TECHNOLOGY POLICY INSTITUTE

Studying the Global Information Economy

# Understanding International Broadband Comparisons

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# Executive Summary

Discussions about broadband policy in the United States today inevitably begin by citing OECD estimates. Many analysts interpret the low ranking of the U.S. in broadband penetration relative to other OECD countries as meaning that U.S. broadband policy has been a failure.

Whatever the relationship between rankings and policy, the OECD estimates are inaccurate and therefore misleading. In fact, broadband is nearly universally available in the U.S. and the U.S. compares favorably to other rich countries in terms of broadband penetration, speeds, and in broader measures of information and communications technology.

High levels of availability, rapidly increasing penetration, increasing available speeds, and ambiguous consumer demand for faster speeds suggest that the market is working reasonably well in the U.S. The apparent lack of a general market failure suggests that any policies intended to affect broadband should be targeted narrowly to avoid directing scarce resources to areas that would not yield net benefits.

This section highlights some of the conclusions in the paper.

**Broadband Penetration**

- OECD broadband counts do not separate business from residential connections and are therefore inaccurate and potentially misleading.
- Data from the U.S. Census and the Nielsen Company together suggest that OECD and Federal Communications Commission (FCC) counts miss about 70 million broadband connections in U.S. workplaces.
- The declining U.S. penetration rank in the OECD numbers is a statistical anomaly resulting from the relatively large U.S. household size and changes in the way OECD sources have counted broadband connections in different countries over time. Household size alone explains most of the change in rank since countries with larger households will have lower per capita residential connections if each household has a single connection.
- Household surveys suggest that the U.S. likely ranks about 9$^{th}$ among OECD countries in terms of household penetration.
- New data from the U.S. Census show that lower income people are less likely to subscribe to broadband than wealthier people. Households that earn $50,000 or more are about 2.5 times more likely to have broadband than households that earn $25,000 or less (about 30 percent versus about 80 percent).

**Broadband Speeds**

- Actual broadband speeds that consumers receive—as opposed to advertised speeds—are similar across many industrialized countries. Speedtest.net reports average speed test results of nearly 25 million unique IP addresses in OECD countries from 2007-2008.

Japan had the fastest speeds, with average tested download speeds of about 14 mbps. Sweden was second, with average speeds of almost 9 mbps. Germany and the Netherlands averaged about 6 mbps, while France, Norway, Denmark, and the U.S. averaged just over 5 mbps.

- Average actual broadband speed is increasing in the U.S., but consumer willingness to pay for higher speeds is questionable. Data suggest that consumers tend not to subscribe to the fastest speeds available in the U.S. or elsewhere, even when price differences between tiers are small.

**National Broadband Policy**

The U.S. ranks at or near the top of nearly every measure of information and communications technology (ICT), including investment as a share of fixed capital, and indices compiled by the Economist Intelligence Unit, the World Economic Forum, and by Waverman, et al (2008). The data suggest that no general market failure exists in the U.S. broadband market. Any policies must therefore be targeted narrowly and carefully to avoid using resources in unproductive ways. In particular, this analysis suggests that policy should focus on the following areas.

- Inventory and evaluate the myriad existing broadband policies whose effectiveness have not been studied rigorously and empirically.

- Improve data on residential broadband. The U.S. Census should include surveys of residential broadband regularly in its Current Population Survey. Firms that provide information to the FCC have legitimate concerns regarding the confidentiality of data they provide, but the FCC should reconsider whether data it currently keeps proprietary is, in fact, competitively sensitive. For example, perhaps the FCC could report the number of broadband subscribers served by different providers in each zip code rather than just the number of providers operating in each zip code.

- Improve data on business broadband. Little data exist on the state of business broadband beyond knowing that businesses nearly all have connections. More data on business broadband would be useful at least to complement data on ICT use that government agencies already collect.

- Make more spectrum available for high-value uses. The $19 billion spent in the auction for spectrum in the 700 MHz band demonstrates that spectrum remains a scarce and valuable commodity. Congress and the FCC should make more spectrum available for high value uses. One component of that approach is to make government agencies currently using spectrum already auctioned and paid for relocate off that spectrum as the law requires so that the license-holders can build new wireless broadband platforms.

- To the extent that policymakers want to encourage broadband adoption, focus on low-income people rather than on rural areas except under narrow conditions. While beneficiaries would be better off with cash transfers than with subsidized computers or Internet access, those goods would at least have some distributional benefits and increase household broadband penetration.

## Introduction

Discussions about broadband policy in the United States today inevitably begin by citing OECD estimates. Many analysts interpret the low ranking of the U.S. in broadband penetration relative to other OECD countries as meaning that U.S. broadband policy has been a failure.

Whatever the relationship between rankings and policy, the OECD estimates are inaccurate and therefore misleading. In fact, broadband is nearly universally available in the U.S. and the U.S. compares favorably to other rich countries in terms of broadband penetration, speeds, and in broader measures of information and communications technology.

High levels of availability, rapidly increasing penetration, increasing available speeds, and ambiguous consumer demand for faster speeds suggest that the market is working reasonably well in the U.S. The apparent lack of a general market failure suggests that any policies intended to affect broadband should be targeted narrowly to avoid directing scarce resources to areas that would not yield net benefits.

Most calls for intervention in the broadband market come from those concerned about the OECD broadband rankings. Unfortunately, the OECD numbers cannot be meaningfully compared across countries or, in some cases, even over time, and thus are a poor basis for policymaking. The main problems with the OECD estimates are that they do not separate business from residential connections and cannot accurately count business connections. Because business connections are counted differently in each country, simple comparisons of the OECD's "total" across countries are not meaningful. Rankings based on these numbers are thus also flawed. These problems are not the OECD's fault. The Federal Communications Commission (FCC) also suffers from the same general problem of the difficulty in counting business connections.

A more precise way to determine broadband penetration is through rigorous surveys, not through incomplete and inaccurate counts. Fortunately, several sources, including the U.S. Census and the European Commission, have done such surveys, which provide a different picture than do OECD and similar estimates.

An accurate understanding of the data is important for policymaking because any policy proposal that affects broadband deployment or adoption involves allocating scarce resources. Policymakers should be reasonably sure that policies direct resources in ways that will benefit society. If those decisions are based on flawed information or a poor understanding of that information, these policies will, at best, have little positive effect.

Cross-country comparisons can be useful, but must be done properly. Even with correct data, normalizing by population or the number of households is not sufficient. Instead, analyses must attempt to control for factors that affect broadband supply and demand that policy cannot affect—like population density and income—to test the effects of particular policies. That type of analysis can be an important tool for evaluating whether a policy proposal is likely to yield net benefits. Unfortunately, existing proposals for a national broadband policy have not included such analysis.

This paper examines problems with OECD estimates and others like them, reviews the results of household surveys, discusses the empirical research on broadband deployment and adoption, and evaluates potential policies in light of this evidence.

## Broadband Penetration

The OECD estimated about 66 million wireline broadband connections in the U.S. in June 2007.[1] The FCC (2008) also counted around 64 million wireline broadband connections in the U.S. for June 2007. When normalized by population, the U.S. ranks behind 14 other countries in penetration per capita by the OECD's count.

Broadband is available nearly everywhere in the U.S., but not everyone subscribes. According to the NTIA (2008, p.16), 92 percent of U.S. households could subscribe to cable broadband services by the end of 2007 and 79 percent of households that could receive telephone service could obtain DSL. Broadband satellite services are available across the country, though bandwidth and latency are inferior to wireline technologies.

Broadband penetration reflects the intersection of supply and demand, each of which is a function of the other. Supply is determined by costs of providing service, which include infrastructure, maintenance, customer service, and by demand. Demand is determined by consumers' willingness to pay (that is, how intensely they want broadband) and supply.[2]

This section explores how to separate business from residential connections and estimates the number of uncounted business connections in the U.S.

### Separating Business from Residential Connections

Both the OECD and the FCC collect data from broadband providers and combine business and residential connections, so it is not surprising that their counts are similar. Combining business and residential connections is a problem for two reasons. First, counting broadband in this way misses most business connections, meaning that these counts do not accurately represent the state of broadband in a country. Second, these counts capture different shares of business connections in each country due to differing ways firms tend to connect in different countries. As a result, the OECD's counts are not directly comparable across countries.

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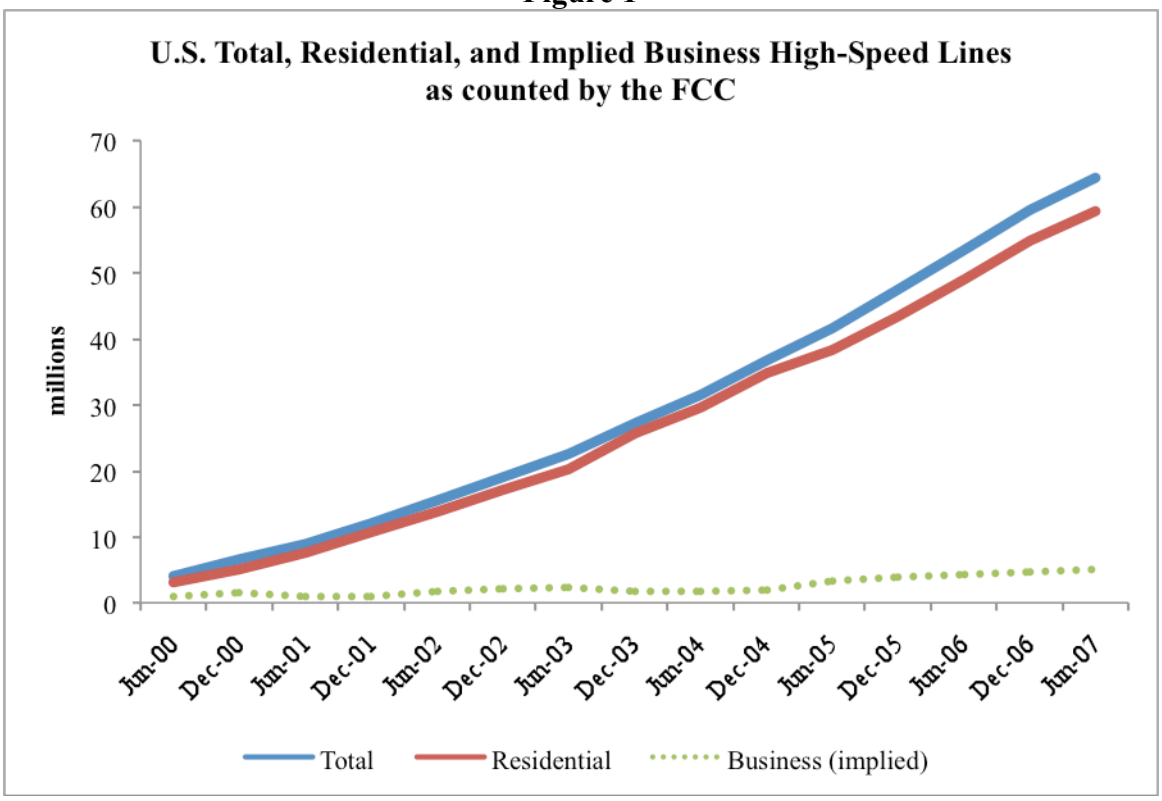
[1] The OECD defines broadband as a connection that supports at least 256 kbps in at least one direction.

2 Savage and Waldman (2005) shed some empirical light on the question of willingness to pay for broadband in a careful study using household data. They find that, on average, people are willing to pay more for faster speeds and better reliability. People differ in their tastes. They also find that willingness to pay "increases with education and income, and decreases with age." Their data, however, are from 2002, when both broadband and the Internet differed in many important respects from today.

An accurate picture of broadband penetration requires separating business from residential connections. This separation is crucial because of the different nature of business and residential demand. While the FCC cannot count the total number of business connections, it separates business from residential connections in its count.[3] Figure 1 shows the FCC's count of total and residential high-speed lines, along with the implied number of business lines derived by subtracting residential from the total.

**Figure 1**




Source: FCC (2008) Tables 1 and 3, excluding wireless.
Note: The FCC included small business lines in residential counts until December 2004. Business count is derived by subtracting residential lines from the total.

The figure shows that nearly all the connections the FCC counts are residential. In June 2007 the FCC was able to count only about 5 million business connections. As discussed below, this number is a small fraction of the actual total number of business broadband connections in the U.S. Since the OECD's U.S. total count is similar to the FCC's total count, it is apparent that the OECD, too, misses most business connections in the U.S.

[3] The FCC asks broadband providers to estimate the percentage of connections that are residential when they report connection data. See question I.B. on the FCC's form 477, available here: http://www.fcc.gov/Forms/Form477/477.xls.

## 70 Million Uncounted Connections in U.S. Workplaces

Business connections are an important component of the broadband landscape because connectivity is crucial for productivity and because some people report no interest in subscribing to broadband at home because they use it at work.[4]

An accurate count of business connections is difficult because of the way businesses—especially larger businesses—connect to the Internet. In particular, businesses often connect via "special access" lines, which they then use for voice and data needs. Because businesses can connect nearly any number of computers this way and because they do not need to report the number of connections, there is no easy way to count the number of broadband connections.

Other data, however, make it possible to estimate the number of business broadband connections in the U.S. and the number of business connections the OECD includes in its estimates for each country.

The U.S. Census reports that nearly 81 million people have Internet access at work (Figure 2). The Nielsen Company reports that 95 percent of workers with Internet access use a broadband connection,[5] implying that about 77 million people in the U.S. have broadband connections at work. That estimate may overstate the number of connections if people share computers. Nevertheless, it dwarfs the 5 million business connections the FCC was able to count. In other words, the FCC estimates appear to miss around 72 million work connections, which would bring the true total number of broadband connections in the U.S. to around 136 million.

**Figure 2**

Table 1127. **Internet Access and Usage and Online Service Usage: 2006**

[For persons 18 years old and over (218,289 represents 218,289,000). As of fall. Based on sample and subject to sampling error; see source for details]

| Item | Total adults | Have Internet access | | | Used the Internet in the last 30 days | | |
|---|---|---|---|---|---|---|---|
| | | Home or work or other | Home | Work | Home or work or other | Home | Work |
| Total adults [1] (1,000) . . . . . | 218,289 | 176,641 | 142,072 | 80,577 | 143,111 | 123,090 | 69,118 |

http://www.census.gov/prod/2007pubs/08statab/infocomm.pdf

While the FCC is frequently criticized for its broadband data collection, it collects and disseminates far more data than does almost any other comparable agency in other countries. The OECD gets its numbers from providers and regulators but, unlike the FCC, cannot estimate

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[4] Parks Associates (Parks Associates 2007) found in the first quarter of 2007 that 14 percent of people who reported no interest in subscribing to an Internet service held that opinion because they had sufficient broadband access at work. Similarly, in March 2006 the Pew survey found that 22 percent of dial-up users did subscribe to broadband because they had it at work.

[5] Nielsen estimates reported here: http://www.websiteoptimization.com/bw/0803/

how many of its "total" number of connections are residential, probably because its sources do not make that distinction. As a result, it is not possible to estimate the number of residential connections using only the OECD data.

Household surveys, however, can provide an accurate measure of residential broadband. These survey results can then be applied to the OECD numbers to estimate the number of business connections the OECD numbers are likely to include in each country. The following subsection reviews data from household surveys and uses that information to separate residential from business connections in the OECD data.

### Household Broadband Penetration: U.S. Probably Ranks About 9th

Because the OECD's numbers combine business and residential data, simply dividing connections by the number of households in each country, as some have done, is inappropriate and does not reveal household penetration.[6] Instead, household surveys designed to be representative and that include large enough sample sizes can provide an accurate picture of household broadband adoption. Several sources conduct such surveys, including the Pew Internet and American Life Project, the U.S. Census Current Population Survey, and the European Commission E-Communications Household Survey.

According to the U.S. Census, in October 2007, 51 percent of U.S. households had broadband connections (U.S. Census as reported in NTIA - National Telecommunications and Information Administration 2008). This estimate is broadly consistent with the FCC's June 2007 estimate of about 59 million residential wireline connections, which translates to approximately 52 percent of all households, assuming one connection per residence and 113 million households.[7]

The European Commission also conducts household surveys of broadband adoption, surveying approximately 26,000 households annually. According to this survey, in December 2006 (the most recent data available) 28 percent of EU households had broadband connections. While this average across EU countries is somewhat misleading in comparison with the U.S. since the EU includes a number of relatively poor countries, Figure 3 shows that U.S. household penetration (which, according to the Pew Foundation, was 47 percent in March 2007) compares favorably to the wealthier EU countries.

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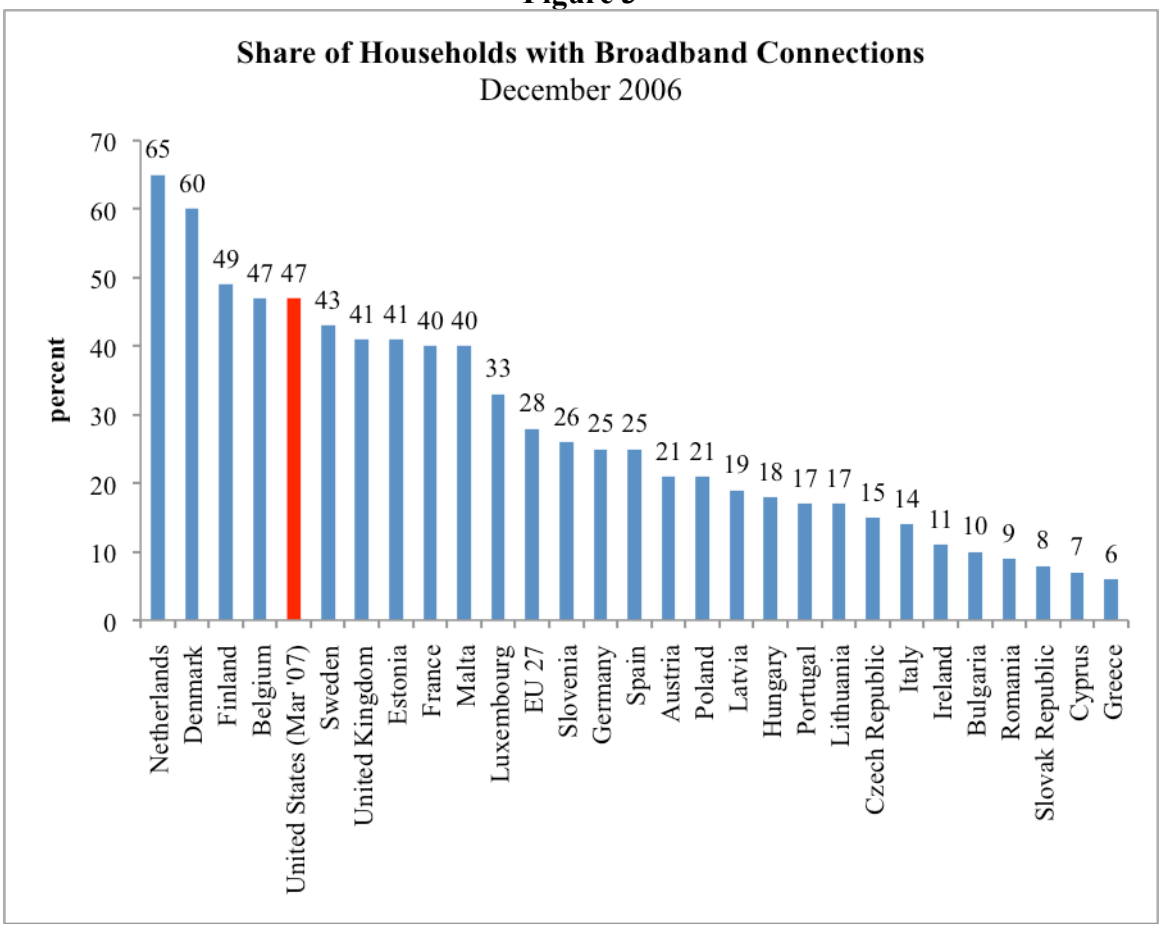
[6] See, for example, Correa (2007).
[7] Number of households in 2005 from http://www.censusbureau.biz/compendia/statab/files/house.html.

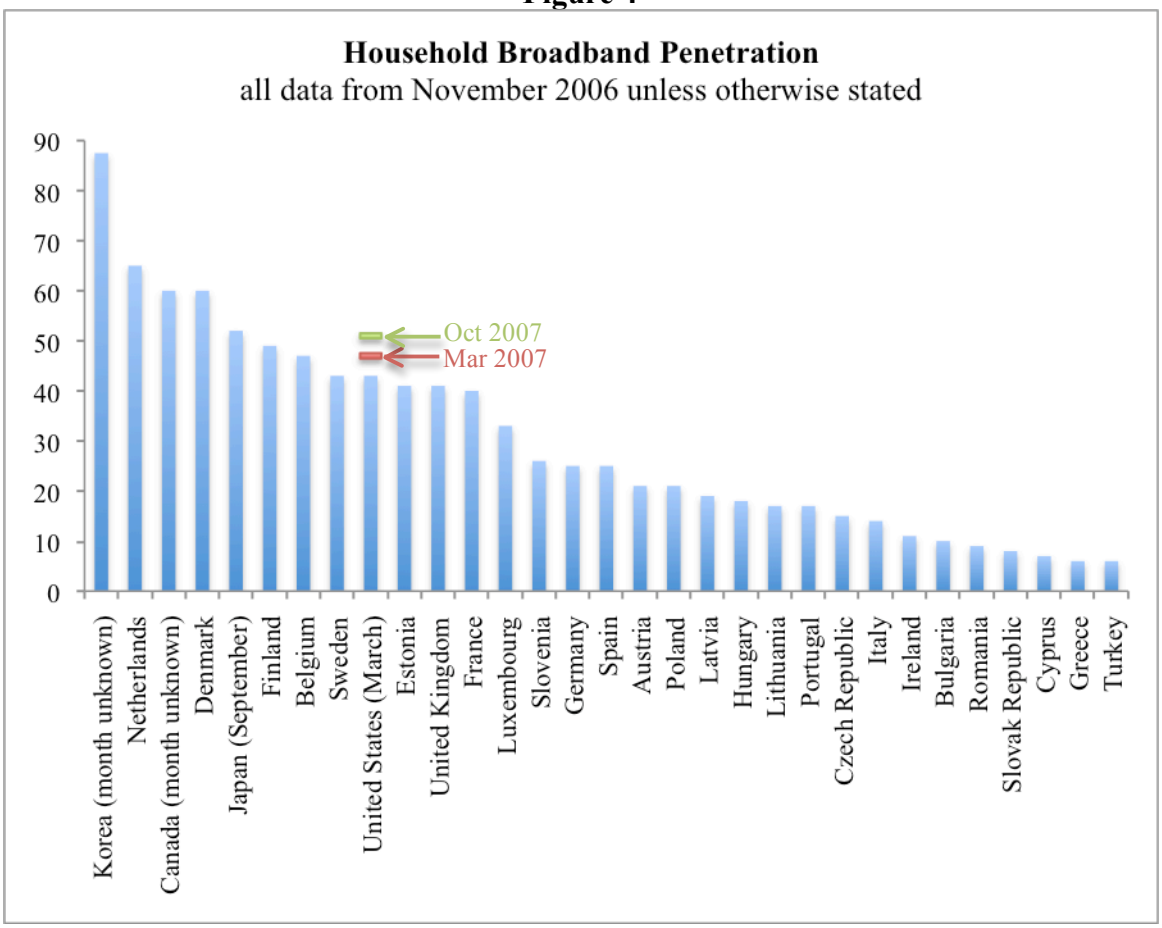
**Figure 3**




Sources: EU data from European Commission (2007b). U.S. data from Pew Internet and American Life Project (Horrigan 2007).

This figure omits other OECD countries, particularly Canada, Japan, and Korea. Finding comparable data on household penetration is difficult, especially due to the frequency with which many publications err by combining business and residential connections. Nevertheless, it is possible to aggregate several sources to fill in those missing countries. Figure 4 presents estimates of household penetration for most OECD countries.

**Figure 4**




Sources: See footnote 8.

Figure 4 must be considered with care. While the data in the figure are all from 2006, they are not all from the same month and survey methods likely differ across countries. U.S. data are from March 2006, Japan from September, and European countries from November. The sources for Korea and Canada do not provide the month the data were collected. The fast growth in household adoption around the world means that penetration can increase substantially in just a few months. Comparing different time periods can lead to incorrect conclusions. In this case, the European numbers are from November—eight months later than the U.S. data, and the Japanese numbers are from September—six months later than the U.S. data. The figure shows

[8] Data for European countries are from the E-Communications Survey (European Commission 2007b). Data for Korea are from the Korean National Information Society Agency (2007) and may overstate household penetration as I cannot verify that these are strictly residential connections. Data for Japan derived from estimates of the number of connections from Ministry of Internal Affairs and Communications, as reported in Harada and Okada (2007), and estimates of the number of households from the "Portal Site of the Official Statistics of Japan" (http://www.e-stat.go.jp/SG1/estat/GL36010101.do?_toGL36010101_). As with Korea, I cannot verify that these are all residential connections, so this estimate may overstate household penetration to the extent that it includes business connections. Data for Canada are from the Canadian Radio-television and Communications Commission (2007, p.60). Data for the U.S. for March 2006 and 2007 are from Horrigan (2006;2007) and for October 2007 are from the U.S. Census Current Population Survey as reported by the NTIA (2008).

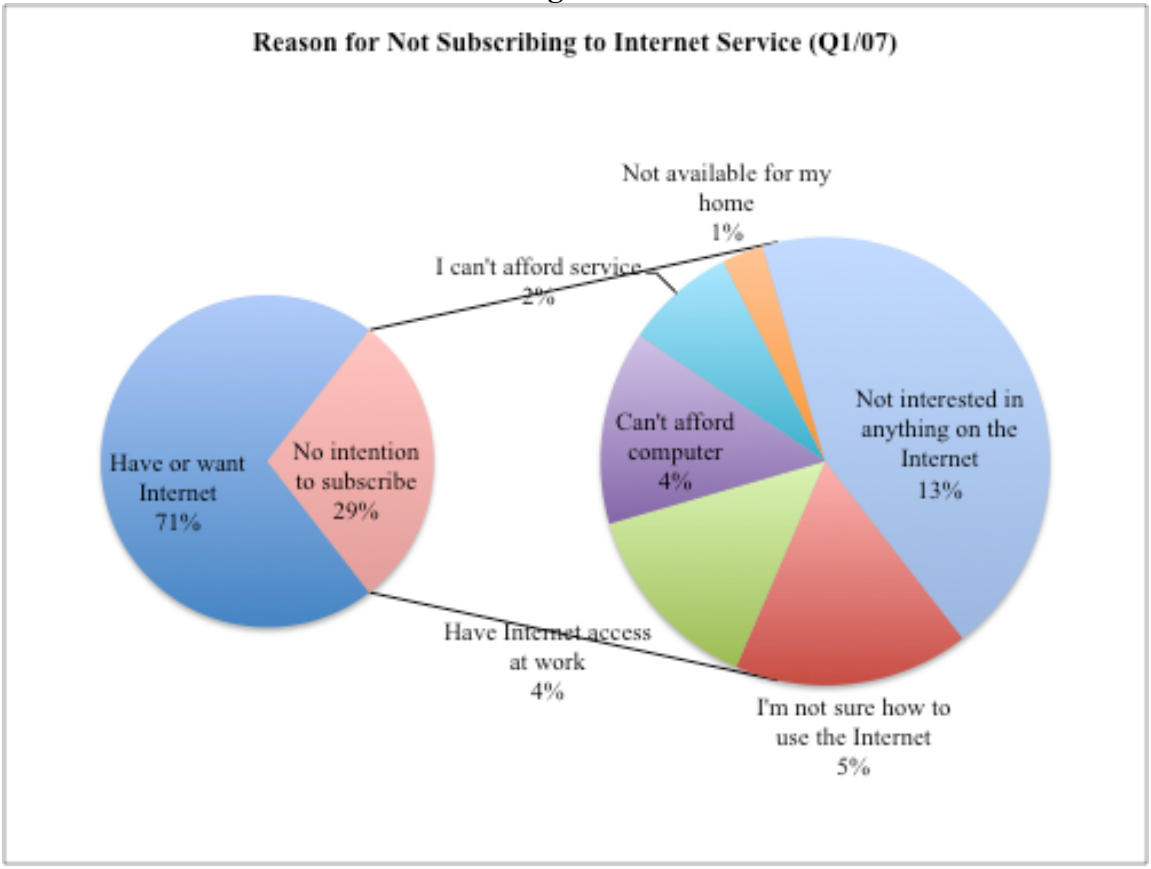
how growth is increasing quickly in the U.S. by also plotting household penetration for March and October of 2007.

Some have dismissed the E-Communications Survey by stating that the results do not agree with other sources (Atkinson 2008). That critique is misplaced. The sources that disagree with the E-Communications survey either suffer from the same residential-business problem the OECD faces or also include wireless connections in their surveys, while the E-Communications does not. See Appendix 2 for a detailed discussion of this critique.

## Consumers Have Different Tastes for Internet Access

If broadband is ubiquitously available, then why don't people subscribe to it? Consumer demand for broadband is more difficult to estimate than is availability. Some people exhibit no desire to subscribe to any Internet service. Parks Associates found in a household survey conducted in early 2007 that 29 percent of all U.S. households not planning to subscribe to a broadband service. Of those households not planning on subscribing, 44 percent said they were not interested in anything on the Internet and 14 percent said they had sufficient Internet at work. 14 percent of those who have no intention of subscribing reported being unable to afford a computer and 8 percent reported being unable to afford service. 17 percent reported not being sure how to use the Internet, and only 3 percent said that Internet service to their homes was not available.

**Figure 5**




Source: Parks Associates (2007).

For the 17 percent who report no interest in the Internet, it would be more accurate to say that they have no interest given current prices and available content. An important feature of the Internet is that it exhibits both direct and indirect externalities. The direct externalities result from the increased value to everyone on the entire network of each additional subscriber. The indirect externalities result from the increased incentives for content and infrastructure providers to invest with larger potential audiences online.[9]

The implications of these externalities are that because of higher-quality broadband and more available content, a given individual is probably willing to pay more now than he or she was in 2002. At the same time, competition among providers will affect price, and thus demand.

As a result, the number of people with no interest in the Internet will decrease as available content increases and prices decrease. Parks Associates (2007) reported that the percentage of people with no intention to subscribe for Internet service decreased to 29 percent in the first quarter of 2007 from 34 percent at the end of 2005. This trend is likely to continue, though we do not know at what rate.

If policymakers wish to increase adoption, this type of information suggests targeting subsidies towards the five percent of consumers who either cannot afford a computer or Internet access. The five percent who are "not sure how to use the Internet" may also have some underlying demand if they were taught. It is unlikely to be good policy to try to induce the remaining 17 percent who either are not interested or use the Internet at work instead of at home to subscribe, aside from encouraging competition.

## Estimating the Residential-Business Mix in the OECD Counts

While the total number of wired broadband connections in the U.S. is probably closer to 136 million than to the OECD's estimate of 66 million, it is not appropriate to replace the OECD estimate with separate business and residential numbers unless we can also do the same for every country. That is, the OECD count probably underreports the total number of connections for most countries, not just for the U.S.

The degree of underreporting is unlikely to be the same across countries. Because the problem stems from the difficulty in counting connections through special access lines, underreporting will be worse in countries where businesses rely relatively more on that method of connection compared to DSL or cable.

While it is not possible to more accurately count total connections in each country using the method used above for the U.S., it is possible to combine estimates of household penetration, the number of households in a country, and the OECD numbers to calculate the number of business connections the OECD counts in each country.

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[9] Note that these factors are external to an individual subscriber but not necessarily to the network. As a result, the policy implications of the externalities are ambiguous.

In particular, the estimated number of business connections the OECD counts (*business*) is simply the total (*OECD*) less household penetration (*pen*) times the number of households (*hhld*):
*business = OECD-(pen)*(hhld).* The share of the OECD's total probably comprised of business connections is, therefore, $\frac{\text{business}}{\text{OECD total}}$, and thus the share of the OECD total comprised of residential connections is $1 - \frac{\text{business}}{\text{OECD total}}$.

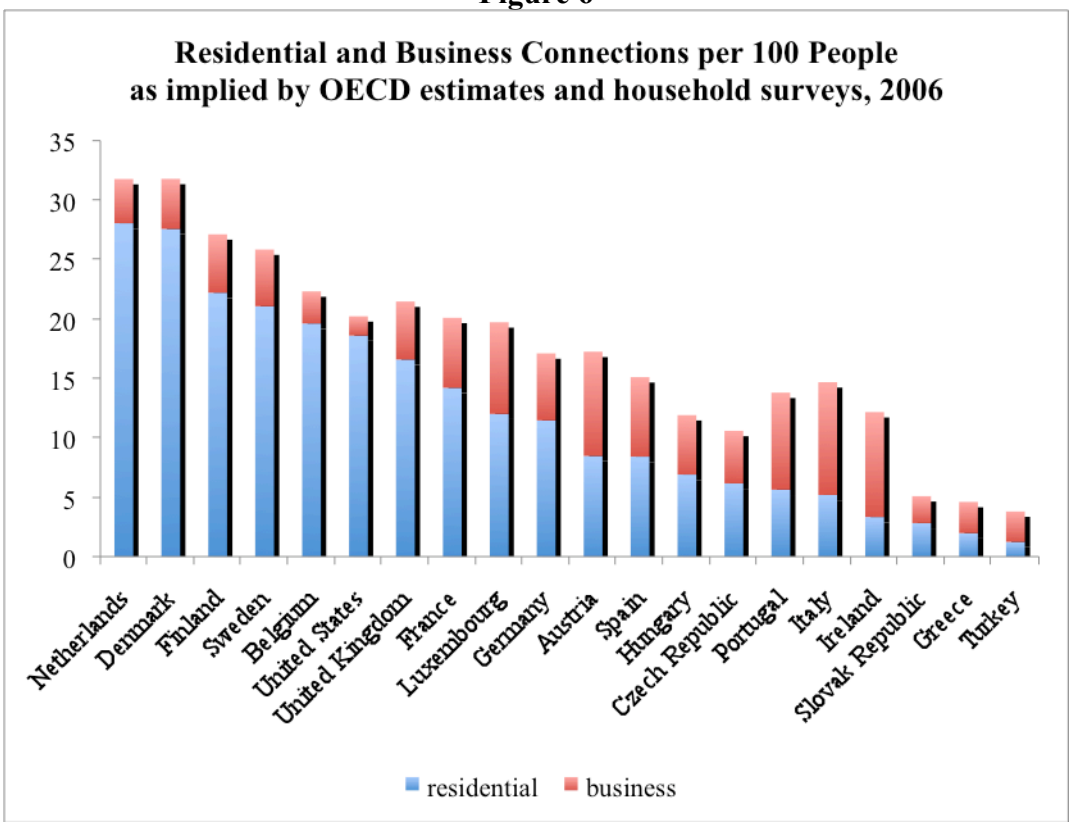
To put it more simply, estimates of household penetration and the total number of households in a country allow us to calculate the number of residential connections. Subtracting that number from the OECD's total leaves us with the number of business connections the OECD counts.

Consider the U.S. as an example of this calculation. The Pew Foundation estimated that 47 percent of households had a broadband connection in March 2007 (Horrigan 2007), while the U.S. Census reports about 113 million households in the U.S.,[10] implying about 53 million household connections that year (0.47*113.1 million). The OECD reported a total of about 60 million U.S. broadband connections in late 2006. If 53 million of those were household connections, then the OECD counted only 7 million business broadband connections.

Figure 6 shows the results of these calculations, normalized by population, for countries for which relevant data are available. The figure separates the OECD's numbers into residential and business broadband penetration as implied by household surveys and orders countries by residential penetration. The figure shows the small number of business connections the OECD is able to count in many countries and also shows that the number differs substantially across countries. For some countries these estimates may, in fact, be good approximations of the true state of residential and business broadband, but it seems unlikely that they accurately capture the actual extent of business broadband in most countries.

[10] Number of households in 2005 from http://www.censusbureau.biz/compendia/statab/files/house.html.

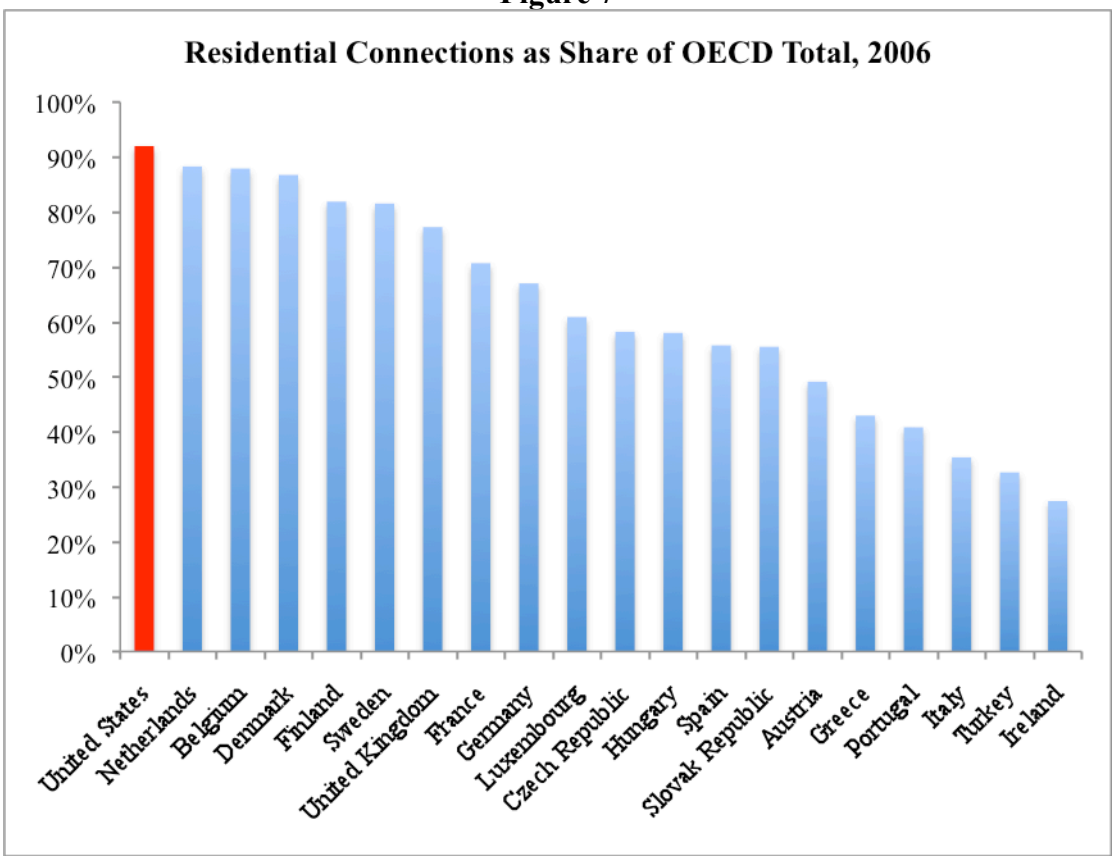
**Figure 6**




Source: Derivations from data provided by OECD, US Census, and EC.

Figure 7 presents this information differently, showing the share of the OECD's total comprised of residential connections for each country. The figure shows that for the U.S. the OECD, like the FCC, counts almost exclusively residential connections. By contrast, in France about 70 percent of the OECD's count is residential, and in Ireland only 30 percent of the count is residential. Unless business connections comprise only about 10 percent of the true U.S. total and 12 percent of the true Dutch total, while comprising 30 percent of the true French total and 70 percent of the true Irish total, the OECD is counting business connections differently in each country and generally missing most such connections.

**Figure 7**




Source: Derivations from data provided by OECD, US Census, and EC.

Because I derived these numbers by combining data from a number of sources it is worth checking to see whether they accurately separate residential from business. They appear to. First, consider the U.S. Using the method described in this section, I estimate that 59 million, or 89 percent, of the OECD's U.S. total is residential. The FCC estimated that 92 percent of its total was residential.

While these estimates are not identical, they are reasonably close, suggesting that this method can give us a rough estimate of the number of business connections the OECD counts for other countries.[11]

Next, consider Ireland. The OECD counted about 517,000 total broadband connections in Ireland in June 2006. Ireland's Central Statistics Office (2008) reported that 193,500 households had broadband connections in 2006. The Irish numbers include wireless connections. Subtracting wireless connections leaves something between 134,000 and 164,000 residential

[11] FCC (2008) Table 1 shows the total number of connections and Table 3 shows residential connections. Both tables also provide the number of wireless broadband connections, but I exclude those from this calculation.

wireline connections.[12] These calculations imply that residential connections account for between 26 and 32 percent of the OECD's total—similar to my estimate of about 27 percent.

It is important to note that because the broadband market is so dynamic some of these figures can change quickly, especially in small countries. Ireland's Central Statistics Office (2008) also reports that the number of households with broadband increased by nearly 274,000 from February 2006 to February 2007, though wireless accounted for nearly 100,000 of that increase.

In short, applying household survey data to the OECD numbers seems to be a valid method of separating residential from business counts.

The conclusion of this analysis is neither to blame the OECD nor to imply that the U.S. leads the world. Absent surveys the OECD is doing the best it can with the data it obtains, and many countries do indeed have higher residential broadband adoption than does the U.S. Instead, the conclusion is that rankings and analyses based solely on counts of observable connections are misleading because they cannot, in fact, observe all connections.

## The Declining U.S. Penetration Rank: A Statistical Anomaly

It is reasonable to ask why the U.S. rank in the OECD estimates has steadily trended down, from 6th place in 2002 to 15th place in 2007. Even with the flaws in the data, shouldn't the trend be meaningful?

Not necessarily. The declining rank of the U.S. is primarily a statistical anomaly having little to do with broadband investment or adoption. The change in rank is due to differences in household sizes across countries, changing methods of counting broadband connections across countries, and simple regression to the mean.

### Rankings of Countries with Larger Households Will Sink Over Time

Countries with larger average household sizes will see their per capita rankings steadily decrease since a single household connection will serve more people, on average, in those countries. For example, a country with four people per household would ultimately have half the residential connections than a country with two people per household, and thus half the per capita penetration. Households could subscribe to broadband services at the same rate in each country, but the per capita ranking of the country with larger households would steadily decrease.

A simulation based on the OECD data highlights this problem. In 2002 the U.S. ranked 6th of 24 OECD countries for which all the data necessary for the simulation were available. In the second quarter of that year the U.S. had about 5.5 connections per hundred people, according to the OECD. Korea was first, with 20.3 connections per hundred people. With estimates of the

[12] Ireland's Central Statistics Office (2008) counted 52,600 fixed wireless connections in 2006 and 102,500 fixed wireless connections and 45,000 mobile wireless connections in 2007. The number of residential wireline connections depends on how many of those wireless connections are for business and residential.

number of households in each country we can estimate the OECD household penetration rate.[13] This calculation gives the U.S. a 15 percent household penetration rate and Korea a 67 percent household penetration rate in 2002.[14]

The rankings for 2002 are based on actual data. Next, assume that all countries experience identical growth rates in household broadband penetration. We will assume that household broadband penetration grows by seven percentage points in each country.[15] So, for example, in 2003 the U.S. household penetration rate would increase from 15 to 22 percent and Korea's would increase from 67 to 74 percent.

Next, estimates of household size allow us to estimate the implied per capita number of connections.[16] So, for example, the 2003 per capita penetration rate for the U.S. is the new household penetration rate of 22 percent times the number of households divided by the total population. We continue this exercise for every country through 2007.

Figure 8 shows the results of this simulation. The figure shows that household size alone has a large effect on per capita rankings. Countries with larger household sizes, such as the U.S. (2.6 people per household) and Japan (2.7 people per household) saw their rank decrease, while the Netherlands (2.3 per household) and Sweden (2.1 per household) saw their rank increase. In particular, the U.S. rank out of 24 OECD countries fell from 6 to 11 from 2002 to 2007 even though household penetration grew at precisely the same rate in all countries.

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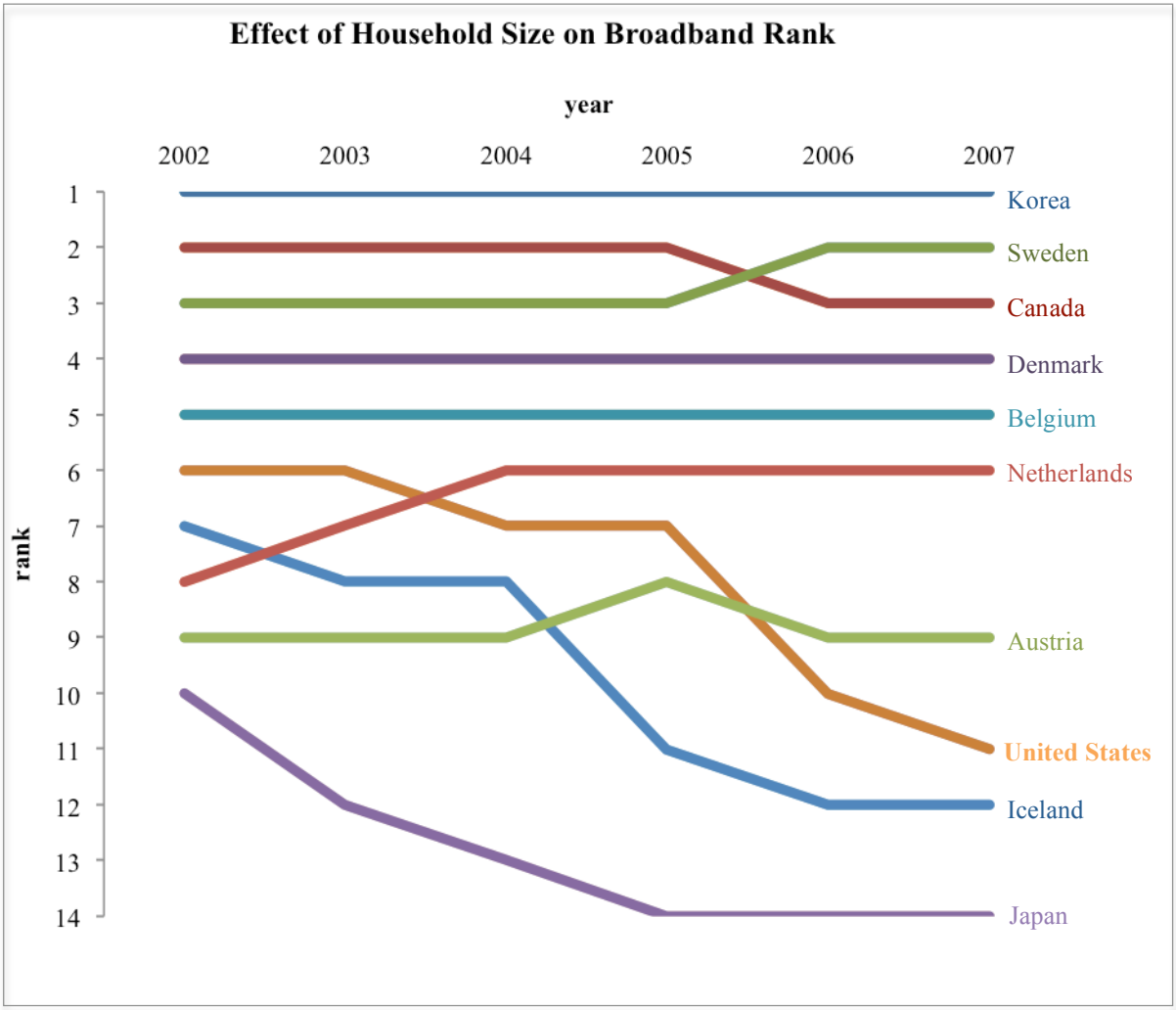
[13] Estimates of the number of households: U.S. Census Bureau 2002 http://www.census.gov/population/socdemo/hh-fam/cps2002/tabAVG1.pdf, 2006 http://www.census.gov/population/www/socdemo/hh-fam/cps2006.html; Australian Bureau of Statistics http://www.abs.gov.au/AUSSTATS/abs@.nsf/2f762f95845417aeca25706c00834efa/D5181CC73561D701CA256F7200832FD9?opendocument; Statistics Canada http://www12.statcan.ca/english/census01/products/analytic/companion/fam/canada.cfm; Ministry of Internal Affairs and Communications: Statistics Bureau Japan http://www.stat.go.jp/english/data/handbook/c02cont.htm; National Statistical Office Republic of Korea http://www.ancsdaap.org/cencon2002/papers/Korea/Korea.PDF; Nordicom www.nordicom.gu.se/common/stat_xls/836_13010_households_1994-2005.xls; Statistics New Zealand http://www.stats.govt.nz/additional-information/dwel-hhold-estimates.htm; Swiss Federal Statistical Office http://www.bfs.admin.ch/bfs/portal/en/index/themen/01/04/blank/key/haushaltsgroesse.html; Sistemas Nacionales Estadístico y de Información Geográfica http://www.inegi.gob.mx/est/contenidos/espanol/sistemas/cgpv2000/100historia/epobla11.asp?s=est&c=996

[14] For the purpose of this simulation we ignore the problem, discussed above, that dividing the OECD numbers by households does not reveal true household penetration. A following subsection will take incorporate that issue into an econometric analysis explaining changes in rank.

[15] I chose a seven percentage point increase because that constant rate from 2002 – 2007 gives the U.S. approximately a 50 percent household penetration rate by 2007, which is close to the true value. Nevertheless, the choice of percentage point increase is arbitrary. The key is to have the rate be equal for all countries.

[16] See footnote 13. Where average number of people per household is not explicitly stated the variable is created by dividing the total population by the number of households in that country.

**Figure 8**[17]




## Changes in Data Collection Methods Affect Rank

In addition to the effect of household size on changes in rank over time, a close inspection of the data suggests that data collection methods have not remained constant. Collection methods or methods of counting broadband appear to have changed differently in each country over time. Such changes are not surprising; as broadband was first becoming popular many regulators and providers may had not yet determined how to best count connections.

As above, household surveys combined with the number of households in a country allow us to estimate the number of residential connections in a country. We can then compare that estimate to the number the OECD reports as the total number of connections. If the difference between those two remains fairly consistent over time, in percentage terms, then we can be reasonably sure that the counting method has also remained consistent. If, however, the difference changes

[17] Germany, Finland, Switzerland, and Norway ranked 7, 8, 10, and 13 in 2007 in this simulation. The figure plots changes only for the countries in the top 10 in 2002 in order to keep the figure legible.

radically then we may surmise that collection methods have changed over time. An undercount in early years could cause a country's rank to appear lower than it actually was. Similarly, if a country's count included progressively more connections that it had previously missed—for example, if it became better at counting business lines—its ranking would improve even if, in reality, broadband penetration was not improving relative to other countries.

Table 1 summarizes changes from 2002 to 2006 in the OECD count relative to implied residential connections. The table shows that in 2002 the OECD counted significantly more than just residential connections in many countries, suggesting they were counting some business connections. In other countries, however, the OECD appeared to undercount, seeming to miss even some residential connections.

In some countries, the OECD appeared to miss a large number of connections in 2002 and then counted far more than just residential connections in 2006. In Luxembourg, for example, the OECD's count was about 22 percent lower than household surveys would suggest in 2002, but by 2006 the OECD's count was 64 percent higher than household surveys would imply. Not surprisingly, Luxembourg's rank improved by seven positions during that time. By contrast, in 2002 in the U.S. the OECD counted 73 percent more connections than household surveys implied, but by 2006 counted only 4 percent more than surveys would imply. The U.S. rank fell by seven positions.

**Table 1**

| Country | OECD Percent Over- or Undercount | | Average household size | OECD Rank change 2002-2006 |
|---|---|---|---|---|
| | 2002 | 2006 | | |
| Australia | | | 2.6 | 2 |
| Austria | 28.4 | 103.6 | 2.4 | -8 |
| Belgium | 4.5 | 13.8 | 2.5 | -6 |
| Canada | | | 2.6 | -7 |
| Czech Republic | | 71.8 | 2.6 | 2 |
| Denmark | -12.9 | 15.3 | 2.2 | 3 |
| Finland | 18.9 | 22.1 | 2.2 | 6 |
| France | 29.9 | 41.5 | 2.4 | 2 |
| Germany | 125.7 | 49.2 | 2.2 | -5 |
| Greece | | 132.9 | 2.6 | 0 |
| Hungary | | 72.4 | 2.6 | 0 |
| Iceland | | | 2.6 | 4 |
| Ireland | | 265.1 | 3.0 | 2 |
| Italy | 208.6 | 182.9 | 2.6 | 0 |
| Japan | | | 2.7 | -2 |
| Korea | | | 3.1 | -3 |
| Luxembourg | -22.4 | 64.3 | 2.5 | 7 |
| Mexico | | | 4.5 | -5 |
| Netherlands | -24.2 | 13.3 | 2.3 | 6 |
| New Zealand | | | 2.6 | -5 |
| Norway | | | 2.3 | 7 |
| Poland | | -9.3 | 3.1 | -1 |
| Portugal | 41.4 | 145.1 | 2.9 | -4 |
| Slovak Republic | | 80.3 | 3.1 | 2 |
| Spain | 53.3 | 79.5 | 3.0 | -4 |
| Sweden | -14.7 | 22.7 | 2.0 | -5 |
| Switzerland | | | 2.2 | 6 |
| Turkey | | 206.8 | 4.7 | 0 |
| United Kingdom | -28.2 | 29.5 | 2.3 | 9 |
| United States | 73.0 | 4.3 | 2.6 | -7 |

Note: Negative numbers in the "OECD Percent Over- or Undercount" columns indicate that household surveys suggested that the country had more connections than the OECD counted (thus, an undercount), while positive numbers indicate that the OECD was counting more than just residential connections.

## Household Size and Counting Methods Explain Nearly All of the Change in Rank

A simple econometric analysis lets us test the effect of household size and changing counting methods on the change in rank. In particular, I estimate the following equation:

$$\Delta rank_{2002-2006} = \alpha + \beta_1(household\ size) + \beta_2(over/under\ count_{2002}) + \beta_3(OECD\ penetration_{2002}) + \varepsilon_i$$

An observation is a country, and because the objective is to determine the cause of rank changes, the dependent variable is the change in rank from 2002 to 2006. Because household size will affect per capita penetration, we include *household size,* which is the average household size in each country. To account for the potential problem of the OECD missing large numbers of

connections in some countries in the early days of collecting data, I include the percent over- or under-count relative to estimated residential connections. *Over/under count*$_{2002}$ is calculated as $\frac{OECD\,count - residential\,connections}{residential\,connections}$. Finally, I include the number of connections per 100 people in 2002 as reported by the OECD (*OECD penetration2002)* to control for the base reported rank and the simple phenomenon of regression to the mean—countries with higher rankings in early days are, all else equal, likely to see their rank fall.

The first column of results in Table 2 shows the results of estimating this equation. The coefficients on all three of these variables are statistically significant and are of fairly large magnitude. In particular, the analysis confirms that countries with larger households tended to see their rank decrease. Each additional person per household, on average, led to approximately an eight-point reduction in rank from 2002-2006, controlling for other factors.

Not surprisingly, undercounts in early years led to an improved rank by 2006 as regulators became more adept at counting connections. Finally, the higher a country's measured OECD penetration in 2002, the more it was likely to drop by 2006, confirming some regression to the mean.

Household surveys only exist for about half of the OECD countries for 2002, so the analysis of change in rank can include only 14 countries. While those data are crucial for examining the change in rank, we have enough other data for nearly all OECD countries to examine factors that may account for a country's rank. I next estimate an equation similar to the one above, but here the dependent variable is a country's OECD rank in 2006. In this model I include per capita income as well as household size and the OECD penetration rate in 2002 because income is a strong predictor of broadband adoption, and thus rank.

The second column of Table 2 shows the results of regressing the 2006 OECD penetration rate on these variables. Recall that the higher the number for the dependent variable the lower the rank (a rank of 28 is worse than a rank of 1). The results are similar to those above. The larger the average household size the lower a country's rank (that is, the higher its number in the ranking). Higher measured OECD penetration in 2002 is correlated with a higher rank in 2006. That is, countries that did well in 2002 also did well in the rankings in 2006, though the table above suggests that, on average, they did not do as well in 2002 as in 2006. Finally, wealthier countries tend to have higher rankings, as one would expect.

**Table 2**
**Household Size and Change in Counting Method Explain Broadband Rank**

| Dependent variable | Change in rank 2002-2007 | | Rank in 2006 |
|---|---|---|---|
| