

Commentary: High-Technology Industries and Market Structure

Erik Brynjolfsson

Let me pick up on what Alan Greenspan said last night and Larry picked up again about how the economy is constantly changing and we need to be updating our roadmap to keep it consistent with the changes in that economy. Of course, today the part of the economy that requires the most fleshing out is the information economy. We are very fortunate to have Hal's excellent roadmap provided in his paper to provide a very detailed guide to what is going on in the economy. Like thousands of other economists, I learned about traditional micro-economics from his textbook. For the past several years, I have been privileged to be learning about the information economy from him. He actually has been a real pioneer in this territory. It was back in the Jurassic era of the Internet—1993, 1994—when he created the first Web site on the information economy, which I remember visiting back then. It remains today one of the best sources for information about the information economy. It obviously has links to hundreds—or probably thousands—of other sources of information about many topics that he touches on in his paper today. Of course, it is all still free, which is also kind of nice.

Hal's survey that he presented today is, of necessity, incomplete, only thirty-two pages or so, but it has supplanted much of the other earlier surveys I've relied on. I have already taken the liberty, Hal, of assigning it to my MBA class for next week, who are studying these

issues and my Ph.D. students will also be looking at it. I think there are five or six dissertation topics buried in there.

There are two reasons why we need such a roadmap. One of them was nicely touched on this morning by Brad and Larry's paper. The rate of technological change has really been quite breathtaking. It is not just Moore's law, but if you look at the different components of modern information systems—the disk drives, the memory, the communication links—many of them are actually declining in quality-adjusted price even faster than the microprocessors. Others, like software, are declining at what rates that would be considered very high for most other goods, although they don't look so high in comparison with the breathtaking pace of much of the hardware. As that technology changes, it puts us into new territory. It may not be new rules of economics, but it is part of the rulebook that we haven't usually paid that much attention to.

The second thing is that sometimes the changes in business models and changes in the economy can be quite discontinuous and can be orders of magnitude greater than the changes in the cost and the changes you might imagine due to the new technologies.

Bundling was discussed a little bit this morning. That is a good example. I've looked at bundling somewhat. It is interesting to see how behavior providers of information goods are very different than providers of the same types of goods in physical environments. America Online bundles together thousands of different information goods and services—news, chat, commentary, horoscopes, sports, stock quotes—equivalent to thousands of magazines or newspapers. If you go to a physical newsstand, like Out of Town News in Harvard Square, they also have thousands of magazines there, but you can't walk in and say, "Okay, I'll take the bundle." They charge you independently, separately for each one of them. That, of course, is the way it is for most physical goods. A Toyota or Lexus dealer will only let you price the goods one at a time. You just buy one specific car; you don't buy the whole set of them, whereas Lexus Nexus gives you a subscription to the entire set of goods there.

As the marginal cost of goods relative to the value gets lower and lower, you might think that bundling becomes more and more attractive and the optional bundle size grows as the cost gets lower for these digital goods. Indeed, it is true at the two extremes that the optimal bundle size for physical goods tends to be around one and the optimal bundle size for information goods is very, very large. But, the analytics, as well as in the empirical evidence, indicate there is a very sharp discontinuity. As the marginal cost becomes lower and lower, the optimal bundle size stays at one until it reaches a certain critical threshold. At that point, it suddenly becomes unbounded. Indeed, America Online continues to acquire and develop new information goods. It is fairly difficult to construct a model with the optimal bundle size; it is an intermediate value between those two levels. So, you can have an arbitrarily small change in some of the underlying cost structure lead to a very dramatic change in the business model. For both of those reasons—the fact that the costs are falling rapidly and, secondly, the fact that not just with bundling but with many of these business models that Hal introduced—the changes in your business strategy in the economy can be very disproportionate. We need a more explicit detailed roadmap to these areas.

