A Survey of the Economics of Information Goods

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Abstract:

The Internet has shaped our economic world into a completely new era with its speed of communication and the high degree of interaction that it generates between people. It has transformed the way we access information in the fields of business, education, and almost every aspect of our social, economic, and political lives. However, given such a significant change, a related development is that innumerable information goods are widely diffused on the Internet without any charge. What is the economic logic that underlies this? What economics properties of information goods are applicable? Based on a survey of the economic literature, the purpose of this paper is to evaluate the characteristics, pricing scheme, demand and supply of scale of information goods. I also discuss some applications in the form of relevant business cases regarding the recent Internet evolution.

Key words: Information Goods, Price Discrimination, Versioning, Bundling

1. Introduction

We are now living in the information age. People can have instant access to the available knowledge, in a way which was hard or even impossible to imagine in the past. The internet has been shaping and changing our economic world at an astonishing rate since it emerged in the early 1990s, and the development of personal electronic devices which transmit the information, such as PCs, Smartphones, Tablet Computers, etc., are accelerating this evolution at an unimaginable speed. Meanwhile, the internet has also become the crucial component in the technology of production for many industries in every country.

It is estimated that 30.2% of the World population used the internet by 2011. Asia accounted for 44% of the internet users in the world. Developing countries are currently experiencing a relatively higher growth rate compared to developed countries. For instance, Africa experienced a growth rate of 2,527.4 %, and the Middle East 1,987.0 % till 2011[1]. This growth is not slowing. In the past five years, a critical development in hardware that the internet evolution brought to us was the Mobile Internet, which partially replaced the static PC internet connection that required users to remain at a certain place to access the stationary internet. Now one can go anywhere with their smart phone or tablet computer and still have access to the WIFI internet. With this fast developing technology, the use of the internet has become more convenient than ever. Meanwhile consumers' habits in using the Internet have been changed in a revolutionary way since mobile internet became available.

[1] Source: Internet World Stats. www.internetworldstats.com/stats.htm Basis:2,095,006,005 Internet users on March 31,2011

However most of the vast amount of information is available at no cost to the user, which can generate free riding behavior. This brings up the economic question to be discussed: should information goods that are diffused through the internet be made available free of charge? If not, how can the information provider or producer of content gain revenue through the production of information goods, in order to cover operating costs and earn a normal rate of return on capital? What are the barriers that actually block producers from profiting from information goods?

2. Background

2.1 Information Revolution

In order to analyze the economic aspects of information goods, one should start by defining the Internet? The internet consists of a worldwide network of computer networks that use a common communications protocol (Mackie-Mason and Varian 1994).

In the 1960s, the United States government constructed the computer networks for its own private commercial interests and national defense. The internet was intended to be a robust, fault-tolerant, and distributed network. The improvement of hardware and the enlargement of the bandwidth allowed for the development of the requisite infrastructure to extend it in the following decades. In the1980s, vast government and commercial investment in the internet technology accelerated the participation in and the development of the new networking technology.

Since the 1990s, the commercialization of the internet on an international scale has completely changed almost every aspect of peoples' lives, from governments to households then to businesses. In both the public and private sectors, a lot of new software packages have been created and distributed through the internet, which has increased productivity. The internet also provided a fast and reliable communication for users. People can send and receive email within seconds, though they may be in different geographical locations, even overseas. The speed and convenience of communication that the Internet offers people has never before been experienced in history. New business mechanisms in online retailing industry, such as ebay.com and amazon.com, had an unprecedented impact on consumer behavior in searching new product and the way of purchasing.

This impact is reflected in the ways of searching for merchandise, comparing products, ordering and shipping. Meanwhile, the construction of the internet infrastructure led to the evolution of hardware and software, which are creating a very significant and extensive worldwide platform for information goods in the future. The internet spread across countries with the fast adoption of new technologies, and also had a monumental impact on culture and commerce. It was estimated that about 1% of information flowing was through two-way telecommunication on the Internet in 1993. That number grew to 51% in 2000, and to more than 97% in 2007, of all the interconnected telecommunication.[2]

[2] "The World's Technological Capacity to Store, Communicate, and Compute Information", Martin Hilbert and Priscila López (April 2011), Science, 332(6025), 60-65.

Schumpeter (1883-1950), considered to be one of the most brilliant economists and political scientists in history, identified innovation as the critical dimension of economic development and change. He once stated that *"the facts of technology influence the course of economic life, and the laws of the latter influence progress and the practical application of technical methods"* (1942). In his opinion, innovation, entrepreneurial activities, and market power all revolve around economic change. They are not independent of each other. He believed that innovation-originated market power might be able to offer better economic results than the competitive market. This is in contrast to the perspective of which is based on the 'invisible hand' notion in classical economic theory. He argued that there are temporary monopolies often created through technological innovation, but that there would soon be competition over the new profits, which would be eroded by the new rivals and imitators. These temporary monopolies are necessary to ensure that firms develop the new products and new processes.

The Information Revolution and communications technology, which brought about the biggest change in economic life since the Industrial Revolution and the Agricultural Revolution, is a good illustration of Schumpeter's idea. This process of technological change has accelerated the course of the industrialization, and the communication between countries. Consequently, these changes among the global population became very influential on economic life. Schumpeter discussed growth, development, economic development, economic evolution and business cycles that primarily result from innovation of technology in his famous book: *Capitalism, Socialism and Democracy* (1942). He believed that technological innovation and development has a critical social impact in our societies.

2.2 Impact of technological development

Varian (2004) defines the internet revolution as "combinatorial innovation". The technological revolution typically takes place over many years, and sometimes it takes decades to fully develop. Varian mentions that the microelectronics industry took almost thirty years to reach its current position, however the internet took relatively fewer years for its revolution to occur. The reason is that in some ways the internet revolution is considered to be relatively minor in comparison with other huge technological developments in the history. One significant difference of the internet revolution is that the components of the internet are not physical devices, and thus it lacks a physical constraint. The new technological developments take a long time to develop, but they are diffused quickly. For example, it took the microelectronics industry decades to design and produce the computer and the inside processing chip, and the infrastructural construction of telecommunication also took decades to build. The project was time consuming, was restricted by different kinds of physical constraints, such as development of the technology, costs of production, and logistical costs. In contrast, in the case of the internet, there are no delays in producing, and transferring new combinational innovations. Once people have gained access to the internet, regardless of where they are situated, they can receive the newest technology diffused through the Internet instantly. They can use the technology, for example open-source software and revealed scripts, and then recombine them and produce something new on their own. Therefore, the speed of the internet revolution was indeed faster compared to those previous technological revolutions.

History proved that a new invention can sometimes capture investors' and the general public's attention and interest, spur investors and consumers' confidence, and thereby trigger a new investment boom. Investors seek to profit from the new invention, so that many combinatorial innovations in history have been accompanied by financial speculation. In times of rapid technological evolution, there are many startup firms. The investment spending takes place in an environment of great uncertainty, as many of these new products will fail in the marketplace. Investment is a risky venture as one is investing in intangible, prospective goods. Excessive confidence tends to be placed in some ventures, which can lead to speculative bubbles sometimes labeled 'irrational exuberance'. For instance, the boom of broadcast radio in the 1920s created its own stock market bubble, much like the case of the internet in the late 1990s, this was labeled the 'dot com" bubble. However, these two newly emerged inventions posed the same challenge to investors namely: how exactly to profit from it?

One of the threats to profitability that concerns investors is the following. Why should the user pay for something they can view on one website, when these materials are available to be searched and read on other websites without charge? Even today, broadcasting radio is still widely used as a broadcasting medium in most countries. The function of broadcasting radio is quite simple. It emits the signal to each radio reception device, and attracts people's attention for the content for the audio program, announcements, or advertisements. It still remains a basic tool for communication. But the Internet has more functions than just being a consumer-oriented mass medium like radio, which only has the single transmission function.

Internet can provide a two-way interconnection function system; distribution and payment can be done at the same time through a website. Instead of only being an advertising medium, the internet provides not only a platform to publish information goods, but also a channel to actually sell and profit from them.

