. Once this production has taken place, however, reproduction is easy and can take place at relatively low marginal costs. This is the case with books since the invention of the art of printing, but more recently it holds for copying computer software as well. The marginal costs necessary for the production of information are nil.

This asymmetry between fixed and marginal costs causes a number of important problems. Because copying is simple, information once produced spreads quickly and easily. As a result, it is questionable whether someone is willing to make the initial investment in the production of new information. After all, there is a real possibility that it will not be possible to earn the investment back. The consequences of this are all the more disastrous when one takes the public good aspect of information into account.[5] Naturally, this is the basis of intellectual property rights, to which we turn in Section 2.4.4.

Information, therefore, can be transmitted from one individual to the next. In that information has the characteristic noted by Arrow that when it is passed on, it remains part of the endowment of the offering party. In most cases this is evident for commodity information, but for information commodities is holds equally true. Trade in information, therefore, typically involves its multiplication. Information is, as a result, not necessarily a commodity for which rivalry exists.

Unintended communication of information can also take place. An example is leakage of information. This happens relatively easily, particularly because information can be exchanged without deterioration and at low costs. In a way, information has as a consequence of these characteristics a natural tendency to spread. In many cases, the leakage of information

is actually very desirable. In general it is socially optimal when information, once produced, is made public to as large a group as possible.

Another special aspect of information is that the determination of its value is hard without consuming it. Information, in other words, is an experience good. This causes problems in its transmission. Decisions on the purchase of information, as a consequence, are generally decisions under uncertainty. We return to the specific possibilities that the new economy offers for trade in information commodities.

In many cases, the tendency of information to spread also allows for abuse. People can have an incentive to leak misleading or false information. A traditional example of the spread of such information concerns the announcement of business news in an attempt to manipulate the price of stocks. Some attribute a large part of the gold rush to this effect: land owners spreading the rumour that the mother lode crossed their property, in an attempt to raise the sale or lease price of the lot.

As a result, the reliability of information is an important part of its economic analysis. In order to be able to judge it, it can, for example, be important to know who spread the information, how many others have already used it, and who knows who has what information. That way, it can be determined whether the information was released with specific perverse incentives. Information can, for this purpose, be categorized: first-order information is the actual information and higher-order information is information about the information. To take movies again: a review constitutes first-order commodity information about the information commodity movie, and second-order commodity information about the review, which is the newspaper in which it appeared, or the name and fame of the reviewer.

A special kind of higher-order information is the so-called common knowledge. This is information that everybody knows everybody has. Such information is a strong form of public information, which is information that everybody has, but of which it is not necessarily known that such is the case. It contrasts sharply with private information, which is information that is available only to one individual. The natural tendency of information to spread easily creates a tendency for private information to become public information, and finally common knowledge.

2.3 COMMODITY INFORMATION

Commodity information has been defined in the previous section as knowledge about commodities and services that allows consumers and producers to specify their chosen problems. Commodity information comes in many varieties. When the costs associated with storing and selecting information

are ignored, individual choice making is enhanced with more specific information. After all, more information facilitates comparing different alternatives, while the original option is still available.[6] As a result commodity information has a derived value for individuals.

2.3.1 The Individual Value of Commodity Information

A somewhat naive approach by which to derive the value of commodity information is to compare the choices made without and with commodity information. A conundrum that arises here, however, is that *ex ante* it is not known what the return of that commodity information will be. Another problem with simply comparing choices made *ex ante* and *ex post* is that a choice made after collecting more information can, purely by coincidence, turn out to be worse than a decision made with less information, even when the information was actually reliable and valuable.

Collected information can be seen as a series of messages. The joint probability distribution of a message and state of the world depends on the view of the individual. Assume that someone has the choice between taking immediate action, or first collecting information with the idea to take action later. The choice of a particular action, together with the selection of a state of the world by chance, results in a certain pay-off. Initially, the individual expects given states to arise with certain prior probabilities. He or she can choose to collect information on the basis of which to change this prior distribution. Given the probability with which any particular message is received, the joint probability of a message and a state, and the conditional probability of a particular message given the state of the world, the so-called posterior distribution can be derived using Bayes' law.[7] On the basis of this model, it is possible to determine whether or not an individual will collect information. The utility value of a message is then equal to the utility of the optimal choice made after receiving the message, minus the utility of the optimal choice made without the message.

The above model also allows for a further sharpening of the distinction between commodity information and information commodities. Commodity information complies with information defined as follows in Arrow (1978 p. 7): 'By "information", I mean any observation which effectively changes probabilities according to the principles of conditional probability.' This is only part of our definition of information as anything that can be represented in a stream of zeros and ones. Therefore, music, for example, is information, while listening to music will scarcely give reason to reconsider the probabilities with which future developments are foreseen.

As said, the utility value of a message is always non-negative. The expected value of information is the expected value under the prior utility

values when all possible messages are taken together. It determines how much somebody would maximally want to pay for the use of a certain message service, such as a newspaper, an Internet site or an expert. In this way it is possible to compare the value of information services, and to rank them. Since subjective worldviews determine the value of an information service, individuals rank information services differently. On top of that, the above analysis does not take into account that there are costs associated with the processing and use of information. These capacities differ for different individuals as well. This is one reason why there is such a variety of information services on the Internet.

