General Discussion:
High-Technology Industries and Market Structure

Chair: Arminio Fraga

Mr. Fraga: Thank you, Kevin. A lot of interesting questions have been raised, both by Hal in his presentation and paper and by the discussants. Perhaps, Hal, if you have any comments on your discussants, maybe we will start that way, and then we will pass on to the audience.

Mr. Varian: Let me just spend a couple minutes responding to some of the remarks. I think we are really too much in agreement at this table. Kevin is absolutely right that the dynamic effects of competition are very important and not well understood.

If you look at competition in the high-tech industry, there are several different dimensions. There is the competition to acquire the monopoly or the locked-in customers. Sometimes this competition is futile, because there will be a new round of innovation and then the dimensions of competition move to that playing field.

There is competition with yourself, either with your own product line that I alluded to or sometimes with your own installed base. The biggest competition that Intel sees is Intel. How do they convince people that they really need a two-gigahertz computer on their desk? And the same problem arises for Microsoft. So, even though they are in a dominant position, they still have to compete against their own installed base.

The third thing is—I don't know if this is a good word or not—but we could talk about "completition." This occurs when you are trying to get the complementary product to have a lower price.

And, finally, there is the competition to invent around the established incumbents or the intellectual property advantage or scale advantage that someone has.

The one point where I think I would disagree a little bit is about the network effects disappearing. I would say the network effects have triumphed in these examples because network effects and standardization are two sides of the same coin. Consumers see a lot of value in having a software product that has all the drivers to interconnect all these disparate pieces of equipment. So someone steps up and provides that product—Microsoft in this case—and, of course, that makes the value of the whole industry much, much greater. It goes back to the effect I mentioned earlier: Your share times the total industry value. If total industry value depends on size of industry, then there is going to be a lot of push toward standardization and interconnection, even if there is not so much action on the share side.

Finally, just one last point: Sometimes there are cases where technology reduces minimum efficient scale. One example we are all familiar with is desktop publishing. While it used to be a very scale-intensive industry—you had to hire typographers and designers and so on—now anybody can produce a lot of these effects on their PC. The next case where this will happen is desktop video, digital video. While we had to learn arcane distinctions like Helvetica and Times Roman fonts, our kids are learning arcane distinctions like the difference between a dissolve and a fade. So, the economics of video entertainment will change because the minimum efficient scale changes.

There are even very interesting examples at MIT and at Berkeley where the computer sciences are experimenting with using inkjet printers to print integrated circuits on potato chip bags. Right now, it is a $1 to $2 billion fixed cost to set up a fab plant. But in a few years, we will be able to produce at least some kinds of integrated circuits

this way and for those ICs, the fixed cost is going to fall to essentially zero. It wasn't too long ago that a chairman of the Council of Economic Advisers got in trouble for saying, "Computer chips, potato chips—What's the difference?" He was really just ahead of his time!

Mr. Fraga: Thank you, Hal. I may be missing a few hands here and there, but somehow I get the feeling we are a group of macroeconomists listening to all of this and really feeling that we have to go home and brush up on our micro, but here is someone I guess swings from both ends.

Mr. Hall: Hal, you kept yourself out of trouble nicely and wrote an uncontroversial paper by not dipping into the topic of government intervention, in spite of the fact that the situations you describe might seem by some to call for intervention. One inevitable intervention we have already talked about is intellectual property law. Antitrust is probably where we are most involved and also the topic that the previous paper didn't shy from, which is government investment. To make this specific, let me ask you the following question. There is a Supreme Court case called "the Image Technology" that Berkeley economists are quite familiar with, which seems to stand for the proposition that it is illegitimate for a company to artificially create lock-in to an aftermarket. You mentioned what is probably quantitatively the most important aftermarket in the whole economy, which are inkjet printers. The inkjet printer makers create the situation you describe by locking out competitors to the market for replacement ink. Do you think it is appropriate to have an antitrust regime in which Hewlett Packard is basically required to admit rivals into its aftermarket? That is an issue that is being litigated right now. I just wondered what your view was—assuming you are not an expert in any of these cases.