Varian (2004) stated a quotation from one of the venture capitalists in Silicon Valley: "the internet boom in 1990s was the greatest legal creation of wealth in human history." Financial speculation led to a dramatic run-up of stock prices for information technology companies. The NASDAQ, which is the title of the second-largest stock exchange by market capitalization in the world, hit its historical peak in early 2000 and eventually crashed. Only a few companies actually succeeded in capitalizing on this internet boom. A very large social gain that was generated by internet companies was in the end passed on to the consumers through competitive market forces. Investors who sold their stocks before the crash profited handsomely, and the remaining investors did not reap much of the social surplus that was generated. However, the enhanced productivity in the late 1990s was attributed to the investment of high technology industry during the first half decade. Furthermore, free entry into the industry tended to result in lower prices for the software itself.

While the internet boom did burst in the beginning of the 21st century, the technological developments still generated human capital investments in high-tech industries. The information highway remained after the crash. Young people are becoming more proficient in operating electronic devices. In fact this can be considered one of the social impacts. This is one of the

crucial conditions for the healthy sustainable development and full exploration of the internet for the upcoming decades.

2.3 Why do information goods become an economic concern?

Varian (2001) points out that history always repeats itself, and one has to know where to find it. In this paper, Varian evokes the book market as an analog to the market for the internet, and he discusses the publication industry in the 1500s. Books, which at the time were the only medium for information, were considered to be luxury items. Only the class of nobles, wealthy citizens, professional scholars, and the clergy had the opportunity and financial means to purchase books in the fifteenth and sixteenth centuries, hence it was very hard to reach great masses of people through the publication of books. In the 1800s the public libraries and circulating libraries assumed an important role in diffusing knowledge, since people with low income were still not able to afford the luxury goods: books.

This case illustrates the point that information was never meant to be free of charge to the user, and never has been free in history. This is especially true when information is contained in a book, the production of which involves a fixed cost as well as a variable cost. It has the features of a private good. Today we can read, translate, send and publish information within minutes, which would have taken years to accomplish and would have consumed a lot of resources one or two centuries ago. However, on the internet, one often obtains information free of charge. This definitely changes the economic logic for the production as well as the consumption of the good.

A lot of internet companies are offering their information product free of charge in order to attract readers' attention, but these companies often are struggling to find a profitable scheme from the information they provide. What features of the internet lead us to this completely different situation? While users can benefit from free riding, what are the consequences for producers of information goods? How can the producers of information goods recover their costs and earn at least a normal rate of return? All these questions guide the following discussion.

3. Information Goods

3.1 Definition of Information Goods.

What are information goods? According to Varian (1998), information goods are any products which can be digitalized, such as a book, a movie, or video tapes. Like any other good, it is the object of an economic transaction between a producer and a user. In this paper Varian claims that information goods possess three main important properties that distinguish them from other economic goods, and these properties complicate market transactions. They are: experience goods, returns to scale, and public goods.

3.2 Information goods are Experience goods

People who are trying to look for information on the internet usually have their own preferences already, or they know the specific target of their search. Consumers cannot know whether

or not they would like to purchase the information goods unless they actually know its nature, and confirm that product matches their preference. This is the meaning of the experience goods; consumers have to try them out before they buy. This situation poses a problem to the producers. It is more costly for them to advertise and recruit customers. Varian classified three social and economic institutions which are used to overcome this problem of experience goods. They are: previewing and browsing, reviews, and reputation.

3.2.1 Previewing

Producers often face the challenge of needing to reveal parts of the information goods in efforts to attract consumers' attention. Information goods producers often offer the opportunities for browsing in order to let consumers know and accept what they are actually purchasing. For example, consider a movie trailer or the sample books in a book store. But for information goods, the situation does change. One of the great difficulties faced by producers is figuring out ways for their customer to only browse through the products, and prevent consumers from copying and downloading them at the same time. For videos and other large-sized files, a preview may work to interest the consumer, but for textual files that previewing becomes very difficult. In contrast to some traditional private goods, for example a box of cookies or ice-cream, if the consumer wants to know the taste, they typically have to indeed purchase it first. Under these circumstances, the producer does not have to face the free-riding problem after the consumers have "experienced" the product.

3.2.2 Reviews

Varian suggests that another way to overcome the experience good problem is to offer specialized reviews of the information goods, and provide these evaluations to other potential consumers. In entertainment industry, this is quite common. Published file reviews, movie reviews, and book reviews can affect other consumers' preferences and purchasing incentives. He claims reviewing is also found in the pure information goods such as academic papers, whose attractiveness is usually measured by the number of citations. Comments and evaluation of information goods provide the consumer or subscriber with a broader perspective and comprehensive understanding.

3.2.3 Reputation

The third way to overcome the experience good problem is via reputation. People are willing to purchase the *Wall Street Journal* today because they read it in the past and found that the Journal was worthwhile for them. Publishers of the Journal would invest heavily in order to establish and maintain this brand identity, and benefit from this reputation in the long term. And when the online version of *Wall Street Journal* becomes available to the public, the publisher is very likely to create something which is same "look and feel" as the older print version. This will carry what developed the reputation to this new medium; it is a brand name. Varian claims that investing in brand and reputation is a standard practice in the information industry, and this investment is warranted due to the fact that information goods are experience goods.

3.2.4 Proportional Share

By knowing these important properties of experience goods, can producers actually convert the disadvantages into advantages in order to increase the revenue received from producing information goods? The answer is probably yes. Shapiro and Varian (1999) claimed that from the perspective of the seller, in the information goods market, the following simple identity applies:

$$\text{Value} = \text{Market Share} \times \text{Total Industry Value}$$

They suggest that this is the case for information goods, such as software, music, and even books. If the producers want to conquer and grow their market share, they must build up their influence and reputation. In order to increase the likelihood of further purchases from the consumers, they have to distribute the information goods free of charge at the beginning of the product launch on a massive scale, in order to generate the potential consumer bases within the market. This is a costly investment.

After they have certain market share that is captured from the distribution of the free information goods, they can start to work on this consumer base and try to make a profit. The objective is to get a higher "share" proportion in the equation, and this share and producer's value vary directly. This can actually explain the phenomenon that we witness of software companies willing to provide their free-trial version to consumers to try. Online books openly give readers free access of certain pages for reading. In this case, the sellers are following exactly this strategy of building and expanding their market share at a significant up-front cost that must someday be repaid, thereby twisting one of the characteristics of information goods

from a disadvantage into an advantage. It is a risky strategy that depends on ultimately being able to charge a greatly expanded group of consumers for their information goods if they can achieve a larger market share.

3.3 Information goods are return to scale

The cost structure of information goods is quite unique compared to other commodities. The start-up costs, consisting largely of the research and development activities at the initial stage are tremendous. However, the variable costs are low, and the marginal cost is almost zero. In the case of a CD for instance, the entire product development process from designing, recording to advertising and publishing, might cost hundreds of millions dollars. The producers of information goods have to face the cruel reality that they may never be able to recoup their fixed costs of such an investment, once their first copy is diffused on the Internet. The cost is very likely to become a sunk cost. The online reproduction cost can be considered to be almost equal to zero after the first copy is published. This extreme cost structure of information goods, characterized by high fixed costs coupled with low marginal costs, leads to a very difficult situation for the producers to actually make a profit. According to economic theory, competitive markets tend to push price down to marginal cost. However, what about the case where marginal cost is close to zero? How can the producer recover any costs at all?

One answer is that rarely are information goods traded in a purely competitive markets, because they are highly differentiated. For example, each CD, movie, or book is unique in its content, and they are supposed to be protected by copyright. Varian (1998) claims that the

market structures for most information goods are characterized by monopolistic competition. The producers may have some degree of market power because of the differentiation, but they lack entry restrictions, which in turn can drive profits down to zero in the long run. Nonetheless, because highly differentiated products give scope for price discrimination, prices can be set at different levels for different consumer groups. This can raise the level of producer surplus by extracting consumer surplus. Varian (2004) mentions that for different kinds of digital information goods, quality discrimination is quite often observed, and this is one crucial way to carry out discrimination.