It is to be expected, for example, that information is different for people with a different attitude towards risk. Intuitively a risk-averse person would want to incur more costs for collecting information before taking a decision than someone with less aversion towards risk. This is not necessarily so, however. If the optimal action without first obtaining information leads with certainty to a particular pay-off, a more risk-averse individual will actually optimally collect less information. The possible variations in income resulting from the new information are not particularly appreciated. The other way around, if collecting information reveals the state of the world with certainty, a risk-averse person collects more information. Extra information, however, always has a non-negative value, for risk-loving and risk-averse people alike.

2.3.2 The Social Value of Commodity Information

A better match between the real probabilities with which events can take place and the subjective expectation of these, therefore, is desirable for the individual decision maker. The significantly improved means of communication in the new economy, therefore, certainly have a private value. Moreover, increased transparency of possibilities and restraints has a positive effect on social welfare as well: it can decrease transaction costs and enhance competition.

General equilibrium models are models in which the social consequences of individual choices in certain economic market structures find expression. Although not inherently, the most important results in general equilibrium models are found in its limit model with rational agents, markets with perfect competition and the absence of transaction costs.

In short, the findings of the general equilibrium research amount to the following. Consider an economy with a complete system of markets, which means that at each point in time there exist markets for commodities that are available at that point in time, but also for all commodities that become available in the future, possibly conditional on the realization of future

uncertain events. The information about future commodities that is initially present is in general asymmetrically distributed over the individuals. The equilibrium prices that result in such an economy, however, are such that all existing information is revealed.[8]

It is possible to relax the assumption of the existence of a complete system of markets to the (still strong) condition that a complete system of financial markets exists, or alternatively put, that agents are able to insure themselves against all possible events. This complies with the more general idea that a system with complete financial markets leads to the same result as a system with complete commodity markets.[9] It should be noted however that, although equilibria in both market systems have identical characteristics, the conditions under which coordination on an equilibrium takes place differ.[10]

Outside the context of general equilibrium, auction theory concerns the question of whether perfect competition leads to the complete revelation of all available information. Consider the situation in which an object is auctioned that represents the same value for all, a value that is unknown. Every participant knows this value, however, and the information of all participants together is sufficient to determine the value of the object. For both a decreasing auction and an increasing auction in which the highest bidder pays the second highest bid, the winning bid is equal to the actual value of the object if the number of participants is sufficiently large.[11]

These results are very powerful. They show that in an economy with sufficient competition, information problems play no role: individuals can use market equilibrium prices to obtain all available commodity information. The level of rationality necessary for this, however, is staggering, and by far surpasses the level demanded in a standard general equilibrium model, as it assumes structural knowledge such as insight into the preferences of individuals. The important lesson learned from these models is that commodity prices can reveal quite a lot of commodity information, provided transaction costs are low and information spreads very quickly. It is particularly these assumptions that gain in empirical relevance in the new economy, so that it may enhance the absorption of commodity information in market prices.

2.3.3 A Disequilibrium Approach

In the absence of a complete system of commodity markets, the usual equilibrium concept in general equilibrium theory takes out a loan on rationality. Economic subjects do not only need to know the prices of commodities, they are also required to have insight into 'the model' of the economy. Originally, this is the idea behind the long popular but increasingly questioned 'rational expectations approach'. The idea is that if

economists know the model, the economic agents in it should be assumed to be able to know it as well. Therefore, they should not be consistently off the mark in their predictions of equilibrium values. There is, however, an important difference between structural insights into economies and parametric knowledge of them. For both, but especially the latter, an unreasonable amount of information is demanded.

Interestingly enough, the literature on rational expectations as justification of the equilibrium approach has pushed aside the ideas of economists such as Friedrich von Hayek and Kenneth Arrow, which apply, however, much better to the new economy. These scholars argued that competitive economies are not to be praised particularly for the existence of efficient equilibria, but for the fact that the competitive process is an important distributor of information. Rival bids and bargaining will reveal options to others they were previously unaware of, so that prices paid will eventually gravitate towards values that reflect the marginal costs of goods. The competitive process may eventually lead to efficiency, but through an adjustment process in which information plays a crucial role.

It is particularly in this disequilibrium sense that an important influence is to be expected from developments such as the growth of modern information and communication technology. As these technologies accommodate the fast distribution of information, they enhance competition. Consumers are better able to compare prices and qualities of different suppliers, so that margins and intermediaries play ever smaller roles.

Illustrative examples of the latter are brokers in houses, or dealers in second-hand cars. Although these intermediaries do have their own added value in determining the quality of the goods offered, that function apparently does not justify the fees paid for their services in the past. Particularly as a result of the increase in communication that runs via the Internet, these margins have recently decreased significantly. Indeed, for the large part they used to be derived from the difficulties that buyers and sellers in the market have in finding each other. These search costs are the direct consequence of a lack of transparency of markets. In the new economy, a decrease in such costs is to be expected, as is an increase in competitive pressures on both suppliers and demanders. The result is that reality will increasingly become like the competitive general equilibrium models with their nice efficiency properties – be they second-best or first-best. Such is highly socially desirable.

With a flourishing new economy there seem to be both private and social benefits. A better connection between preferences and possibilities on an economy-wide scale can lead to an important increase in social welfare. Nevertheless, it is important to make some qualifications with respect to unbridled enthusiasm based on this type of argument. It follows, for example, that unlimited growth cannot be expected if the benefits of the

new economy are particularly found in the resolution of inefficiencies of the old one. Growth is more likely to take the form of a temporary spurt, after which equilibrium is reached at a permanently higher level of welfare. This view may shed light on the burst dot-com bubble, for example.

