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ECONOMIC PHENOMENON IN COMPUTER TECHNOLOGY

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ABSTRACT:- This is an overview of economic phenomenon that is vital for high-technology industries. Topics covered include personalization of products and prices, versioning, bundling, switching costs, lock-in, economies of scale, network effects, standards, and systems effects. Most of these phenomena are present in conventional industries, but they are particular important for technology-intensive industries. We provide a survey and review of recent literature and examine some implications of these phenomena for corporate strategy and public policy.

Key-Words- Computer Applications; Demand and Supply; Economics; Information Security

1. INTRODUCTION

During the 1990s there were three back-to-back events that stimulated investment in information technology: telecommunications deregulation in 1996, the "year 2K" problem in 1998-99, and the "dot com" boom in 1999-2000. The resulting investment boom led to a dramatic run-up of stock prices for computer technology companies. Many IT companies listed their stocks on NASDAQ. Figure 1 depicts the cumulative rate of return on the NASDAQ and the S&P500 during most of the 1990s. Note how closely the two indices track each other up until January of 1999, at which point NASDAQ took off on its roller coaster ride. Eventually it came crashing back, but it is interesting to observe that the total return on the two markets over the eight years depicted in the figure ended up being about the same. Figure 1 actually understates the magnitude of technology firms on stock market performance, since a significant part of the S&P return was also driven by technology stocks. In December 1990, the technology component of the S&P was only 6.5 percent; by March, 2000, it was over 34 percent. By July 2001, it was about 17 percent. A prominent Silicon Valley venture capitalist described the dramatic run-up in technology stocks as the "greatest legal creation of wealth in human history." As subsequent events showed, not all of it was legal and not all of it was wealth. But the fact that only a few companies succeeded capitalizing on the Internet boom does not mean that there was no social value in the investment that took place during 1999-2001. Indeed, quite the opposite is true. One can interpret Figure 1 as showing something quite different from the usual interpretation, namely, that competition worked very well during this period, so that much of the social gain from Internet technology ended up being passed along to consumers, leaving little surplus in the hands of investors.

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Figure 1: Return on the NASDAQ and S&P 500 during the 1990s.

Clearly the world changed dramatically in just a few short years. Email has become the communication tool of choice for many organizations. The World Wide Web, once just a scientific curiosum, has now become an indispensable tool for information workers. Instant messaging has changed the way our children communicate and is beginning to affect business communication. Many macroeconomists attribute the increase in productivity growth in the late 1990s to the investment in IT during the first half of that decade. If this is true, then it is very good news, since it suggest we have yet to reap the benefits of the IT investment of the late 1990s.

2. TECHNOLOGY AND MARKET STRUCTURE

A major focus of this monograph is the relationship between technology and market structure. High-technology industries are subject to the same market forces as every other industry. However, there are some forces that are particularly important in high-tech, and it is these forces that will be our primary concern. These forces are not "new". Indeed, the forces at work in network industries in 1990s are very similar to those that confronted the telephone and wireless industries in the 1890s. But forces that were relatively minor in the industrial economy turn out to be critical in the information economy. Second-order effects for industrial goods are often first-order effects for information goods. Take, for example, cost structures. Constant fixed costs and zero marginal costs are common assumptions for textbook analysis, but are rarely observed for physical products since there are capacity constraints in nearly every production process. But for information goods, this sort of cost structure is very common-indeed it is the baseline case. This is true not just for pure information goods, but even for physical goods like chips. A chip fabrication plant can cost several billion dollars to construct and outfit; but producing an incremental chip only costs a few dollars. It is rare to find cost structures this extreme outside of technology and information industries. The effects we will discuss involve pricing, switching costs, scale economies, transactions costs, system coordination, and contracting. Each of these topics has been extensively studied in the economics literature. We do not pretend to offer a complete survey of the relevant literature, but will focus on relatively recent material in order to present a snapshot of the state of the art of research in these areas. We will try to refer to particularly significant contributions and other more comprehensive surveys. The intent is to provide an overview of the issues for an economically literate, but non-specialist, audience.