3.4 Information goods are public goods

We know that public goods are neither excludable nor rivalrous in consumption. These two fundamental characteristics of public goods pertain to the case of information goods as well. Given free access to the internet, it is often difficult to exclude others from viewing, downloading, reading, or playing most of the information goods online, while these information goods are not likely to have either their quality or quantity diminished by sharing them with others. There are some ways to achieve excludability of information goods related to legal jurisprudence, such as intellectual property laws which can set barriers of sharing, and password protecting content, through which access to non-subscribers can be denied. Nonetheless, these mechanisms are only partially effective in free riding. None of the consumers would have high incentive to pay for public goods, when the searching cost is relatively low-just a few clicks away. Furthermore, it is likely that they can find close substitutes free of charge.

3.4.1 Non-rivalrous consumption

One of the significant properties of public goods is that they are non-rivalrous in consumption, which means that the consumption of the good by one does not reduce the ability of any other person to consume the good. The difference between public and private goods has a huge impact on consumers' decision making. Usually a consumer has an incentive to pay for some goods that are rivalrous. In contrast, the non-rivalrous property of a public good implies once the good comes into existence, many people can benefit from it without impinging on anyone else's consumption. Therefore people usually have a low incentive to pay for public goods, and the free riding problem arises. As a consequence of free riding, public goods tend to be under-provided from a social point of view.

3.4.2 Non-excludable

The second important property of public goods is that they are non-excludable in consumption. People cannot prevent someone else from consuming the same good. For a private good, excludability makes it possible to charge the consumer for consuming it. People will be excluded from having and using the products or services if they are not paying. But the unique characteristic of information goods on internet makes it difficult to exclude others from reading when users access the internet simultaneously.

3.4.3 Possible solution to the public good problem

The claim that information goods are public goods appeared to be quite true when Shapiro and Varian wrote their book: *Information Rules (*1999). This may still remain true if users

continued to use the static PC Internet access. However, now as the technological evolution of the Internet continues to progress, the possibility of converting information goods from public goods into private goods has been enhanced, through the development of personal mobile devices and the mobile internet. The same can be said regarding consumers' willingness to pay. Mobile internet is revolutionizing the entire framework of technology nowadays. People are so habituated to using their totally portable browsers, which can easily fit into a purse or a backpack, that they are willing to pay for their own personal copies of internet content. It has become more inconvenient, and hence relatively costly, to access the internet from a stationary work station, even though access through that channel is free of charge. The technology raises the degree of rivalry and excludability.

4. Price discrimination

As discussed earlier in this paper, due to the high degree of product differentiation and the fact that production is characterized by returns to scale, in high-tech industries price discrimination is feasible and is likely to be a feature of the pricing strategies. Varian (2004) indicates that usually there are two conditions to be considered before pricing information goods: 1) With high fixed costs and low marginal costs, reproduction is not costly, which can lead to a significant degree of market power, along with the accompanying inefficiencies. 2) Consumer behavior becomes easier to observe and analyze once the firms accumulated preference data from their purchasing histories. These conditions tend to facilitate price discrimination.

In every market, the firm has various levels of market power, so that firms can provide highly differentiated products in uncompetitive market conditions. Firms can influence and set the price of information goods by exercising control over their demand, supply or both, and usually highly differentiated products lead to the monopoly power. While price discrimination results in a transfer of social surplus from the consumer to the producer, the level of production becomes closer to the allocatively efficient once price equals marginal cost. The division of the total surplus became less equitable, but efficiency is enhanced.

4.1First degree price discrimination

In order to achieve effective price discrimination, here are a few approaches. Information technology improves firms' ability to observe consumer behavior. By capturing their preferences, highly personalized products can be sold at prices according to consumers' full willingness to pay. Varian (2004) calls this phenomenon "mass customization", it means one seller and one buyer for each particular product. In the most extreme case, information technology allows for a "market for one". He also gives as an example Amazon.com trying to sell the same product to their customers at different prices depending on their past purchasing behavior. For price discrimination to be successful, one always has to separate consumers so that resale is not possible. As all the transaction historical data can be recorded to the online retailer, Amazon has the advantage of analyzing consumers' preferences carefully, then creating a certain pricing strategy to fit individual preferences. This allows Amazon to sell the products at the highest price possible in order to capture the consumer surplus.

According to the theory of monopoly first-degree price discrimination, firms will charge the highest price that they can to each individual consumer, therefore capturing all the consumer surplus for each unit. Ulph and Valkan (2001) examined the theory of first-degree price discrimination and product differentiation in an environment that assumes full information. They found that there are two effects: "enhanced surplus extraction effect" and the "intensified competition effect" , in which consumers differ with respect to the products that they consider most desirable, and firms choose where to locate in the product space and how much to charge each consumer. The first effect shows that a price closer to the reservation price can be charged by firms for each consumer. The second effect shows that each consumer is a market to be fought over. They concluded that when consumer tastes are not quite different, the intensified competition effect dominates the surplus extraction effect.

Firms are worse off and consumers are better off with competitive personalized pricing circumstances. The result shows that long-term suppliers are able to know more about their customers than the alternative suppliers. The historical data on purchasing allows the seller to understand consumers' purchasing habits much better than the alternative new competitors. The first degree price discrimination is based on the firm's ability to determine how much each consumer is willing to pay for the good. The firm is trying to extract all consumer surplus as profits from its customers, and would sell the quantity of output 'Q*' up to the point where the price of the last unit sold covers the marginal costs of production. The difference between the price charged on each unit product and the average cost of producing "Q*" unit

of output is the firm's profits.

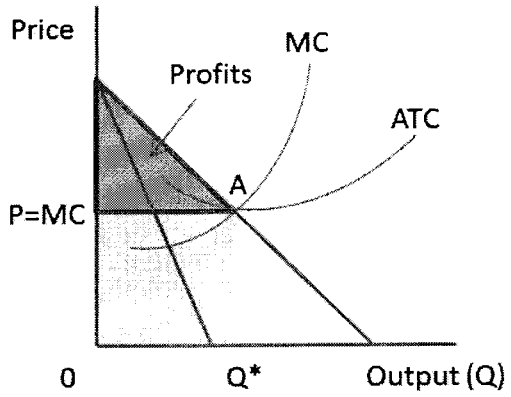

Figure 1, First degree price discrimination[3]

4.2 Second-degree price discrimination

Second degree price discrimination is the situation in which every consumer faces the same menu of prices for a set of related products. It is known as "market segmentation" or "versioning". Basically, it means that firms are able to use their own data or knowledge in order to separate their market into segments and produce different products for different consumer tastes. It is called "product line pricing". Second-degree price discrimination is widely used, and versioning is one of the best examples to illustrate it. Books are sold in both hard and soft copies with time delay, as are DVDs and other traditional information goods. Information versioning also takes place in online information services, as time-delayed stock prices can be viewed free of charge on website, but real-time stock quotes are available only at a certain charge to subscribe. As it was called "delay" as one of the function of versioning information products.

[3] "E-commerce, mass customization and price discrimination",Technical report, Ulph, David.,Vulkan, Nir, 2001.

Varian argues that information technology revolution has not only changed the technology of production in many industries, but it has also had a profound impact on the demand for information goods themselves. It is very helpful in both collecting information to help develop better product lines, and actually producing the different versions of the product itself. This leads to the apparent contradiction of the firm competing against itself. The customers with the high willingness to pay cannot always be prevented from buying the lower-priced products targeted initially to lower-end consumers. This is so called "self-selection problem", it seems more like an issue of separating customers, the goal is to separate the groups of consumers, and this is achieved in part by inducing consumer to self-select into the two groups. Varian suggests that in order to solve this problem, either the firm has to lower the price of the high-end product, or lower the quality of the low-end product. If either of these two strategies does not work well independently, a firm may choose a mixed strategy that combines the two of them together.

In comparison with the first degree price discrimination scheme, the second degree price discrimination scheme aims to build a pricing structure for a particular good, or product line. Firms attempt to extract part of the consumer's surplus as profit with the residual surplus still going to consumers. Similar to the case of the first degree price discrimination, firms would produce the level of output at the point where the price charged just covers the marginal costs of production. In the following diagram, the firm is charging three prices for the same product. Price P_0 is charged per unit on the quantity sold at Q_0, the relatively lower price P_1 is charged on the higher quantity sold at Q_1, and Q_2 is the level of production such that price

P_2 equals marginal cost. In this case there is still some consumer surplus left over. First degree price discrimination is a limiting case of second degree price discrimination.

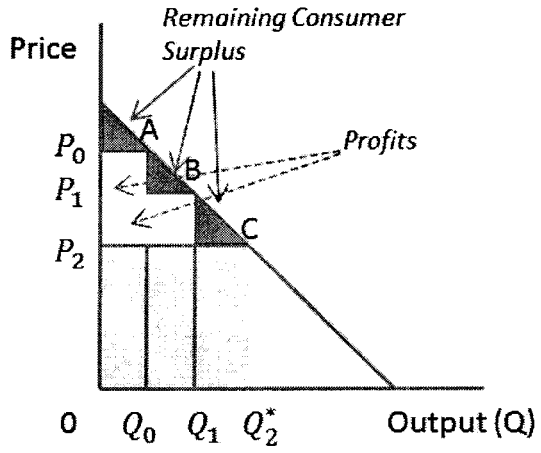

Figure 2, Second degree price discrimination[4]

4.3 Third degree price discrimination

For third degree price discrimination, the firm has to segment its consumers into different groups for the targeted market. The firm might end up charging higher price P_1 at the quantity Q_1, in the first market segment, and a lower price P_2 at the quantity Q_2 in the second market segment. The total profit would be greater than with a single price P* charged for the entire market, given P_2< P*<P_1 for all the units sold.

Under third degree price discrimination, firms sell at different prices to different consumer groups. This classical approach has been widely used. Armstong and Vickers (2001) exam-

[4] "E-commerce, mass customization and price discrimination",Technical report, Ulph, David.,Vulkan, Nir, 2001.

ined third degree price discrimination based on two different types of consumer preferences. If there is a fixed cost to serve each consumer, then the competitive third degree price discrimination will make each consumer better off compared to first and second degree price discrimination. Competition forces the firms to maximize consumer utility, and the flexibility is offered through price discrimination. If there are no fixed costs in this case, consumer utility falls with competitive third degree price discrimination regardless of overall welfare increases.

Another form of third degree price discrimination is based on purchasing history. Fudenberg and Tirole (1998) found that monopolist firms are targeting different consumers and placing them into different groups according to their purchasing history. By analyzing the purchasing history, firms are able to offer different kinds of products to different groups of customers, such as software upgrades, latest versions, enhancements, and the like. But Acquisti and Varian (2001) argue that within a simple model that only considers two types of customers, high-value and low-value, although monopolistic sellers can make conditional offer prices based on the previous purchasing history, it is not profitable to do so. The only optimal condition that the monopolist can generate is offering some enhanced services such as one-click shopping or recommendations based on the consumers' purchasing history.

5. Implementations of price discrimination

What are the effective price discrimination implementations that firms can use in high-tech industry? Especially for information goods, how can a firm design the product quality and

set the price in order to generate more profit in the market? We know that this is critical given their high fixed and start-up costs. I summarize a few strategies which are feasible for pricing information goods.

5.1 Versioning

Versioning refers to the situation in which the producer provides different qualities or versions of a good which are sold at different prices. It is essentially the same product with some degree of differentiation. Varian (1997) claimed that the purpose of versioning is to sort consumers into different groups according to their willingness to pay (WTP). Firms design the versions in order to induce the consumers to self-select into their appropriate category. Consumers with a high willingness to pay are targeted for one version, while those with a lower willingness to pay are targeted for different versions. In this paper, Varian states that large fixed costs of production and low variable costs of reproduction are the prominent features of information goods. Cost-based pricing makes little sense here, and value-based pricing is much more appropriate. The techniques for differential pricing become crucial. The fundamental problem firms have to face in differential pricing is to set the actual price so that consumers are able and willing to pay as much as the firms can charge. The firm has to have a good idea of the consumers' reservation prices.

Varian illustrated with an example that supposed that there are two groups, one with a high willingness to pay for "quality", and the other with a low willingness to pay. The "quality" in this case refers to certain attributes of the good that are desirable to consumers. Taking

information goods as an example, quality may represent the digital resolution, the timeliness of financial news, or some professional operating functions in software.

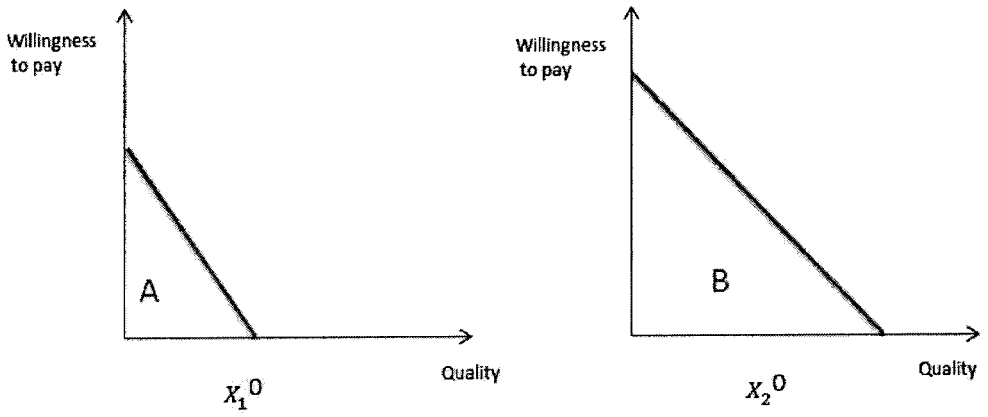

Figure 3 Low demand and High demand consumers[5]

Figure 3 depicts the demand curves for quality for the two types of consumer. Note that the demand curve in Figure 3A depicts a lower willingness to pay for the good than the demand curve in Figure 3B for each quality at which the good may be offered. For simplicity in modeling, in this example he assumes that the marginal cost of producing incremental quality is zero. The profit-maximizing policy for this problem becomes easier to understand, since the firm by assumption can perfectly identify different types of consumers and their willingness to pay, it will price the good so as to extract the entire consumer's surplus. Total surplus can be maximized, and the level of output will be efficient, the firm is able to extract the entire surplus. By using the notation in Figure 3, the firm would set the quality intended for type 1 to be X_1^0 and charge r_1= area A; the quality intended for type 2 would be X_2^0 and the charge is r_2= area B. This pricing solution is Pareto-efficient. Differential pricing has allowed the producer to capture the entire consumer's surplus in this simple

[5] "Pricing Information Goods", Presented on Research Libraries Group Symposium on "Scholarship in the New Information Environment" held at Harvard Law School, May 2-3, Varian, Hal R, 1995.

case.

In contrast to what happens in this simple example, what is the case when price discrimination is not feasible? Varian supposes that a fraction π of the population is the high-WTP type, and a fraction 1-π is of the low-WTP type. The firm sets the price and quality so that only the high-WTP type buys the good, in this case the low WTP group does not participate in the market, or that both types buy the good. πr_2 is the profit from the former strategy, and $\pi r_1 + (1 - \pi) r_1 = r_1$ is the price and profit from latter strategy. The firm will choose the strategy yielding more profit.

Next he considers a second condition under two groups. The firm knows something about the distribution of the willingness to pay in the population, but cannot identify the willingness to pay of a given consumer. In this case, the firm can base its price on an endogenous characteristic, such as the quality of the choice the consumer makes instead of an exogenous observable characteristic, such as membership in some group. Firms would choose two qualities and associated prices, and then offer them to the consumers. Different consumer types will choose one of the two quality/price pairs, and the firm wants to maximize profit by offering the optimal quality and price packages. The purpose is to let the consumers self-select into the high and low-WTP groups by setting price and quality accordingly. Firm set different price/quality packages to ensure that consumers with different WTP will be targeted specifically, so that consumers with high WTPs and low WTPs choose their own price/quality packages respectively.

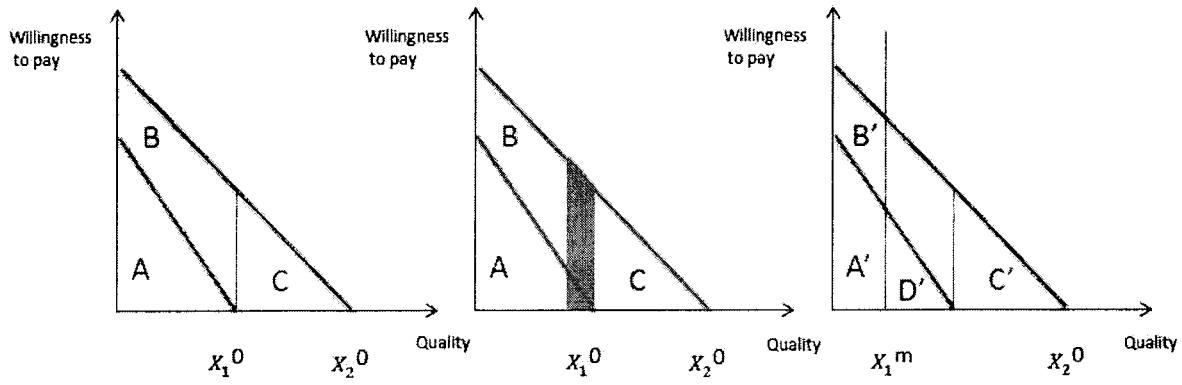

Figure 4 Strategies to induce self-selection[6]

Figure 4 depicts a possible strategy for this self-selection problem. In this figure, the firm produces qualities (x_1^0, x_2^0) and sells these at prices r_1^0 = A and r_2^0= A + B + C respectively. Each consumer gets zero surplus if he chooses the package which is specified for him. This example shows us that the particular price/quality pairs indicated do not satisfy the self-selection constraints, since the high-WTP consumer can choose the package intended for the low-WTP consumer and achieve a positive surplus. In this case the high-WTP consumer chooses the bundle (r_1^0, x_1^0), and he will achieve the surplus represented by area B. The firm's profit would then be r_1=A , which is same as if price differentiation were infeasible.

The firm could set a price of A + C for x_2^0 to prevent this arbitrage, noting that the high-WTP consumer would be indifferent to purchasing x_1^0 at a price of A, yielding a surplus of B, or purchasing x_2^0 at a price of A + C, yielding the same level of surplus. This

[6] "Pricing Information Goods", Presented on Research Libraries Group Symposium on "Scholarship in the New Information Environment" held at Harvard Law School, May 2-3, Varian, Hal R, 1995.

pricing is definitely more profitable than the original pricing for the seller, since it yields profits of $\pi(A + C) + (1 - \pi)A = A + \pi C > A$.

The second strategy offers the firm a chance to capture the incremental surplus to the high-WTP consumer area, denoted by C, that is associated with improving the quality from x_1^0 to x_2^0. But this strategy is not profit-maximizing because the firm can increase its profit more by reducing the quality available to the low-WTP consumers.

The number of versions of a product that are offered should be equal to the number of types of consumers in the market. What happens when there is no obvious market segmentation? A common choice is to have two versions: a "standard" and an "enhanced" version. However, Varian supports his argument by recent work in marketing suggesting that the optimal number of versions in this case is not two but three. Appealing to a paper by Simonson and Tversky (1992) who conducted a marketing experiment between two groups of consumers. These consumers were asked to choose microwave ovens, and one group was offered a choice between two ovens, an Emerson priced at $109.99 and a Panasonic priced at $179.99. The second group was offered these ovens plus a high-end Panasonic priced at $199.99. The result shows that by offering the high-end oven, Panasonic increased its market share from 43% to 73%. Adding a premium product to the product line perhaps will not result in increased sales in the premium product itself, but it will enhance buyers' perceptions of lower-priced products in the product line and influences low-end buyers to trade up to the higher-priced selection.

Here are three practical implications Varian claimed from his analysis for the producer of information goods. First of all, the firm has to design the information goods that can be versioned, and products should be designed such that it is easy to reduce the quality in order to implement differential prices for the particular market segment. Taking software as an example, the production line has been varied for different price levels and customer needs, with higher prices being associated with higher value added.

Varian (1999) lists different versioning types for information goods: delay, user interface, convenience, image resolution, speed of operation, flexibility of use, capability, features and functions, comprehensiveness, annoyance, and technical support. Secondly, it is desirable to design the product for the high end first and then downgrade the product to get different versions for the other segments of the market. Recall that the previous analysis implies that the product for the high-demand consumer was chosen when the marginal willingness to pay for additional quality equals the marginal cost of producing additional quality. Once the high end has been determined, the producer can then remove certain features to sell to the lower segment of the market segmentation, recognizing that each feature it removes allows it to increase the price at which the item is sold to the high-WTP consumers, provided that it has gauged the consumers' preferences properly. Firms usually face a tradeoff. The more they differentiate their product, the greater the capacity for price discrimination, which in turn boosts their revenues. Finally, in the absence of any additional information, having three versions rather than two may be more attractive to consumers and more prof-

itable to firms.

5.2 Bundling

New opportunities are created for pricing information goods since the internet became the new channel to distribute digital information goods online. Providers of information goods are usually struggling with the phenomenon of almost prefect copies of information goods being created and distributed almost costlessly. The efficiency condition of price equals marginal cost under the competitive market does not apply here. Bundling is one of the effective ways of implementing price discrimination of information good under such circumstances. It can be thought of as aggregating information goods. Fishburn, Odlyzko, and Siders (1997) argue that aggregation will dominate the pricing structure when marginal production and distribution costs become negligible, which is consistent with the situation that applies for diffusing information goods. Between aggregation and disaggregation, which is more applicable for pricing information goods?

Bakos and Brynjolfsson (1999) find that lower transaction and distribution costs tend to make disaggregation (unbundling) more attractive for firms, while lower marginal cost of production tends to make aggregation (bundling) more attractive. They also find that with bundling, aggregating information goods across consumers or across time is often an effective strategy that maximizes social welfare and the firm's profits, but aggregation is less attractive when marginal costs are high or when consumers are not homogeneous in their preferences. Bakos and Brynjolfsson claims that there are basically two reasons why firms would prefer to ag-

gregate when selling information goods. First, aggregation can directly increase the value available from a set of goods, due to the technology complementarities in production, distribution, or consumption. Second, aggregation can make it easier for firms to extract value from a given set of goods by enabling a form of price discrimination, and it can dramatically affect both efficiency and profits. The near zero marginal costs of reproduction for digital goods make many types of aggregation more attractive. Economic efficiency and profitability are maximized by providing the maximum number of information goods to the maximum number of people, at prices as close as possible to the consumer reservation price, and therefore selling information goods in large aggregates will often achieve this goal.

They illustrated this phenomenon with a simple linear demand curve for all goods, and assumed that the initial fixed costs of producing a good are quite significant, but right after the first copy is produced, the marginal cost of production denoted by C, is near zero in this case. At price p, the number of units purchased is q, resulting in a profit of pq. When p>c, there is one group of consumers who value the good at more than its production cost but are not willing to pay as much as p. They would not buy the goods in this case, and deadweight loss (DWL) is then created. There is another group of consumers who are willing to pay more than p to access the good, but only have to pay P to receive it and enjoy the consumers' surplus.

In this case, if the firm is able to price discriminate and charge differential prices on different product lines based on their willingness to pay, this will increase the firm's profits and eliminate both the consumer's surplus and the deadweight loss. If the firm is not able to price dis-

criminate and can only charge a single price instead, the only single price that would eliminate the inefficiency stemming from the deadweight loss would be a price equal to marginal cost, which is near zero. Obviously, this is insufficient to cover the huge fixed cost incurred from producing the first copy of the information good. Aggregation can become one of the useful tools for price discrimination in this situation: bundling goods together instead of selling them individually.

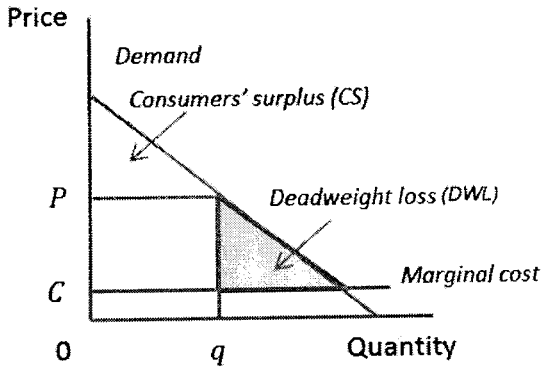

Figure 5 Deadweight loss from sales of a zero-marginal-cost information good[7]

Bakos and Brynjolfsson state that as more and more goods are added to the bundle, the sum of valuations becomes more concentrated around the mean, reflecting the law of large numbers. The high and low values for individual goods tend to "average out". Instead of increasing the variation of prices to match the heterogeneous distribution of consumer's preferences, bundling reduces the effective heterogeneity of consumers, such that a single price can efficiently allocate goods to the consumer. We end up with a higher price than we would in a competitive market.