2.3.4 Information Costs

So far our analysis has assumed that relevant commodity information is readily available at close to zero cost. Collecting, storing and processing information, however, does involve costs. If commodity information can only be obtained and used at a cost, it is still true in general that more information leads to more efficient choices. The efficient amount of information to collect, however, is no longer equal to the total of relevant information. If the marginal contribution to the decision problem is equal to the marginal costs of getting the information, one should stop further inquiries and make a decision.

In many decision problems there is not one single individual who decides, but a group that takes decisions collectively. If the members of the group have different expectations or different objectives, there is a tendency to collect too much information. In the case of different expectations, the reason for this is that these can only coincide when large amounts of identical information are shared. Inefficiently large amounts of information then only serve to justify an otherwise unavoidable decision for all. If there are different objectives, collecting more information helps to put off decisions and keep alternatives open. In both cases abundant information may well have a negative influence on welfare.[12]

There is yet another important social danger that lurks when too much information is available: some options of choice disappear when more information becomes available. Moreover, certain markets exist only by the grace of incomplete information. A well-known example of this is the insurance market. If it is possible to determine with certainty that someone suffers from a certain illness or will be struck by disaster, there is no possibility of insuring against it. In other words, after revelation of the state of the world it is no longer possible to insure oneself. Such can lead to important welfare losses.[13]

The above-mentioned detrimental effects of more information increase the costs of obtaining information. This latter effect is a certain danger that exists in the new economy. As a result of the large supply of information on the Internet, it has become increasingly difficult to separate important from less important, useless, or even false, information. This introduces at least two new problems. First, the overload of information requires storage capacity and time to select valuable and less valuable information.

Second, the reliability of information is not always easily determined and extra costs are incurred in verification.

2.3.5 Virtual Markets

The necessity to select and verify information generates direct costs, but it also has consequences for market structures, especially the structure of virtual markets. These are meeting places of supply and demand that only exist on-line. Whereas the increase in available information reduces the role of certain traditional intermediaries, it also creates room for new ones that select and individualize information. Search engines already do this, albeit quite imperfectly. It is likely that they will be further developed to play into the specific interests of those seeking commodity information. It remains to be seen, however, whether they will ever be able to compete with human consultants. Moreover, if a search engine were to have this potential, it would be likely to exercise a local monopoly power over anyone who used it.

The reputation of suppliers in virtual markets is important in establishing transactions. Concerning commodity information, the Internet creates intervals between the different stages of an exchange. When someone buys a book in a local store, he or she pays while the book is being wrapped up and it can be taken out immediately. A transaction with an Internet bookseller, however, involves an impersonal electronic order, after which it takes some time and risky shipping, before the item, which then has already been paid for by credit, is eventually received. Because there is no cash on the nail, both the method of payment and the delivery require trust of the buyer in the system of the seller, as well as trust of the seller in the credibility of the buyer.

This has several negative effects. Starting entrepreneurs will first have to build confidence among consumers, and this can be very difficult when there are already well-established large incumbents. This is apart from the fact that the incumbent is likely to have other scale economies already, for example in the access to distribution channels. As a result of these problems, market power rises, and can nullify large parts of the efficiency-enlarging possibilities of the increased means for communication. Reputation becomes an important barrier to entry as a result.

Crucial in Internet transactions are the credit card companies. They accommodate the larger part of Internet transactions by means of virtual payments. In order to prevent hesitation and reluctance to trade on the Internet, credit card companies offer a guarantee against potential fraudulent use of credit card numbers. This insurance against fraud is costly, however, which represents a cost typical to virtual transactions that is likely to rise rather than fall.

Another problem is that credit cards are not suitable for all types of transactions on the Internet – particularly not for one-to-one transactions between individuals. Cash payment methods, or bank wires, on the contrary do not fit when transactions are to be completed immediately. For other uses in the new economy it is important to make payments in very small units. An example is downloading information for the price of just a fraction of a cent. Although alternative methods of payment have been developed, confidence problems play an even greater role there.

Confidence issues in payments clearly have the potential to reduce potential efficiency gains. A lack of confidence will put a certain upper bound to virtual transactions. In this context, extensive research has been done into drugs transactions. In the drugs trade there have always existed confidence issues, simply because there is no possibility for falling back on a judicial system for sanctions. Larger transactions are, as a result, split into smaller parts. It has been observed even that dealer and customer exchange little suitcases with drugs and money in several transactions following each other, in order to reduce the risks of unilateral default. The comparable risks of unilateral failure to close a deal in Internet transactions may well put a similar type of upper limit to these transactions. Larger ones will then only take place in a personal meeting – even though parties may still have found each other via telecommunication.[14]

New intermediaries specialize in providing identification methods to reduce confidence problems. Moreover, the increased role of credit card companies as insurance providers leads to a drive for size. After all, the more transactions, the lower the variance in returns caused by non-payment and fraudulent use. Together with the reputation effects that hold for credit card companies as well, this effect kills competition in the payment traffic.[15]

A confidence problem on the side of the buyer is the fact that it is not transparent what consequences placing a virtual order may have for his or her anonymity. In traditional transactions, apart maybe from the local supermarket, some anonymity is guaranteed. Payment can take place with non-traceable money after which the parties split up. Internet transactions, starting from the surfing to obtain information, reveal the preferences and purchases of the customer and offer the possibility to store, and therefore use and exploit, that information for many years to come. Companies have developed protocols to protect private information from being misused. Also, there exist virtual banks where money can be put and from where anonymous payments can be made. It is particularly the lack of transparency concerning the possibilities and impossibilities of undesired use of private information that can be an important cause of reluctance to trade on virtual markets.