Hal's paper focused a lot on the issues of how these different business models affected industry concentration, not just bundling but switching costs, price discrimination and personalization, standards and systems' effects. As he points out, many of those tend to point in the direction of greater concentration and, indeed, that is what you see in many parts industries. He also spends one page on search and how lower search costs can also affect the optimal economic models. Other people have tended to pick up much more and stress the role of much lower search costs, the ability of consumers, and industrial buyers for that matter, to quickly search out and identify alternative sources for their goods. Michael Porter recently wrote an article in *Harvard Business Review* that was fairly influential, stressing that the lower search costs and lower barriers to entry are going to lead to much greater competition and falling profits and greater difficulties sustaining what he calls "competitive advantage." And he is, by no means, the first. It is a theme that has been in the literature for five or six

years, as people see the ease with which buyers can trade off sellers, one against the other.

I want to take a little bit of time just to flesh out that piece of the discussion and see how it balances against the greater concentration effects that are the other effects that Hal listed will tend you toward. In many ways, these concepts are actually not at odds with one another. It is quite possible that you can have both greater concentration and greater competition. For instance, look at the book retailing market where there are in excess of 30,000 physical bookstores that people could go to. On the Internet, there are far fewer. Nominally, there are a few thousand; but, in practice, three of them have over 85 percent market concentration. One might at first think that this greater market concentration is going to lead to higher prices. When you look at the actual prices through the two channels for identical goods, what you find is that, on average, the prices on the Internet are about 10 to 12 percent lower, despite the nominally greater concentration. Why is this? Obviously it is because it is so much easier to search and find competitors on the Internet. There may be tens of thousands of bookstores in the physical world, but the average person may only live next to one of them. That store, therefore, has a local monopoly. Geography and ignorance provide very powerful barriers and allow that bookstore to have higher prices. On the Internet, competition is only a mouse click away. As a consequence, that prevents even a relatively concentrated industry from raising prices nearly as much.

How big are these effects? We did some looking at what the size of the search cost was in differing channels. We had some students go out and try to buy things in different ways. They found that the Internet was at least 30 times cheaper than using the telephone and about 300 times cheaper than physically visiting stores in order to find the quality and price of various types of goods they were looking at. It is not just in consumer markets; you see it even more dramatically in business markets. This was alluded to by Alice Rivlin and others. General Motors is the sponsor of the Center for eBusiness@MIT, and they provided us with some data that a typical purchase order costs about \$118 for them to manage through conventional channels and about \$8 over

the Internet. Fleet Bank, another sponsor, when they do a business transaction inquiry over the telephone costs about \$1.25, while over the Internet about 2 to 3 cents. So, there is some really dramatic order of magnitude, several orders of magnitude, differences in the cost of search and transactions. We tried to see what the effect of this would be on competition. The nice thing is that, just as the costs are lower for the consumers, they are much lower for researchers like us and we are able to gather lots of data very quickly and very efficiently. We work with a “shopbot” called DealTime that routinely gathers data from thirty-three top book sellers and gives you the price, the delivery time, and a lot of other information about what each of these sellers are offering. So, if you want to buy a book, you can go there and it automatically ranks them by price. This is just one of many of these “shopbots” becoming increasingly popular.

How many people here have visited a “shopbot” like DealTime? This is a little troubling. When I asked this question of my MBA students, all the hands go up—100 percent. Even when I ask a business executive audience, I’d say that at least 50 to 75 percent of the hands go up. So, I think this audience needs to get out a little bit more. Try the Internet a few times to maybe get a feel for what you can do. A “shopbot” will allow you to say the product you are looking for, say, Hal Varian’s book, and it will report back in the blink of an eye the thirty-three top sellers of that ranked by price.

They provided us with the data. It wasn’t hard for us to get a million and a half transaction observations from this, so you can quickly retrieve a lot of data very cheaply this way. What we found was three main results. What we found was that when people saw the data laid out this way, the people who visited the “shopbot” interestingly less than half of them picked the low-price retailer. Most people would go down a few and pick a different retailer, even though we are talking about commodity items. In fact, they are defined as being identical because they have the same ISBN number, and once you have it in your hands you can’t tell the difference one from the other.

