



# Dog days for broadband

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..... Every school kid learns how to calculate dog years from human years—multiply by seven. The principle appears in many guises, even if the proportions for the units are not integers: 2.2 pounds per kilogram, 2.54 centimeters to an inch, and so on.

It is also essential to get the proportionate units right in economic measurement, but there are many challenges to applying that principle in high-tech markets. For example, the present situation in dial-up and broadband markets contains a problem with its units.

In today's column, I want to show how big such a problem can be. If measured in the correct units, broadband revenue for the last seven years looks very different.

### Consumer price index

It is no secret that in the last decade the number of broadband lines has increased. The first three rows of Table 1 provide estimates of household Internet use, combining estimates from US government surveys (until 2003) and Pew surveys (after 2003) about the use of the Internet. Today, more households use broadband and fewer use dial-up, resulting in 47 million broadband households by 2006.

The engineering trends are seemingly straightforward to state, but they are hard to pin down. In the last decade, download bandwidths in residential lines increased. However, it is not clear how much typical use improved. Although many cable and telephone firms advertise bandwidths up to a maximum, that number may or may

not have any relation to what users get in a typical session.

It is also not obvious that the typical user understands the details, or even cares to know them. In the winter of 2006, the Pew Internet and American Life Project asked households about their broadband lines. As it turned out, most users knew whether they had dial-up or broadband, but the vast majority of the broadband users could *not* name their system's bandwidth, promised or actual. (Pew did not ask the household whether its VCR was blinking "12:00.")

The interesting economic question also is straightforward to state but hard to pin down: What price did the typical US household pay for Internet access, and did those prices decline? Without reliable data on the changing quality of Internet access, the estimates might be problematic to formulate.

However, a government statistician usually can do the next best thing: match prices to models and calculate the average changes in prices in what is known as a *match-model index*. This ought to work, because most households get their Internet access from the same firm year after year. It will miss qualitative change, but it should measure change in prices for existing goods.

Indeed, the actual US price index for Internet access is built around such methods. It combines data for dial-up, cable, DSL, and wireless. (The latter is too small to matter much yet, but it is there because government statisticians are foresighted enough to anticipate its growth.)

You might reasonably ask, "So what is the problem?" In a nutshell, the price index gets the units wrong when it adds these components together. Yes, it is as if a government statistician summed a number in centimeters to one in inches. It potentially does not make sense.

Let me put it concretely. The index is constructed so that a one-dollar decline from \$20 in dial-up prices is just like a two-dollar decline from \$40 in broadband prices. They are both treated as a five percent decline.

This has to be wrong. Most households' own actions say why. Millions of households have converted from dial-up to broadband and never switched back. In other words, the benefits per dollar from using broadband exceed that for dial-up (at existing prices). That means a one percent decline in the price of broadband generates more satisfaction to the household than a one percent decline in dial-up. If the units are the same over time over all the components, then the index should reflect that different satisfaction.

At its core, this is a problem with units. If the value of broadband were represented in the right units—in terms of the household's satisfaction with broadband over dial-up—then the consumer price index could get the result right. How much of a benefit? The right question to ask is this: "When a household converts from dial-up to broadband, what level of decline in the price of broadband would be equivalent to the satisfaction gained by converting from dial-up to broadband?" Let me show that

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**Table 1. Household Internet use and estimated revenues, 1999–2006.**

| Household use                          | Year   |        |        |        |        |        |        |        |
|--|--------|--------|--------|--------|--------|--------|--------|--------|
|  | 1999   | 2000   | 2001   | 2002   | 2003   | 2004   | 2005   | 2006   |
| Total Internet households (1,000s)     | 35,490 | 43,990 | 53,821 | 56,700 | 59,514 | 66,000 | 73,260 | 81,760 |
| Dial-up households (1,000s)            | 34,545 | 40,810 | 44,191 | 43,740 | 40,984 | 38,500 | 32,190 | 34,720 |
| Broadband households (1,000s)          | 945    | 3,180  | 9,630  | 12,960 | 18,530 | 27,500 | 41,070 | 47,040 |
| Broadband converts (1,000s)            | 945    | 3,180  | 9,630  | 12,330 | 16,846 | 24,119 | 35,121 | 39,962 |
| <b>Revenue estimates</b>               |        |        |        |        |        |        |        |        |
| Dial-up revenue (millions)             | 8,291  | 9,794  | 10,606 | 10,498 | 9,836  | 9,240  | 7,726  | 8,333  |
| Nominal broadband revenue (millions)   | 454    | 1,526  | 4,622  | 6,221  | 8,894  | 13,200 | 19,714 | 22,579 |
| Corrected broadband revenue (millions) | 660    | 2,220  | 6,724  | 8,853  | 12,424 | 18,184 | 26,903 | 30,740 |

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such an adjustment makes a big difference.

### Watching an index

The fourth row in Table 1 shows an estimate for conversions from dial-up to broadband. There are no precise estimates of the number of broadband users who converted from dial-up and the number who had no such dial-up experience (that is, households who were totally new to the Internet). Pew’s surveys indicate that new users are a small fraction of the 47 million broadband users. I will put “converts from dial-up” at just over 80 percent of the total broadband users after 2002.

The fifth and sixth rows of the table provide estimates of the total dial-up and broadband revenue among households. These estimates assume prices for dial-up remained at \$20 and prices for broadband remained at \$40, which is what most surveys showed. These are plausible assumptions about prices, because the official price index for Internet access did not change much over the last eight years—until last fall, when AOL dropped its policy of charging for subscription.

(Truth in advertising: These nominal revenue numbers are only estimates. Nobody is privy to the actual data except a few US government employees. Nonetheless, I have verified that these are in the right range; as they should be, these revenue estimates are a little less than the *actual* revenue generated by both households and business users, which are the only publicly available data.)

The basic pattern in the table should not surprise. Revenues for broadband have grown greatly in the last few years. Revenues have eventually gone down for dial-up.

My point is this: These revenue data cannot be right if expressed at their nominal levels. For proper economic measurement, they must be adjusted.

How much of an adjustment? In my last column, I reviewed estimates about the additional value a typical household places on converting from dial-up to broadband. They were done by Scott Savage and Don Waldman, two economists at the University of Colorado, Boulder (see “The Fifteen-Billion-Dollar Broadband Bonus,” *IEEE Micro*, vol. 27, no. 4, July/August 2007, pp. 5, 58). These are conservative estimates, but that is a good place to start. According to that survey, the average the benefit from converting to broadband is worth \$12.50 on a \$40 purchase (or more, if broadband costs less). In other words, it is similar to a 31 percent discount on a \$40 price on broadband, the year a household converts.

Does that make any difference to the measurement of the size of the broadband economy? It sure does, after households convert to broadband. As the table shows, this happens to be the era in which we live.

I calculated a proper price index, based on using the assumption that all adopters prior to 2001 had converted from dial-up and the seven million new users were evenly spread over 2002 through 2006, as shown in the fourth row. This conversion puts dial-up and broadband revenue in the same units.

To be clear, this adjusted estimate for revenue is a low number. Users of broadband with no prior experience get no

additional benefit. Converts from dial-up to broadband get a benefit equivalent to average estimates for that gain.

The last row shows what happens to estimates of annual broadband revenue once it is adjusted for the gain received as a result of conversion from dial-up. The price index is much lower and, consequently, revenues are much higher. In 2001, for example, this correction increases estimated broadband revenue by \$2 billion. It grows thereafter. In 2005, this correction leads to an additional \$7 billion of measured revenue, \$7.5 billion in 2006.

In other words, when the consumer price index for broadband is valued properly, users perceive much lower prices. Accordingly, the contribution of broadband is much higher than the recorded level of nominal revenue. And the importance of that correction grows as we reach the present, when many more households have converted to broadband.

### Does it matter?

I could have used different assumptions for the level of prices and conversion from dial-up to broadband. It might have led to slightly different levels of estimates, but I used conservative estimates, just to keep from exaggerating.

In any event, different assumptions lead to the same qualitative conclusion: The actual growth in broadband revenues is underestimated. That is a point worth knowing. Billions of dollars of consumer GDP annually gets unrecorded. Even using the most conservative estimates, the real gains from the conversion to broadband are understated.