Even when the commodity information offered is reliable, it can still be incomplete. It is not easy to compare prices on the Internet: even at a transparent site it demands quite some work to establish the exact total outlay necessary to acquire an item, as this includes transportation and insurance costs, for example. As there does not exist a simple standard by which one can easily compare prices, there remains scope for monopolistic competition and costly intermediaries.

Stronger than this effect, however, is a related drive for intermediaries to keep information dispersed. Suppose that the virtual markets are in perfect competition. Then none of the consumers has an incentive to incur expense in order to search for commodity information, not even when costs are very small. Likewise, websites with comparative price information for homogeneous commodities can only exist by the grace of price dispersion. This type of site therefore has an incentive to leave a certain amount of price dispersion remaining, since that provides the rights to their existence and their profit opportunity.[16]

In a market with sufficient numbers of competing sellers, an efficient and reliable information service gives rise to strong pressures from potential competition. This induces a collective incentive among the sellers to make the Internet into the type of unreliable and uninformative medium that television is with commercials, for example. In that case, the informative role has been pushed away by entertaining and manipulative functions that strengthen the positions of market power. This is a clear and present danger.[17]

2.4 INFORMATION COMMODITIES

In this section we address the second important product of the new economy: pure information in the form of information commodities. The high fixed costs of information commodities make it far from socially optimal to produce all imaginable information commodities, even though the costs of reproduction and distribution are zero. The social benefits of an information commodity need to exceed its fixed costs to make its production desirable. As soon as an information commodity has been produced, and is therefore available, social optimality requires that each and every person who associates a positive value with the information commodity (or would potentially do so after experiencing the commodity), has it at his or her disposal.

Reality differs substantially from this social optimum. Money is made on information commodities by charging non-negligible prices for them and by restricting their distribution. This is not only so for Microsoft's

'Windows' software, but also for publishers of books and music, or for old movies, which are only available on DVD at prices that are excessive when compared to the costs of reproduction and distribution. This is so for a number of reasons, studied in some depth in this section.

2.4.1 Market Structure

The underlying structure of demand and supply for information commodities makes a competitive market structure, with many suppliers behaving like price-takers, very unlikely. The ultimately evolving market structure will display high concentration rates instead. In most cases a natural monopoly will result; or a market structure with one dominant firm and a number of small competitors; or a market structure of monopolistic competition, where a number of firms offer variations of basically the same product.

Even though there are few industries where increasing returns to scale take the extreme form of the production of information commodities, strongly increasing returns to scale are not a new phenomenon. The production of airplanes is a well-known example. Comparably strong increasing returns to scale are also present in the airline industry as long as an airplane is not filled. However, in these traditional industries capacity constraints are much more clearly present than they are in the production of information, which naturally limits the potential benefits from increasing returns to scale.

Although the long-run market structure of information commodities has monopolistic features, the way towards market equilibrium is often characterized by severe competition between producers of the same information commodity. The importance of exploiting increasing returns to scale, namely, creates a first-mover advantage when selling an information commodity in large quantities. There are strong incentives to quickly build up a large market share. This causes large investments in research and development, perhaps excessively large.[18] Moreover, the drive for market share makes substantial outlays on advertising unavoidable.

Another reason for large outlays on advertisements is the fact that information goods are pre-eminent examples of experience goods. An information commodity such as a message service or a television series, with repeated sales and consumption, enables a producer to acquire a reputation for being a high-quality supplier. For an information commodity that is sold only once, it is more difficult to build up a reputation by means of selling high quality. Problems of adverse selection are likely to occur if it is difficult for a consumer to distinguish high-quality from inferior information commodities.[19] Consumers who are not able to assess the value of an

information good will infer that the information commodities offered for sale are low quality, and will decide not to buy. This may prevent mutually advantageous trade from taking place.

Sellers may use advertising to escape problems caused by asymmetric information. Suppliers of high-quality information commodities in particular may signal high quality by means of a well thought-out advertisement policy. Suppliers of information commodities with a beneficial price to quality ratio have higher profits per unit sold than suppliers that are less efficient. This increases their incentives to spend money on advertising. In addition to this, advertising outlays may serve to build up a brand name that sustains a strong reputation. This provides producers of information commodities with additional reasons to incur high expenses on advertising.[20]

The road to monopoly is paved with intense price wars that drive prices to nil, should the structure of competition evolve into a Bertrand-type. As a consequence, producers of information commodities have strong incentives to avoid price competition on homogeneous goods. Instead, they seek and protect monopoly positions. The common instruments to achieve these goals are product differentiation, the lock-in of existing customers and the protection of information commodities by means of intellectual property rights.

2.4.2 Product Differentiation

Whenever possible, producers of information commodities will try to differentiate their product from those of their competitors. It is, however, more difficult to differentiate one's product than it may appear to be. Many forms of product differentiation do not stand the test of imitation. This is even more so as the Internet makes imitation quite simple in many cases. On the other hand, the new economy offers possibilities for product differentiation that were traditionally less readily available. The information available on customers, for example, makes it possible to offer a tailor-made information commodity. Information acquisition on customers is possible by studying their past sales records, the terms they used in search engines, as well as their search behaviour on the web. Such information is of crucial importance for formulating advertising strategies, since it allows for well-focused campaigns.