We also found that some of the more branded service-oriented

retailers had very significant, disproportionately large market shares. Amazon, for instance, had about eight times as large a market share, as one would predict, based totally on their position on price and delivery time in the tables. So, clearly, there is something else going on there.

And, finally, we found that loyalty was very important. We could track people through cookies, which you should also learn about if you want to be up on the Internet. What the cookies allow you to do is to track who has come back to the site repeatedly. We found that customers were remarkably loyal. They would go back to the same site over and over and over, even if there are other sites with faster delivery time or lower prices.

So, the implication was that differentiation and branding, and trust and loyalty were still quite important, even in this environment. It would be hard to construct an environment that was more hostile to those kinds of issues, with commodity goods where the prices are all laid up side by side. That leaves some room for some sorts of differentiation. The pessimistic forecast of the people who have been focusing on the very low search costs wiping out profitability and differentiation don't seem to be borne out even in this environment. Nonetheless, it is still difficult to raise prices too much. Amazon was able to have about a 10 to 12 percent price premium we saw on this and still get good sales, but couldn't go much beyond that. One executive said that it was the quick response of the competitors was accelerated Darwinism. It forced them to always be very much on their toes. Another lament at the end of what is called "the ignorance premium," that previously bookstores had been able to charge a little bit extra because their customers were ignorant of what the store across the street or across the country was charging.

Now, how should we think about these issues? Hal has pointed out that many of these tools, such as personalized pricing and bundling, allow sellers to capture a larger share of the area under the demand curve. But the greater competition changes the shape of that demand curve. I'm not supposed to bring any high-tech visuals here, so I'll just

use a low-tech analog. When I imagine a demand curve like this, the price discrimination of bundling allows the seller to capture much of the area under that. Instead of having a single price, they can perhaps capture much or all of the consumer surplus below that demand curve. At the same time, this greater arms race is going on is not just giving tools to the sellers, it is also giving tools to the buyers. So, the demand curve is getting flatter. Hal and I talked about this at a National Academy of Sciences conference a few years ago. As that curve gets flatter, then the ability of the sellers to extract as much of the consumer surplus is commensurately reduced. Then, of course, it is another phenomenon of potentially a better fit between the products that are being sold and that may just raise the whole curve altogether.

Let me conclude by saying that there is a tremendous amount of work still to be done in understanding the economics of information, especially in these market-sorts of transactions. Hal's paper is an ideal roadmap to that list of issues. Each of those points can be expanded and studied in great detail. I want to also stress that perhaps the most important information in the information economy is that which has difficulty in going across firm boundaries. A lot of the really important knowledge in the information economy stays behind firm boundaries for a variety of reasons that many economists could lay out. An example was given of the ERP system that, like SAP, where only one-tenth or so of the total cost is in hardware. The other nine-tenths or more are in knowledge. I think we are required to under what new business processes can leverage that technology. How can we better use the technology? So, when a company rolls out an SAP system, they will spend upward of \$20 million hiring consultants from Accenture and other companies to come in and help them redesign their business process and a lot of management time as well. All of that upfront cost creates a viable system that is meant to have faster customer response, lower inventories, and lower costs. Only the hardware and some of the software costs show up as a capital investment. The knowledge that goes into the rest of that is clearly very valuable. Managers are putting their money where their mouths are by spending millions of dollars to purchase that knowledge and put it in place in organizations and develop it internally. Some of the work we have done looking at the

stock market effects indicates that investors also put a very high premium on that knowledge. There is at least a 10 to 1 ratio in the firm's total market value relative to its information technology hardware investments. There seems to be another nine-tenths that aren't accounted for on the balance sheets anywhere but can be well explained as this kind of tacit knowledge.

So, I would close by saying that information assets are probably the most important type of asset for us to understand in the information economy, but, ironically, they are also the least well-understood asset. As we try to chart and understand, recognize, measure, value, and ultimately manage this knowledge, that would be the real agenda for the next ten years or so.