Mr. Varian: No, I'm not an expert on any of those cases. I think it really depends a lot on the nature of the facts. I think I alluded in this paper that, when you look at the inkjet printer case, which is the nice example that everybody's familiar with, the fact that you have this

increased competition for the printers is going to be beneficial to people who print a little bit. And it is going to be, in fact, an ex post monopoly in the cartridges, and it is going to be costly to people who print a lot. So, there is a price-discrimination dimension here as well. You are charging a higher price to people who intensively use the product and a lower price to the people who casually use the product. Normally, I think that is a good thing. But, it isn't to say that in each and every case that is going to be a good thing. You would really have to do a market analysis to try to understand this. When we refer to the antitrust issues, in general, the drift of the antitrust law is much more toward, "let's look at the facts of the case." We are getting away from per se infringement and we want to ask what kinds of tactics are being used to create or defend a monopoly. Is there exclusive dealing? Is there illegal tying? Are there these other tactics that really prevent the competition from getting a foothold? We should focus our antitrust considerations much more on those kinds of dynamic issues than just whether somebody has a monopoly at this point in time.

Mr. Fraga: Comments from Kevin.

Mr. Murphy: I guess I would be much less inclined to intervene in such an example, particularly given that there could be competition among different printers offering different combinations of those two things. If consumers really wanted to have cheap cartridges in more expensive printers, then somebody could certainly offer that kind of deal—either by guaranteeing the availability of aftermarket suppliers, or reputation, or other things. Why we would want to get in there and say, "Well, Hewlett Packard can't do that, what about Apollo or somebody who has a small share of that market who may have the same pricing behavior?" It is hard to explain that. If not Apollo, there are some small ones out there. I don't see why we would intervene in that case.

Mr. Fraga: A question here.

Mr. Eisenbeis: I want to push on the antitrust issue a little bit further because the typical concern that we have with high fixed-cost, zero

marginal-cost situations, is monopoly, and that provides a rationale for government regulation. Yet, I am hard pressed to identify industries where we've had a lasting monopoly over a long period of time. Contestability does seem to be a very powerful force, whether you are talking about electrical utilities or whatever. The question is: Is the pace of development such that contestability will take care of all the antitrust issues and is, therefore, not really something we need to worry about at all? This is really the crux of the public policy concern from a regulatory perspective.

Mr. Varian: I think it is very important when you look at a monopoly to make sure you include the phase of competing for monopoly, because competing to acquire the monopoly passes some of the benefits back to consumers. That has to be counted in the welfare calculations. I also think it is very important to think about price discrimination. Remember, to a perfectly discriminating monopolist there is no dead-weight loss. If you have people competing to be perfectly discriminating monopolists, then the perfect discrimination gets rid of the dead-weight loss and the perfect competition gets rid of the monopoly rents. It's great for consumers. That's obviously a very extreme and simple story, but I think it's one that we should keep in mind.

One aspect of antitrust law that is very important is to lay out the rules of competition. Because when the prizes are really big, people are going to compete very, very fiercely to try to obtain those prices. You want to make sure that that competition is a fair and reasonable competition. Some tactics should be illegal because they give unfair advantage to firms who are not necessarily the highest quality or most cost-effective producer. I'd like to see the focus much more on trying to establish the appropriate rules of the game.

Mr. Fraga: Thank you. We have two more questions here in the middle.

Mr. Stern: I wanted to respond in relation to this discussion to the request by Arminio and Larry to not only talk about what goes on in the U.S. economy, but also what goes on elsewhere. If you look at the

two, in my view, driving forces for growth and productivity increase in developing countries, the way in which markets function—the liberalization and functioning of those markets and the functioning of governance—I think we can see already the possibility of very big effects of these new technologies on those rather backward economies.

To give you one example on the market functioning side, the Indian government recently liberalized the mobile phone market. Now, you are seeing very poor fishermen in Karwar off the southwest coast of India calling in on mobile phones after they have their catch to find out where and which ports are the markets better and which people are buying better. They go back to those ports and they're seeing the real price of their fish to them go up quite strongly.

If you look at the way it affects governance, you're seeing in Ambarnath, a state of 80 million people, an attempt by the chief minister to get an Internet connection into every village. Now, if you try to get a form in India, you cycle to the nearby town, you pay 1 rupee to get your bike looked after because it will be stolen while you are inside, you pay 2 to 3 rupees to get by the guy at the door, you find the right office, it's another 4 or 5 rupees to bribe the secretary, and you find they ran out of forms. Now, if you have the Internet connection in the village, you don't have to know how to use it yourself. There will be a guy or woman in the village who knows how to use it and they will print you out a form. These kinds of things can have a really big effect over time—it won't happen fast but over time—on both the functioning of the markets and the governance, the two key drivers of productivity and growth in developing countries.

Now, none of this will work unless the old economy works. The biggest explanatory variable for Internet connections in developing countries is telephone connections. You can't do a lot of these things without electricity. There is a profound dependence of the new economy in developing countries on the old economy. You have to do advancing on the infrastructure side at the same time if any of this thing is going to work. This explains some of the enthusiasm at the

World Bank—and I think Larry said "euphoria" as a rare slip of the tongue when he meant "enthusiasm" from the World Bank for these kinds of things. There is a profound dependence on the functioning of the old economy, the infrastructure, if these things are going to get anywhere.

Mr. Fraga: Thank you, Nick. Okay, so I'd like to offer a chance to our speaker and discussants to have a final word and, if not, we'll move on.

Mr. Varian: One last word about this globalization development issue, since I didn't really touch on that in the paper. One of my faculty members at Berkeley, AnnaLee Saxenian, is writing a very interesting book on the role of immigration in Silicon Valley. One of the topics that come up in this book is the old idea of the "brain drain." Remember the "brain drain?" That was a 1960s economic concept. It is very difficult for Taiwan to educate its electrical engineers because they all go off to the United States and get high-paying jobs and Taiwan doesn't get any value from it. What she found is that when you really look at these stories, Taiwan—as we all know—has gotten huge value from higher education. Immigration is a very, very different thing these days than it used to be. Now, we have cell phones and e-mail and 747s. The correct model is not "brain drain" but "brain circulation." When you bring those Taiwanese engineers over or the Indian software programmers or Israeli programmers, they are going back periodically, they are making connections, they are making deals, they are outsourcing, and they are making contracts. What you are doing is you are pulling economies closer together because the brain circulates from one to another. You are not taking something from one country and giving it to the other, making it a zero-sum transaction, but making it a positive-sum transaction by increasing the communication flows among these different countries.

Mr. Fraga: Erik?

Mr. Brynjolfsson: Yes, briefly. I think a lot of the stress in this session has been on the information technology industries and how they are being affected. We should also bear in mind the broader effects on the

rest of the economy that, as the cost of information processing dropped dramatically, we are going to see big changes in the rest of the economy—not just in the production side, where you have the Fortune 500 companies really being affected in a far larger way than the dot.coms were in terms of the effect of the Internet on the economy. Also, a lot of innovation comes from the juxtaposition of different ideas and the complementary explosion of the way different innovations can feed off each other. The more efficient we all get at communicating those innovations, and that information, and those ideas within the country and across with other countries, the likelihood is that we have a lot more opportunities for advances in other industries, not just the information technology industry.

Mr. Fraga: Thank you, Erik. Kevin?

Mr. Murphy: I would just stress one last point, which came up in this printer example—which is, again, the idea that there are a lot of avenues through which competition can find its way through. We have to keep that in mind and, when we look at a market, not be fooled into saying, "Well, there is no competition here," just because of one aspect of the market that we see. Oftentimes, competition on one dimension is a good substitute for competition on others—not always, but in many cases.

Mr. Fraga: Thank you all for a very interesting session.