



Diamonds are forever; computers are not

Diamonds and computers have much in common. They are very expensive. They come in many shapes and sizes. Before any purchase, it is important to carefully research the market. They also have in common Lenis's law, which is: "A good diamond ring costs about as much as a Toshiba laptop."

In the interest of full disclosure, Lenis's full name is Lenis Hazlett. She is a Silicon Valley computer industry consultant, Stanford MBA, mother of two, and wife of Stanford professor and computer industry economist, Tim Bresnahan (with whom I often collaborate). Lenis illustrated this law with a particular brand, Toshiba, for dramatic effect. This should not be construed as a product endorsement. She informed me of the law when I recently entered the market for an engagement ring.

While I did not do a scientific survey, nearly all my married friends have heard Lenis's law or some variation on it. Everyone understands that Lenis's law precludes cubic zirconium. If the budget is tight, then it is a choice between marital bliss and a new computer.

Lenis's law provides an indirect entry to the main point of this column. Except for the reference to the laptop, this story seems not to have changed in a dozen years or more. Then, the typical basic PC cost about as much as a decent diamond ring. Today it still does.

So here is the interesting economics: The better and fancier products of today dominate the leading technology from the mid-1980s at any price. Diamonds have stayed more or less the same, but as everyone in this industry knows, today's typical PC hardly resembles the typical PC of a dozen years ago. Put in a different way, the market for old diamonds is still alive, but virtually no one buys old computers. The addition of new diamond designs to the market does not

drastically alter the value of old diamonds. In the computer industry, the addition of new designs does drastically alter the value of old designs.

In fact, it almost completely devalues old designs. Has anyone seen a new 286-based CPU for sale recently? What about a new 1,200-baud modem? Today's systems have faster modems, better printers, brighter and wider screens, nicer keyboards, better sound, more backup technology, and everywhere you look, software with more features and better performance.

This is not just an observation about better engineering; it is also a statement about market value. Prices for old designs are so low because no one desires an old design at any price.

This pattern has prevailed for so many years that it no longer seems odd to most computer industry participants. Well, it is odd to anyone with a sense of the economics of technology. The common calculator illustrates the more typical pattern. When first invented, the calculator was expensive. Today it is so cheap that even most college students can afford several different models. To be sure, fancy calculators with lots of neat features are available. But stores mostly sell a simple product, the Chevy equivalent of calculators. Though it took a few years to reach this era, we have been here for some time now. Technical change resulted in moderate improvements in quality over the basic invention, but also in a comparatively large decline in price.

Most examples of technical change to consumer-oriented products involve a period of improvement in features followed by a comparatively brief era of sharp declines in price. Solid-state stereos, photography equipment, televisions, VCRs, refrigerators, freezers, washing machines, dryers, copiers, electric typewriters, cash registers, and fax machines all fit this pattern.

Here is the general pattern. The first phase

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involves the introduction of an invention and its adoption by a small set of users. These users are fanatical. They experiment. They will pay almost any price. This phase potentially involves lots of product improvement. Price may be quite high. Phase one can last a long time.

Phase two is associated with the diffusion of a refined version of the product to most consumers. Prices decline rapidly, and, compared with the first phase, sales are massive. The second phase usually does not last very long.

Then there is the third phase. It never ends, but it is quite boring as an economic phenomenon. Now most buyers find that they have what they want. New features of new products no longer thrill them. These markets are calm, predictable, and not so turbulent. They're not dead, just not turbulent. The main firms stay the same. A large used market thrives because the old models still provide satisfying service for many people. The used products are a bit cheaper than the new ones and not much worse. In other words, third-phase markets look a lot like today's markets for automobiles, tractors, boats, construction equipment, VCRs, TVs, refrigerators, washing machines, and so on.

The microcomputer industry is past the first phase, and it is not yet in the third phase. It has been in the second phase for a long time, and therein lies the puzzle. Most inexpensive business and consumer-oriented products do not stay in the second phase for long. Consumers buy the new product and then shift their limited disposable income to other discretionary purchases. Discretionary purchases are what people buy after taking care of food, clothing, and shelter, that is, things such as automobiles, vacations, jewelry, and an occasional diamond ring. Similarly, most businesses operate on a budget and a tight profit margin. The budget pays salaries, benefits, materials, rent, dividends, and usually interest on a loan. What is left does not

go back into computer equipment unless the firm needs it to match the competition or to offer a new lucrative service to their loyal customers. Once that is done, the money gets shifted to something else.

The economic factors at work in the computer industry are the same factors at work everywhere. These factors should slow the purchase of new systems. But they do not seem to do so very much—at least, not as much as one would predict from a sensible reading of the history of other major innovations. Put another way, product improvement in the PC industry keeps inducing more new purchases, and that defies every sensible reading of history.

More than a dozen years ago, very few observers could see where PC improvements were leading. The mainstream press dismissed most of the visionaries as dreamers or technofreaks who were overly obsessed with their electrical toys. The press had a good case to make then, and they still do now. This is not to say that the mainstream business press lacks imagination. (After all, lack of imagination is no sin in this industry. Thomas Watson, Sr., is famous for predicting in 1955 that there was room for only 50 computers in the world.) Instead, this is a comment about how historically unusual is the pattern of change in PCs. The press is right to note that there are limits to the valuable improvements possible on any technological platform.

Although phase two is fun to watch, and I hope it lasts a long time, the sensible reading of history has to be right eventually. The PC joyride will be over when new applications no longer offer big changes in features that users value; when every vendor complains of being unable to find "killer apps"; when a vibrant used-computer trade dominates the new market; when surveys indicate a shift in consumer and business spending priorities; when incumbent firms desperately discount prices, observers talk about a massive

"shake-out," and then, quite suddenly, many firms exit and only a few persist. Growth will slow, and minor innovations will demarcate differences between technical vintages.

Despite the forces pushing toward the end of the second phase, I predict that its end is not near. Several years ago, product improvement was associated with the introduction of laptops, and last year it was CD-ROMs. For the next few years it may be client/server applications. After that, I do not really care to speculate. Some new component or software program will hit the market, and I will be as amazed as the next person at its functionality and low price.

It is best to put this prediction in terms of diamonds. On a clear, sunny, warm winter day, my girlfriend and I went for a walk along the shores of Lake Michigan north of downtown Chicago. At the appointed spot, I knelt before her, pledged my everlasting commitment, and presented her with a diamond ring. For my purposes, a ring was much better than a laptop. While diamonds are forever, new computers are almost immediately devalued. Manuel Trajtenberg, an economist and friend opined wistfully, "Do not tell your kids the story about the Toshiba laptop. In a few years, you will look really cheap." More to the point, I might look really obsolete.

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Correction

April's issue contained an incorrect World Wide Web address for IEEE standards information. The correct address is <http://stdsbbs.ieee.org:70/0/pub/ieeestds.htm>.