3. THE INTERNET BOOM

First we must confront the question of what happened during the late 1990s. Viewed from 2003, such an exercise is undoubtedly premature, and must be regarded as somewhat speculative. No doubt a clearer view will emerge as we gain more perspective on the period. But at least we will offer one approach to understanding what went on. We interpret the Internet boom of the late 1990s as an instance of what one might call ``combinatorial innovation." Every now and then a technology, or set of technologies, comes along that offers a rich set of components that can be combined and recombined to create new products. The arrival of these components then sets off a technology boom as innovators work through the possibilities. The attempts to develop interchangeable parts during the early nineteenth century are a good example of a technology revolution driven by combinatorial innovation. A century later the development of the gasoline engine led to another wave of combinatorial innovation as it was incorporated into a variety of devices from motorcycles to automobiles to airplanes. It is not surprising to see simultaneous innovation, with several innovators coming up with essentially the same invention at almost the same time. There are many well-known examples, including the electric light, the airplane, the automobile, and the telephone. A new piece of software could be sent around the world in seconds and innovators everywhere could combine and recombine this software with other components to create a host of new applications. Web pages, chat rooms, clickable images, web mail, MP3 files, online auctions and exchanges, the list goes on and on. The important point is that all of these applications were developed from a few basic tools and protocols. They are the result of the combinatorial innovation set off by the Internet. Given the lack of physical constraints, it is no wonder that the Internet boom proceeded so rapidly. Indeed, it continues today.

4. DIFFERENTIATION OF PRODUCTS AND PRICES

Price discrimination is important in high tech industries for two reasons: first the high-fixed cost, low-marginal-cost technologies commonly observed in these industries often leads to significant market power, with the usual inefficiencies. In particular, price will often exceed marginal cost, meaning that the profit benefits to price discrimination will be very apparent to the participants.

In addition, computer technology allows for fine-grained observation and analysis of consumer behavior. This allows for various kinds of marketing strategies that were previously extremely difficult to carry out, at least on a large scale. For example, a seller can offer prices and goods that are differentiated by individual behavior and/or characteristics.

5. SUPPLY-SIDE ECONOMIES OF SCALE

We have already noted that many information and technology-related businesses have cost structures with large fixed costs and small or even zero, marginal costs. They are, to use the textbook term, ``natural monopolies." The solution to natural monopolies offered in many textbooks is government regulation. But regulation offers its own inefficiencies, and there are several reasons why the social loss from high fixed cost, low marginal cost industries may be substantially less than is commonly believed. First, competition in the real world is much more dynamic than in the textbook examples. Computer technology has reduced fixed costs and thus the minimum efficient scale of operation in many markets. Typography and page layout used to be tasks that only experts could carry out; now anyone with a computer can accomplish reasonably professional layout. Desktop publishing has led to an explosion of new entrants in the magazine business.

The same thing will happen to other content industries, such as movie making, where digital video offers very substantial cost reductions and demand for variety is high. Even chip making may be vulnerable: researchers are now using off-the-shelf inkjet printers to print integrated circuits on metallic film, a process that could dramatically change the economics of this industry.

When costs are falling rapidly, and the market is growing rapidly, is often possible to overcome cost advantages via leapfrogging. Market share alone is no guarantee of success. It should also be remembered that many declining average cost industries involve durables of one form or another. PCs and operating systems are technologically obsolete far before they are functionally obsolete. In these industries the installed base creates formidable competition for suppliers since the sellers continually have to convince their users to upgrade.

Finally, we should mention the pressures on price from producers of complementary products. Since the cost of an information system to the end user depends on the sum of the prices of the components, each component maker would like to see low prices for the other components. Hardware makers want cheap software and vice versa. In summary, although supply side economies of scale may lead to more concentrated industries, this may not be so bad for consumers as is often thought. Price discipline still asserts itself through at least four different routes.

Competition to acquire monopoly: In many cases the competition to acquire a monopoly will force lower prices for consumers, at least for a time. However, such competition may also produce inefficient rent dissipation.

Reduction in fixed costs: IT has, in many cases, reduced fixed costs over time, leading to more entrants, particularly in industries where there is high demand for variety. Even in commodity industries, rapid reduction in costs and rapidly growing markets offer a fertile ground for competition and disruptive technologies.

Competition with your prior production: Often, the installed base of a firm's own output is a formidable competitor, particularly when technological progress is so rapid as to exceed the ability to utilize technology fully.

5.1 Demand-side Economies of Scale

Demand-side economies of scale are also known as "network externalities" or "network effects," since they commonly occur in network industries. Formally, a good exhibits network effects if the demand for the good depends on how many other people purchase it. The classic example is a fax machine; picture phones and email exhibit the same characteristic. The literature distinguishes between "direct network effects," of the sort just described, and "indirect network effects," which are sometimes known as "chicken and egg problems." I don't directly care whether or not you have a DVD player-that doesn't affect the value of my DVD player. However, the more people that have DVDs, the more DVD-readable content will be provided, which I do care about. So, indirectly, your DVD player purchase tends to enhance the value of my player. Indirect network effects are endemic in high-tech products. Current challenges include residential broadband and applications, and 3G wireless and applications. In each case, the demand for the infrastructure depends on the availability of applications, and vice versa. The cure for the current slump, according to industry pundits, is a new killer app. Movies on demand, interactive TV, mobile commerce-there are plenty of candidates, but investors are wary, and for good reason: there are very substantial risks involved. Much of the discussion in the previous section about competition to acquire a monopoly also applies in the case of demand side economies of scale.

When network effects are present, there are normally multiple equilibria. If no one adopts a network good, then it has no value, so no one wants it. If there are enough adopters, then the good becomes valuable, so more adopt it-making it even more valuable. Hence network effects give rise to positive feedback.

We can depict this process in a simple supply-demand diagram. The demand curve (or, more precisely, the "fulfilled expectations demand curve") for a network good typically exhibits the hump shape depicted in Figure 2. As the number of adopters increases the marginal willingness to pay for the good also increases due to the network externality; eventually, the demand curve starts to decline due to the usual effects of selling to consumers with progressively lower willingness to pay. More and more transactions are being mediated by computers. As we have seen,

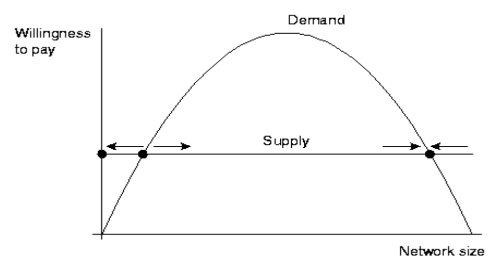

Figure 2: Demand and supply for a network good Computer mediated transactions

the data gathered can be mined for information about consumer behavior, allowing for various forms of price discrimination. But this is not the only function that transactions-mediating computers can play. They can also allow firms to contract on aspects of transactions that were previously unobservable. Consider, for example, video tape rental industry. Prior to 1998, distributors sold video tapes to rental outlets, which proceeded to rent them to end consumers. The tapes sold for around $60 a piece, far in excess of marginal cost. The rental stores, naturally enough, economized on their purchases, leading to queues for popular movies. In 1998 the industry came up with a new contractual form: studios provided video tapes to rental stores for a price between zero and $8, and then split revenue for rentals, with the store receiving between 40 and 60 percent of rental revenues. The interesting thing about this revenue-sharing arrangement is that it was made possible because of computerized record keeping. The cash registers at Blockbuster were intelligent enough to record each rental title and send in an auditable report to the central offices. This allowed all parties in the transaction to verify that revenues were being shared in the agreed-upon way. The fact that the transaction was computer mediated allowed the firms to contract on aspects of the transaction that were previously effectively unobservable, thereby increasing efficiency. As more and more transactions become computer mediated, the costs of monitoring become lower and lower, potentially allowing for more efficient contractual forms.

6. CONCLUSION

Better information for incumbents, lock-in, demand and supply-side economies of scale suggest that industry structure in high-technology industries will tend to be rather concentrated. On the other hand, computer technology can also reduce minimum efficient scale thereby relaxing barriers to entry. People value diversity in some areas, such as entertainment, and IT makes it easier to provide such diversity. Standards are a key policy variable. Under a proprietary standard, an industry may be dominated by a single firm. With an open standard, many firms can interconnect. Consider, for example, the PC industry. The PC itself is a standardized device: there are many motherboard makers, memory chip makers and card providers. There are even several CPU providers, despite the large economies of scale in this industry. Compare this to the software world, where a single firm dominates the PC operating system and applications environment. What's the difference? The hardware components typically operate according to standardized specifications, so many players can compete in this industry. In the software industry, standards tend to be proprietary. This difference has led to a profound difference in industry structure.

REFERENCES

[1] Alessandro Acquisti and Hal R. Varian. Conditioning prices on purchase history. Technical report, School of Information Management, UC Berkeley, 2001.

[2] Mark Armstrong. Price discrimination by a many-product firm. Review of Economic Studies, 66 (1): 151-168, 1999.

[3] Yannis Bakos and Erik Brynjolfsson. Bundling information goods: Pricing, profits and efficience. Management Science, Dec 1999.

[4] Erik Brynjolfsson and Michael Smith. Frictionless commerce? A comparison of Internet and conventional retailers. Management Science, 46 (4), April 1999.

[5] Paul Klemperer. Price wars caused by switching costs. Review of Economic Studies, 56 (3): 405-420, 1989.

[6] Nir Vulkan. The Economics of E-Commerce: A Strategic Guide to Understanding and Designing the Online Marketplace. Princeton University Press, Princeton, NJ, 2003.