2.4.3 Lock-in

Suppliers of information commodities are certain to use the opportunity of keeping customers once they are acquired by incorporating a sufficient amount of switching costs. In this respect it is helpful to such suppliers that

for many information commodities lock-in arises in a natural way. Yet the amount of lock-in is a parameter that can be influenced by the supplier of an information commodity, which will play a prominent role in the strategic plan of many suppliers.

Consider the situation where a number of suppliers each offer a similar information commodity for sale. From the moment a customer has chosen a certain information commodity, it will often be difficult to make use of another supplier because of switching costs. For an information commodity like a word processor, the switching costs do not only involve the investment of the time needed to learn to use a new program. The choice of a new software package often implies the necessity to rework old files, a lack of compatibility with other software, increased difficulty in communicating with others, and so on. Moreover, the possibility to fine-tune information commodities to a specific customer leads to high relation-specific investments, and thereby to lock-in.

After a consumer has chosen a particular information commodity, the producer of that commodity obtains a monopoly position with respect to that consumer when switching costs are high. A consumer who realizes that he or she becomes a sitting duck after lock-in may decide not to buy at all. As a fortunate circumstance, this restricts the possibilities of lock in somewhat. It is also the case that a consumer who will become locked in is in the position to negotiate *ex ante* for attractive discounts. When a sufficient amount of competition is present and consumers are rational, a producer will only achieve a normal rate of return, even in the presence of lock-in, and a form of monopoly power *ex post*. The discount a producer gives initially as a 'teaser' will have to outweigh the consumer surplus appropriated by a producer later as a consequence of consumer lock-in.

Lock-in reinforces the concern of producers to strive for a large market share fast. Waiting too long to land customers has the consequence that many customers are lost forever: they are locked in with rivals. A supplier of information commodities will, on top of that, try hard to further increase switching costs, for instance by selling complementary information commodities, by using long-lasting contracts, and by giving quantity discounts. In particular a monopolist with lock-in customers may cause great harm.

2.4.4 Intellectual Property Rights

Another means producers have available to monopolize information commodities is to build up intellectual property rights (IPRs). The standard economic argument for assigning property rights is that these rights enable producers to retrieve sunk costs by means of a temporary monopoly.

Assigning property rights protects producers of information commodities against reproduction and might thereby create a stimulus to the production of information commodities.[21] This can be achieved by means of patents, copyrights and trademarks. Yet in the case of information commodities, which are so diverse that they have quite different payback periods, easily too much such market power is given. On the other hand the protection of IPRs is not watertight. It is often possible to copy information commodities illegally, even when they are subject to copyright. As long as information commodities are produced, it is perhaps an unfair practice to produce illegal copies, but also a welfare enhancing one. When illegal copying becomes too excessive, then it may cause a restraint on the development of new information commodities, or even bring the development of new information commodities to a standstill.

Nevertheless, it seems quite improbable that the development of new information commodities would come to a stop because of too much unbridled copying. The scale at which illegal copies can be made is subject to limits. Copying sometimes leads to a loss in quality, even when it concerns information commodities. Illegal versions of software for example are often obsolete and, moreover, are not accompanied by technical support. Illegal versions of books, movies and compact disks often do not have everything the original has, such as a nice accompanying booklet and perfect performance. These differences will be reduced quickly by new technological developments. On the other hand, there will be new possibilities for the industry to introduce new differences, thereby enforcing its position. For that matter, there are also indications that illegal copies have positive effects for producers, because it is helpful in getting a larger market share.[22] This implies that producers of information commodities should not be too restrictive in the protection of their intellectual property rights.

In fact, a strategy that is frequently used is to give away information free. This strategy can gain market power in the future. Another reason to achieve a large market share can be found in advertising goals. Suppliers of websites often earn their money through advertisements, or they receive a fee from the provider of the connection on the basis of the traffic they generate. Both for advertising goals and Internet traffic, it holds that more users imply more revenues. This is not without risks for social welfare. Indeed, incentives are no longer determined by the quality of the information, but by the number of people that make use of it. This implies that it pays more to create a website that is somewhat appealing to many people, rather than one that is thrilling for only a small group, whereas the latter is often socially optimal.[23]

Finally, when innovation is both sequential and complementary, there exists both theoretical and empirical evidence that intellectual property

rights cause both less innovation and less welfare.[24] Sequential innovation is where each invention elaborates on the one before, and complementary innovation causes some central higher goal to be reached with higher probability. The problem of too strong intellectual property rights protection in this context is that it prevents competitors from making use of existing inventions to generate further innovation. Both sequential and complementary innovations seem to be pervasive in the new economy.

2.4.5 Price Discrimination

Whereas naive contemplation on the new economy quickly leads to the idea that the ideal of the perfectly competitive market is approached more closely, we have already indicated that the new economy offers at the same time ample opportunities to build up and maintain monopoly positions. Subsequently, a producer who has achieved a monopoly position is likely to exploit it to the full, for example using price discrimination. The Internet offers great opportunities to apply price discrimination, precisely because it is in principle open to producers to charge each buyer a different price.

Virtual markets make it possible for producers to capture a larger proportion of consumer surplus than in traditional markets, not only because of the possibility to deal with consumers individually, but also because of the possibility to collect large amounts of information about them. That information can give an indication of reservation prices. The Internet also displays a high degree of interactivity. Search behaviour that reveals certain characteristics of the consumer can immediately be matched by an electronic offer.

There is, therefore, enhanced scope for firms to apply price discrimination of the first degree, making individualized offers. Also, price discrimination of the second degree is applied by offering quantity discounts. Likewise, information commodities are typically offered in a number of forms that are each priced differently – so-called versioning. Versioning is a form of price discrimination of the second degree that is very attractive for the producers of information commodities. For many information commodities it boils down to the firm producing a superior, all-embracing version first, and thereafter it is then fairly cheap to produce a second type of information commodity by elaborating on this and creating simpler variations. Concrete examples are information services that offer for instance financial information, where the price charged for real-time information is a multiple of delayed information, or of enhanced features that are switched off.

We expect that particularly price discrimination of the second degree will be the norm in the new economy. It will occur in its traditional form of

quantity discounts, but also take in the somewhat more subtle forms of bundling and versioning. The social implications of these practices are not obvious. Compared to single product monopoly output, versioning – as with second-degree price-discrimination in general – may enhance welfare by making the product available for the low-quality types without infringing on the high-quality consumers. In general, however, deliberately dumping-down products at additional costs does not seem to serve welfare well. And indeed it does not when compared to a competitive market. Finally, versioning is likely to be used as a marketing tool. Low costs of reproduction of information commodities, combined with versioning, may make it easier for information commodities to be experienced. Producers may offer free inferior versions of their information commodity as a sample copy to give consumers more insights into its value. As far as this suppresses the outlays on advertising, it is a positive effect of versioning.

2.5 INFORMATION INFRASTRUCTURE

A third important category for consideration in the new economy is the infrastructure on which information travels. It consists of everything that makes it possible to store, search, copy, filter, manipulate, see, send and receive information. We have already argued that the information infrastructure reinforces the importance of certain less traditional properties of information, and thereby creates part of the specific possibilities and problems of the new economy. The information infrastructure itself, however, also introduces a number of interesting economic aspects.

Where we expect commodity information to cause mainly transparency increasing and transaction costs decreasing effects and thereby ample opportunities for a sunny future, yet foresee scattered showers for information commodities as a consequence of the dangers of monopolistic market structures, aspects of information infrastructure are likely to give occasion for stormy weather. The reason for this is that specific characteristics of the information infrastructure can easily give rise to a problematic market structure. In this section we look closer into two of these characteristics: network externalities and standardization.

2.5.1 Networks

The information infrastructure of information commodities has positive network externalities.[25] Network externalities are not just a novelty of the new economy, they are also present in traditional sectors of the economy, for instance in railway networks and pipelines for oil or gas. What might be

different in the new economy is their abundance, in the form of both physical and virtual networks.

Network externalities exist when the value of a product for one user depends on the number of other users; examples are telephone, e-mail, Internet, fax and modems. The original idea behind network externalities is simple. In a network with n users, there are $n - 1$ possible links for each user. The total number of links is then equal to $n^2 - n$. As a result, the value of a network increases quadratically in the number of users. This principle, known as Metcalfe's law, relies on the rather simplistic assumption that each link in a network has equal value as a starting point. A somewhat more economic approach tells us that the first links in a network have the highest marginal revenue, whereas later users show by self-selection they are of lesser value. Nevertheless, it remains true that large connected networks are preferred by everyone over many isolated smaller ones.

In an industry with positive network effects it is often of great importance to have the largest market share. Positive network effects are self-enforcing as the network grows, which makes growing ever more easy. It is only after crossing a certain threshold market share that there is sufficient momentum to generate an explosive growth of the market. This phenomenon is one rationale behind many observations of new economy firms that make losses over prolonged periods. They follow a strategy of building up a large customer base as fast as possible by offering free services, and revenue requirements are postponed to some distant future.

Positive network externalities are accelerated because consumers have an incentive to eventually be part of the largest network. It is therefore of the greatest importance to producers to convince consumers, who have to pay costs and therefore have to make a choice, that their network will be the largest one and that its technology will become the standard. As a result, the announcement of a new product, possibly long before it actually becomes available, may be as important as the introduction itself, since it may make consumers decide not to pass over to the purchase of a competitive product.

The problem of lock-in returns with even greater intensity for information infrastructure aspects. As soon as a consumer has chosen to use a certain technological standard, it will often be very difficult for him or her to pass on to another technology, because of switching costs. Switching from one generation of computers to the next one causes for instance software problems and a need for renewed training of employees. On top of this, there typically are investments in several, complementary and durable capital goods in the case of information infrastructure that are specifically appropriate to a certain kind of information technology, which reinforces the lock-in.

An additional problem for the case of networks is that there is not only individual lock-in, but also collective lock-in. It is not sufficient for a consumer to overcome his or her own switching costs. Consumers have to be convinced that others will do the same. This implies that the disciplining force of potential entrants deteriorates. It is no longer sufficient for entrants to persuade customers on an individual basis. Consumers should be convinced that other consumers will pass on to a new technology as well, which makes entry difficult.

Another consequence of network externalities is that existing technologies, as a consequence of individual and collective lock-ins, are used far past their socially optimal date. The general trade-off for producers is either to develop a completely new technology, or a technology that is compatible with the existing technology. The former is only possible if it concerns a revolutionary improvement over existing technology, which is hardly ever the case. A continuation of extending on old base technology, however, is typically inferior to a quick conversion to a new standard, and often delays technological innovation.

There are common interdependencies between information commodities and information infrastructure. To introduce new technologies, it is often necessary for firms to focus their attention not only on their competitors, but also on firms with whom they may want to collaborate. A prominent example of successful collaboration is the one between Microsoft and Intel. From a competition policy point of view, however, these collaborations may cause the formation of formidable centres of power in the twilight zone between collaboration and abuse of power. The risk of monopolization is, therefore, serious in the presence of positive network externalities. An exception to this might be the case where consumers have such a large desire for variety that several networks may co-exist.

2.5.2 Standards

Information infrastructure uses protocols that rely on standards of communication and inter-compatibility. One can distinguish open and closed standards. The former concern technology that is accessible for all producers, whereas the latter involve technology that is protected by means of intellectual property rights. A closed technology is seemingly more attractive to a producer. An advantage of open technology, however, is that it makes it far easier to build up a large market share fast, and to profit from the advantages that go with that. Moreover, very often producers will have to collaborate, offering complementary products to one another, which is easier in the case of an open technology. The relationship between Microsoft's

operating system and application software also shows that an intermediate form may be stable.

An important way to fight the formation of monopolies is by realizing open standards. As soon as a certain technology has the largest network by far, it is possible to promote competition by making this technology an open standard. Standards make switching costs decrease considerably. They enhance the formation of one large network, which is important when there are positive network externalities. An open standard trades competition between networks for competition on a network. Standards can differ immensely with respect to the amount of detail. The more detailed the standard, the less possibilities producers have to differentiate their products.

Governments can play an important role in the creation of standards by establishing independent institutes that set them and keep them pure. Also, governments can set standards 'by example', bearing the initial switching costs by moving to an open standard first.[26] In some cases such an independent institute should have the possibility to impose compensation payments. Conflicts about standards might arise when several companies have an interest in putting forward their own technology as the standard. A role might be played here by auction mechanisms. These could be designed in such a way that the most efficient standard will be realized. A matter of concern, however, is to maintain the independence of such an institute, and to keep social welfare its objective.

We have already observed that as long as it is unclear to consumers whether a certain technology will make it, they will be very reluctant to purchase its compatible products. It is important for producers, therefore, to convince consumers that their technology will break through and dominate. A standard might be helpful to overcome such problems. This provides additional reasons why a standard is not only in the interest of consumers, but often also in the interest of producers. As a result, strong government oversight may not always be necessary to establish a universal standard. It is not inconceivable that the market itself will create institutions that determine standards, for instance in the form of strategic alliances between producers. From a competition policy point of view, such a development is not without danger – an alliance might effectively eliminate competition if it centralizes intellectual property rights and opens standards up only for firms within the alliance.

As soon as a monopoly has emerged, authorities have a number of options. European legislation offers more possibilities here than American legislation does. Government may abstain from intervention, thereby using the argument that it is efficient to have only one supplier in a natural monopoly. This may also be an interesting option when there is a sufficient amount of potential entry. Governments may furthermore improve the

conditions under which more entry is possible, for instance by introducing an open standard and pursuing a restrictive policy regarding the protection of intellectual property rights. Current legislation for the protection of intellectual property rights seems far too rigid in this respect. The option of flexibility when it concerns length and scope of intellectual property rights on specific commodities and standards may be most useful to permanently maintain the appropriate balance between sufficient competition and sufficient incentives to innovate.

In the short run, property rights will be less important anyhow, because of the fast pace of technological progress that makes the vast majority of monopoly positions temporary ones only. In the mid-term, under the scenario where rapid technological progress has come into quieter waters, a large number of markets with strong network externalities and huge switching costs may threaten to stabilize into single dominant firms. In such a situation, extensive intellectual property rights protection is undesirable.

Government intervention can break the power of a monopoly in such cases – as in the Microsoft antitrust trials. This is particularly attractive if it is possible to organize competition on a network. In other cases, governments may regulate a dominant firm controlling a network, for instance by installing an independent regulator. An interesting discussion here concerns the scope of the industry to be regulated, because there is simultaneously convergence between industries and globalization of their activities.[27] Sectors that traditionally have been separated from one another, such as the telecommunication, media, and information technology sectors, all produce information commodities and make use of a common information infrastructure.[28] Some of these sectors are not regulated at all. Others, like the telecommunication sector, have to deal with strict supervision. Borders between countries, traditionally greatly influencing trade flows, are hardly important for a medium like the Internet. It is therefore highly debatable whether local regulation of the Internet is meaningful. Instead, global oversight for the information and communication technology sector seems called for. There are, however, also advantages in having several regulators. The case of several regulators makes yardstick competition possible; industry-specific regulators have more specific technological knowledge available and it is often easier to give the right incentives to regulators when they confine themselves to a single industry. These arguments need to be weighed to strike an appropriate balance.

2.6 CONCLUSIONS

There seems to be a sufficient number of similarities between the conditions under which the existing micro-economic theory provides its useful

insights, and the fundamental properties of the reality of the new economy. As a consequence, there is no need for a 'new economy' in a theoretical sense.

We distinguish between commodity information and information commodities, where commodity information refers to information about commodities, which is available in the new economy at lower costs and in greater supply than before. This concerns information that facilitates decision-making. Information commodities, on the other hand, are commodities that consist of information. They have an intrinsic value, where commodity information has a derived value. Finally, we consider the flow of both types of information on information infrastructure.

There is reason for moderate optimism with regard to the opportunities offered by the new economy in the area of commodity information. An easy and extensive exchange of commodity information enhances individual decisions, and leads to more transparent and therefore more competitive markets. It is important, however, not to lose sight of the problems for the nature of competitive processes caused by the new economy. Collecting information is costly, which leads to the threat of an inefficient amount of absorption. Information intermediaries will try to find their niches in the selection of information. Firms and credit card companies may profit from problems with trust and deliveries, and even have an incentive to purposely increase these problems. There furthermore is the possibility that firms will attempt to work against greater transparency by applying or strengthening product and price discrimination.

There seem, therefore, ample reasons for being alert regarding developments in the domain of information commodities. Their properties, in particular the presence of large fixed production and distribution costs, and very low marginal costs, may give rise to the emergence of dominant suppliers. Suppliers also have various means to promote such a market structure, for instance far-reaching forms of product differentiation, lock-in of consumers, and the gathering of intellectual property rights. Although increased opportunities to learn about the preferences of consumers may cause great welfare improvements, those same opportunities lead to an appropriation of a substantial share of consumer surplus.

Monopolistic market structures seem inevitable where it concerns information infrastructure. This is mainly because of strong network externalities, both at the individual and the collective level. It is also possible that firms further exploit a dominant position by striving for closed standards that deter new entry effectively, for example by means of the acquired exclusive property rights. The Microsoft case is only the first spectacular instance where the abuse of monopoly power in the information infrastructure has caused the authorities to intervene. There are already several firms in

similar positions, and others trying hard to achieve them too. Many more cases are likely to follow.

In general, governments need to watch the new developments closely in order to pre-empt the problems mentioned. The boom of companies that invested in Internet offspring indicates that one may expect niches with a certain amount of protection. One of the courses of action that governments could take is to open up the opportunities for entry of firms and institutions. They can do so by means of direct competition policy, and intervention when companies play too large a role in setting up entry barriers. A good example of an intervention that was too late in this respect concerns the practice of claiming idiosyncratic Internet addresses that were subsequently offered for sale at very high prices. This is a typical form of inefficient speculation. In particular the market for information infrastructure needs to be watched closely by competition authorities. It has a strong inclination to create market structures that are socially particularly undesirable, both from a static point of view, since they restrict the distribution of commodity information and information commodities, and from a dynamic point of view, since they hinder the development of new technological standards.

Even more important perhaps is the role governments need to play as providers of standards and transparency. Though the demand for such services may also provoke privately based responses – such as a virtual consumers' association or specific search engines – the role of the intermediary remains potentially one that has tendencies to disturb competition. Neutrality of government in these matters promotes reliability and transparency. Full exploitation of the potential world-wide-welfare that is offered by the world-wide-web calls for solid, government controlled monitoring of the open network society and its enemies.

NOTES

1. See Hirshleifer and Riley (1995).
2. This coincides with the characterization of commodities by Debreu (1959).
3. See Chapter 7 of Knight (1921) for an interesting discussion of the relationship between risk and uncertainty.
4. See Blackwell and Dubins (1962).
5. For information as a public good see Hirshleifer and Riley (1995), Chapter 6.
6. This is only true if the information does not lead to a reduction in the number of available choices, which can certainly be the case, for example in the purchase of insurance – the so-called Hirshleifer-effect, see Hirshleifer (1971). It is also well-known that when strategic effects are present, less information can lead to more favourable outcomes.
7. Bayesian learning is, as described in the following, widely seen as rational learning. Of importance for its effects is the structural specification of the relations that are to be learned. See on this subject Schinkel et al. (2002).

8. See Radner (1979).
9. See Arrow (1953).
10. An analysis of the conditions under which convergence of a number of price adjustment processes takes place on a perfectly competitive equilibrium can be found in Hens (1997) and Herings (1999).
11. Wilson (1977) and Milgrom (1979) analyse the decreasing auction and Milgrom (1981) the increasing auction.
12. It can also be the case that groups with conflicting objectives collect too little information, and even ignore free information in order to avoid real conflicts, see Hirshleifer and Riley (1995) and Jones and Ostroy (1984).
13. This is the so-called Hirshleifer effect.
14. See Binmore (1994).
15. The developments in virtual banking are of important concern for monetary policy. An increase in this is comparable to the creation of money taking place outside the realm of central banks.
16. See Baye and Morgan (2001) for a formal model of this phenomenon.
17. For further critiques of the idea that the Internet leads to markets with perfect competition, see Dolfsma (1998).
18. For further insights into optimal investment in research and development, refer to Scherer and Ross (1990), in particular Chapter 17.
19. Akerlof (1970) was the first to point out this kind of problem in his ground-breaking work.
20. See Nelson (1974) and Milgrom and Roberts (1986). For an exposition on excess advertisement in Nash equilibrium, see Schmalensee (1986).
21. The United States Congress is obliged by the constitution to promote the progress of science and useful arts by granting exclusive rights to authors and inventors for their writings and inventions during a limited time span.
22. A good example is the commotion around Napster, against which prominent artists like the rock band Metallica protested. We refer to Shapiro and Varian (1999) for a defence of the stance that illegal copies can be beneficial for sales.
23. For a similar example concerning television broadcasts, see DeLong and Froomkin (2000).
24. See Bessen and Maskin (2000).
25. See Katz and Shapiro (1994) for an overview of the area of network externalities.
26. See Varian and Shapiro (2003).
27. See Chapter 7 of Laffont and Tirole (2000).
28. For the specific problems that the convergence of industries poses for regulation, see de Fontenay (1999).

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