[7] "Shared Information Goods",*Journal of Law and Economics.* Vol. 42, No. 1. Brynjolfsson, Erik., Bakos, J.Y.,and Lichtman, Douglas,. 1999.

Bakos and Brynjolfsson also argue that under three circumstances, complete disaggregation and "mixed aggregation" can become more profitable than aggregation strategies for information goods when consumers utilize micropayment for their online purchasing transactions. First of all, if the marginal cost is nontrivial, disaggregation can economize on the cost by allowing users to "opt out" of components with a marginal cost greater than their marginal benefit. Secondly, mixed aggregation may be beneficial if it can sort consumers when they are willing to pay for entire goods. Third, if the firm can feasibly aggregate over some small number of goods and offer them outside of the bundle of large amount of goods, this may become more profitable and executable.

They also suggest that information goods can be offered in bundles on a site-license basis to multiple users for an extended period of time. Firms would get closer to the point of full efficiency and earn higher profit since aggregation along one dimension will not exhaust the benefits of aggregation in other dimensions. They also conclude that due to the dramatic reduction in marginal production, distribution and transaction costs of information goods, strategies based on aggregation and disaggregation are significant. Aggregation strategies substantially reduce the deadweight loss from monopoly, but at the same time also lower the surplus left to the customers.

5.3 Switching cost and lock-in

Varian (2004) stated that switching costs are endemic in high-technology industries, they can be so large that switching suppliers is virtually unthinkable. This is the situation of "lock-in",

which makes consumers totally captive. For example, it is very costly to change the software environments at the organizational level, due to the cost of infrastructure upgrades, consultants, retraining programs, etc.

Shapiro and Varian (1998) examined some of the implications of switching costs and lock in. They illustrated with a simple two-period model for n consumers, in which every consumer is willing to pay v per period to buy a non-durable good. There are two producers who produce one good for a constant identical marginal cost of c, and the producers are unable to commit to the future prices. By switching consumption from one firm to the other, a consumer must pay for a switching cost s. If $v \geq c$, and $v + s < c$, it pays each consumer to purchase the good but not to switch. The Nash equilibrium in the second period is unique for each firm. It sets its price at the monopoly price v, the profit is $v - c$, and in the second period, the seller is able to extract full monopoly profit, when the consumers are "locked in".

Firms seek to generate a substantial source of profit from the "locked-in" consumers, resulting from high switching costs, and competition is intense to attract new consumers. Chen and Hitt (2001) claimed that the breadth of product offering is the single best explanatory variable in their random utility model for online brokerage firms, and the demographic variables do not have much explanatory power in comparison. This conclusion indicates that the breadth of product offering is quite important for a firm. By offering a variety of products at reasonable cost, consumers' willingness to switch would be reduced. "Lock-in" can be very profitable for a firm, and the competition to acquire new consumers can actually be quite beneficial.

While the first round is extremely competitive, as firms vie for new customers, the second round is monopolized. The long-term effect on consumer surplus of "lock in" might well be negative. Firms will try to induce consumers to remain with their products for a long time, thus contributing to future profit flows. Klemperer (1995) claimed that the switching cost is detrimental for consumer welfare. Firms can typically raise prices over the lifetime of the product, thus creating deadweight loss.

5.4 System Effects

It is quite common in high-tech industries that some products have little value unless they are combined into a system with other products. In this way, they are complementary goods. The partial demand of one good determines another's demand simultaneously. For example, computer hardware is useless without accompanying software, and an operating system is useless without software applications. For these complements, the value of goods usually depends on their being used together. The Lock-in effect usually occurs when the consumer must invest in the complementary goods at this stage. However, the consumer typically has some choice. Varian (2004) states there are two kinds of network effects raised from complementary goods: direct and indirect. They are both considered as symmetric forms of complementarities.

Due the property of complementary goods, he indicated there are five ways for the producer of a complementary good to cut its price. 1) Integrate. One producer can acquire the other and form a merged entity, which internalizes the externality. 2) Collaborate. Firms can set up

a structure for revenue sharing, then set the price for the joint system. 3) Negotiate. A firm can commit to cut its price while other firms also cut their price. 4) Nurture. A firm can work with others to reduce their costs. 5) Commoditize. A firm can stimulate competition in the other's market, therefore pushing down the price. Varian stated that all these factors are important, and their effect is to lead towards high industry concentration ratios and monopoly power in the end.

In *Information Rules (1998),* Shapiro and Varian once criticized Apple for pursuing an integrated system strategy which was quite different from other major high-tech companies in the United States. The integrated system led to higher price and temporarily reduced its product popularity among consumers. By producing is own hardware and software platform together, Apple indeed dominated its complementary product lines and acquired great monopoly power in this case. Up until 2010, this highly integrated strategy became the crucial component of its competitive advantage among other consumer electronic products. From personal music player Ipod , the newest smartphone Iphone, to the tablet computer Ipad, all these hardware are combined with software operating systems and online shop together, the highly integrated product portfolios successfully created huge switching cost for their users, and contributed to a significant profit for this company in the long run.

6. Economies of scale

6.1 Supply-Side economies of Scale

In the information goods market, given the unique cost structure, characterized by a large fixed

cost with low incremental costs of reproduction, firms in the technology-related business are "natural monopolies". Varian (2004) discussed why the social loss from high-fixed cost, low-marginal cost industries are substantially less than is commonly believed, due to the fact that government regulations offers its own inefficiencies.

First of all, the real world is usually much more dynamic than what is depicted in economics textbook. Textbook analysis typically takes the existence of the monopoly as given. Secondly, the most significant cost advantage usually belongs to the biggest firm, and other firms will compete intensively to become the biggest firm. Consumers indeed will benefit from this competition. Take online retailing as an example. These firms acquired significant market power from the scale economies, and consumers benefit from the lower price they are offering. Third, the total cost for production is largely reduced by information technology. Fourth, Varian claimed that many declining average cost industries produce durables of one form or another. For instance, in the software industry , the installed base creates formidable competition for suppliers, since the seller has to convince their users to upgrade the software continually. The software can therefore be considered as a durable good, and these firms are very likely to become the durable goods monopolies. Finally, there is the pressures on price stemming from producers of complementary products. Because the cost of the information system to the end user depends on the sum of the prices of all the components, each of the component makers would like to see that other component provider charge a lower price for its own product. For example , hardware makers have an incentive to obtain cheap software applications for their users.

Varian argued that there are at least four different effects that supply-side economies of scale exert on the price. They are 1) In the case when monopoly power is first acquired through competition, it will force lower prices for the consumers. 2) Due to technological evolution, high-tech industry tends to reduce fixed costs over time, leading to more entrants, particularly in industries with a high demand for the product variety 3) Competition with its own prior product lines. For example, the newer version of the software usually has to compete with the previous version as an upgrade. 4) Pressure coming from producers of complementary goods. Complementary goods producers want to see lower prices from other firms with which they trade, and therefore they would exert their pressure or market power to enforce this.

Even though Varian has argued that supply-side economies of scale can reduce prices, Delong and Froomkin (2001) disagreed. They claimed that an industry that exhibits high fixed cost, low marginal cost usually leads to the conventional inefficiencies. From standard neo-classical economic theory, we know that the efficiency condition is that price is equal to marginal cost and that in the long run price equals average total cost. By implementing the price discrimination scheme for information goods, the same goods are sold at different prices to different consumers. Profit-seeking behavior may result in consumers with low willingness to pay ending up with a lower price, and consumers with a high willingness to pay ending up with a higher price. This implies that efficiency losses are not substantial. Deadweight loss to total surplus is usually created by the monopoly, but prefect price discrimination eliminates the deadweight loss, and the monopoly rents are being transferred to consumers through

competition as shown in Figure 6.

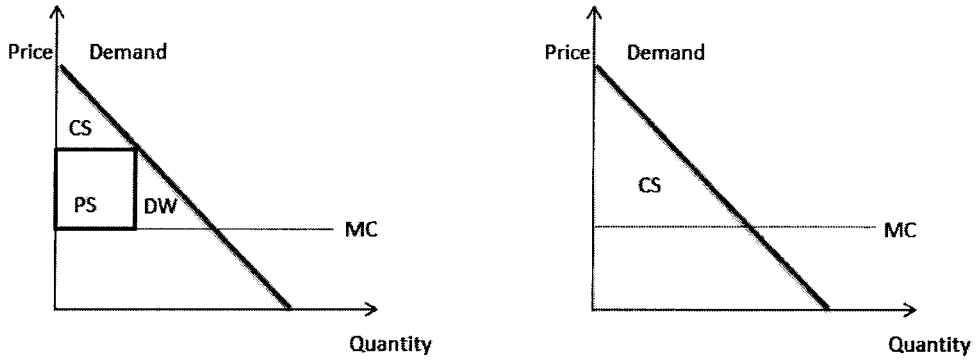

Figure 6 Competition for an (a) ordinary and (b) perfectly price discriminating monopolist[8]

6.2 Demand-side economies of scale

The definition of demand side economies of scale, as explained by Varian (2004) is the presence of "network externalities" or "network effects". They occur very commonly in network industries. One product exhibits a network effect when the demand for this product depends on how many other people would purchase it. For instance, take the example of a DVD player. As more and more people purchase DVD players, both the machine and DVD disk will become more popular. Given the fact that the market expands, production expands, and therefore the per-unit cost of production on a mass scale will be reduced. Consumers will benefit from such economies of scale through lower average costs of production.

[8] "Speculative microeconomics for tomorrow's economy" ,Internet Publishing and Beyond: The Economics of Digital Information and Intellectual Property. *The MIT Press, MA.* Delong, B.J., Froomkin.M.A., 2001.

6.3 Network Effects Interconnections

A network externality exists when the value of a good depends on how many people use it. Varian (1999) stated that if there are several different providers of the networks, consumers would benefit from interconnecting with each other's network. In this way, consumers are actually intending to be connected to as large a network as possible. This applies to the case of the internet because it is built on a common platform of uniform standards, and this enables different networks to interconnect with each other.

According to Metcalfe's Law, which is named after Bob Metcalfe, the inventor of Ethernet, which links computers within a network, the value of a network rises with the square of the number of users. If N people are on a network, the total value of a network is $\boldsymbol{N^2}$. Although some firms may try to avoid interconnection with new entrants in order to preserve their market power, dividing the increase in value due to interconnection would make all participants better off. Varian illustrated one example consisting of two networks of sizes n_1 and n_2 in the beginning. The network size becomes $n_1 + n_2$ after the interconnection. Δv_1 represents the user difference between interconnect network n_1 itself and interconnect n_1 and n_2. The difference in value is the same.

$$\text{Network 1: } \Delta v_1 = n_1(n_1 + n_2) - n_1^2 = n_1^2 + n_1 n_2 - n_1^2 = n_1 n_2$$

$$\text{Network 2 : } \Delta v_2 = n_2(n_1 + n_2) - n_2^2 = n_2^2 + n_1 n_2 - n_2^2 = n_1 n_2$$

This result shows that each network ends up with equal value from interconnecting. People using the small network get a lot of extra value by connecting with the larger network. Sup-

pose that not all the networks are willing to connect with each other on a payment-free basis. Then network 1 pays network 2 its standalone value in order to merge it into its own network. As demonstrated below, the new value becomes $2n_1n_2$, and network 1 acquires about twice the value by buying out network 2 instead of interconnecting with it. Varian claimed that the threat of non-connection increases the larger network's bargaining power, because the smaller network will benefit much more in comparison with interconnecting with a larger network, by being bought out by the larger network.

The increased value for Network 1 after merger:

$$\Delta v_1=(n_1+n_2)^2-n_1^2-n_2^2=n_1^2+n_2^2+2n_1n_2-n_1^2-n_2^2=2n_1n_2$$

7. Mini Case Studies

7.1 The Bankruptcies of Blockbuster and Borders

In the past two years, two cases of information firms filing for bankruptcy why they are failing now instead of 10 years ago during the so called "irrational exuberance" era of the internet boom? What change or evolution in technology caused such a phenomenon to happen? The irrational exuberance refers to the huge financial speculation surrounding the internet in the 1990s, during which billions of dollars were invested into high-tech industries chasing a potentially high return. The public exhibited a lot of interest in the new technology. Eventually, the bubble of equity prices burst, and huge amounts of financial capital were lost after the internet boom.

On September 23rd 2010, Blockbuster video, one of the biggest retail video-rental chains , filed for bankruptcy protection in New York. The bankruptcy announcement revealed that 3,000 American stores would be closed and thousands of workers would lose their jobs. Within six months, on Feb 16th 2011 Borders, the second biggest U.S. bookstore chain, filed for bankruptcy in New York after management changes, job cuts, and debt restructuring took place.

Are they just cases caused by random factors, or are there relevant underlying economic forces behind these phenomena? Netflix.com and Amazon.com were substitutes that brought on the demise of Blockbuster and Borders, but within a few years they in turn faced competitive threats. When the business of Netflix.com and Amazon.com soared, two traditional competitors lost their market share and struggled in debts. Eventually the competition put these companies out of business. Perhaps the threat was not strong enough when the bandwidth of the Internet was slow, or when the E-commerce channel for shopping was not as developed, and the logistic chain and on-line micropayment method was still unable to support such a business structure. But after decades of evolution, the companies with strong market power in the industry obtained the capability of becoming the next new dominant firm in the market. This is an illustration, of Schumpeterian "creative destruction" driven by technological evolution.

7.2 Apple and Angry birds

In the past Varian and Shapiro (1999) once criticized the Apple computer company for pursuing a strategy of producing a highly integrated product which consisted of both a hardware

platform and the software operating system, which at the time was quite different from the business model of other major IT companies in the Untied States. They argued that since Apple had less market power due to their high price and inefficient network externalities among the end users, it was quite unlikely that Apple would outperform other high-tech companies. At that time, Microsoft did dominate the operating system market for many years, and became one of the most profitable companies in the world. Until the beginning of 2000, Apple was struggling to survive with its highly integrated products.

In the past ten years, Apple has changed the information technology world through gradually building its integrated system from the hardware device to owning and operating its online stores, where they sell complementary goods within their own product portfolio. They branched out from personal computers and software to other electronic devices. When they developed new innovations, they were able to exploit market power and earn rents for long periods of time before new competitors could enter the market. Apple continues to execute its integrated strategy among all of its product lines, pricing their products with a relatively high price as the reward of innovation and popular design. They successfully converted their disadvantage in the past of selling highly integrated products into an advantage. For example when Iphone, a smartphone made by Apple, was first introduced to the market, Apple opened its software application system to multiple software development companies. "Angry birds", an entertainment game application on the Iphone, attracted numerous users globally. As re-

ported by Reuter9, the estimated value of the Rovio, the company who designed "Angry birds" application, reached $1 billion by Aug 18th 2011. The App store, which is the retail store of the Apple corporation, was able to benefit a lot from these sales by virtue of having developed the hardware.

The revolutionary innovation was demonstrated by Apple through how it became capable of selling information goods via online channels. The integrated system design fits the economics theory of complementary goods perfectly. By producing not only the hardware device, but also owning and operating the online software store, plus connecting with the micropayment method through credit cards, an entire channel of selling information goods had been established. All stages of the production and distribution process have been vertically integrated.

Many of the information goods that are in the form of apps can be accessed on the mobile internet and smartphones instead of only on stationary microcomputers. Meanwhile, the way that new hardware delivers information goods makes them more of a private good and less of a public good, as free riding becomes harder. And most of all, the convenience and feasibility of the mobile internet, for the first time in history converted information goods' property from public goods into private goods that entirely belong to certain consumer rather than staying on the static PC computer for numerous individuals to share it. A majority of users end up with their own personal copy. This is a remarkable change in the evolution of Internet, and this change will benefit the digital publishing market in the subsequent years. Taking the China

[9] http://www.reuters.com/article/2011/08/18/us-rovio-ipo-idUSTRE77H29720110818

online publishing industry as an example, there is further evidence of this trend.

7.3 China's digital publishing industry

Usually when we think of books, we think of tangible, concrete printed matter containing information with a cover, having a certain weight, and taking up physical space. The digital publishing industry completely changed the market for that medium. With the growth of E-commerce book retailing stores, such as amazon.com and dangdang.com, the profit of book publishers were squeezed. A lot of local book stores in China found that their demand collapsed.

In contrast, the existence of highly personalized literature or magazine website platforms, with stable micropayment accounts provided by banks and dealers, enhanced consumers' incentives and their ability to purchase the digital material online. The transaction of purchasing digital books to consumers' own terminal smartphones, e-readers, or tablet computers are fast, convenient, and relatively cheap. Economies of scale in production allow for cost reductions for online publishers, so they can acquire a competitive advantage in the market.

Recent data illustrate this trend of the rapid growth in the on-line publishing industry. It is estimated that in 2010, the total revenue from the digital publishing industry reached 105.179 billion RMB, five times the level of 2006 total revenue. The value of mobile phone publications for the first time surpassed online entertainment games and reached 34.98 billion

RMB. It accounted for 33.26% of the total revenue of digital publishing industry. This significant growth and change tell us that in the future, information goods will be transformed from "public" to "private" goods to a greater extent in the existing market. Consumers will have a higher incentive to pay for what they view and read when they can access WIFI anywhere, anytime, and when they can download the content to their own personal device.

8. Further applications drawn for more recent literature

A major theme of this paper is the inherent difficulty in pricing information goods in conventional markets, which stems in part from the fact that information goods can be created and distributed almost costlessly. This brings up the question of what is the optimal price for each additional copy of information good? Some recent applications are surveyed in this part of the paper.

McCabe (2004) modeled journal pricing behavior and considered how the technology of digital distribution has led to endogenous changes in pricing behavior. When the distribution costs decline, price discrimination becomes more attractive. This paper models the pricing behavior of journal publishers within a portfolio demand framework. He assumes that journal publishers cover costs through the collection of revenue from libraries. However, given the opportunities that the Internet offers, new entrants have begun to adopt an "open access" business model with free online access. Author fees and advertising are the main source of revenues. It would be useful to endogenize pricing behavior along these several

channels for pricing in the journal market, and then to explore the implications for market evolution.

McCabe shows that in an endogenous change in pricing strategies, a decline in distribution costs can be result in a shift from non- discriminatory pricing to price discrimination. This shift can improve aggregate consumer welfare as libraries with limited budgets can afford to purchase more titles. Firms may need to bundle their journals to avoid displacement of their individual titles, since this cost decline also creates new entry opportunities, and the incumbent publishers may choose to bundle to deter entry and therefore limit the welfare gains.

Cremer and Pestieau (2008) study the effects of piracy on prices and welfare and determine the optimal enforcement policy. The paper assumes that the monopolist sells the information good using a at a non-linear price schedule for different kinds of consumers according to their willingness to pay. High- valuation customers can not engage in full-fledged piracy, and consumers with low willingness to pay can copy the good with some quality loss. They argue that copying or piracy may be welfare enhancing because it enables the information good to be provided to individuals with a low willingness to pay without undermining the producing firm's capability to cover the development cost via the pricing scheme applied to high valuation consumers. In their study they state that there are then three levels of piracy control that the firm selects, and the highest is the one chosen by the private monopoly. The second level is the one chosen by a welfare-maximizing monopoly, and the lowest level is the level of control chosen by the public authority when the good is sold and

priced by a profit-maximizing monopoly.

The enforcement of property rights is a prominent issue for the production and the pricing of information goods because the development and creation of information goods are often threatened by copyrights and patents. But from an economic perspective, the impact of illegal copying on profits is only part of the issue; the study of its welfare effects is also of crucial importance. Cremer and Pestieau state that welfare analysis is particularly significant for the design of enforcement policies which are intended to balance the costs against the benefits.

The case for a stringent enforcement can be strong when piracy has an adverse effect on welfare. Social welfare is defined as consumers' surplus plus profit, and consumers can either purchase the product or copy it from other consumers free of charge. Therefore the piracy protection has two opposing effects on social welfare. On one hand, according to design, it increases reproduction costs, which lowers consumer welfare. On the other hand it leads to more productive efficiency as producers can recover fixed costs. They consider a monopolist that produces the information good that is sold in different versions to two groups of consumers whose valuation of the good varies. The consumers with low willingness to pay would copy the information good at some cost and at some quality loss. The consumers with a high willingness to pay cannot engage in full-fledged piracy, but they can consume the version designed for the other customer type. These two types of consumers could be, for example libraries and individuals, who in practice typically pay different sub-

scription rates.

Viard (2007) models the case of a monopolist offering successive generations of an information good in a dynamic model. The monopolist offers up to two prices for each generation during each period. The model's predictions accord well with data from the PC software industry, and the model explains why firms issued version upgrades with every new generation, why firms provided a discount to those who upgraded relative to first-time buyers , and why late adopters commonly purchased the latest version at full price. In an upgrade offer, a firm sells a generation of its durable product to owners of an earlier generation product at a price that is lower than the full price charged to those who have never purchased. Upgrades are an important marketing tool for information-goods firms because the product's high degree of durability and low marginal cost of production make upgrade offers an appealing price discrimination tool.

He develops an overlapping generations model with infinite-lived firms and consumers. This model predicts the effect of relevant factors on upgrade issuance and the relative prices of the product offerings. He models a monopolist given characteristics that closely approximate an information goods market. The result shows that the firm offers successive generations of a perfectly durable, zero marginal cost good. The firm offers a better product in each generation, and no secondary market exists for the older product. The model's main predictions follow from the firm practicing a combination of static second-degree and inter-temporal price discrimination. Consumers with the highest willingness to pay purchase earlier than

those with a lower willingness to pay. This fact divides consumers into two cohorts: consumers attached to the firm and unattached consumers. Because consumers can credibly identify their previous purchases, the firm can practice second-degree price discrimination between these groups.

Schmidt (2006) develops a general model for the revenue flows in a multi-level market, describing quantitatively the incentives that buyers receive through resale revenues. He shows how a basic model for the revenue flows in an idealized multi-level market can be applied to examine market mechanisms for the distribution of virtual goods. The marketing of information goods is conventionally countered by copyright protection regulations and technology. Information goods share the attributes of transferability and non-rivalry with public goods, and additionally they are durable. The cost of the first copy production could be huge, but the cost of reproduction is relatively low and close to zero.

In this model the marketing of information goods is plagued by the problem of free riding, the usual channel of illegal copying being file sharing on the Internet or transferring through peer-to-peer networks. Schmidt points out that the conventional ways to counter piracy are copyright protection and digital rights management (DRM) measures. These practices are controversial due to economic, policy-related, and pragmatic reasons. He suggests that in the view of its idealized and simplified nature, the model should be considered as a starting point for further model building and theoretical analysis. The most important qualitative traits of the markets described by the model are discussed. He deals in particular with the illicit

schemes employed by the pirates, the free-rider problem, network externalities, and the possibility to determine the incentive schedule by dynamic forward pricing. In the end he concludes this present model may give rise to some fecund directions for further research.

9. Conclusion

It is interesting to discuss where the technology trend will eventually lead. This survey of the economics of information good suggests that these predictions and discussions do make economic sense. The economic principles have been validated in the application of the information goods market.

In this survey paper, I investigated the background of internet and the social impact of its technological evolution. Then I discussed the nature of the information goods, and the three primary characteristics of information goods that typically undermine their profitability, namely the feature of experience goods, returns to scale in production, and public good qualities. Price discrimination can be applied to information goods, through the tools of versioning, bundling, and creating switching cost for consumers which lock them in with system effects. Then I investigated the economies of scale effects on both the demand and supply sides, along with the network externalities in order to generate a full perspective of information goods market. At the end of the paper, I briefly illustrated three real-life cases to reflect the predictions that have been made in the past. The future market trend of information goods is becoming more promising than ever for both consumers and producers.

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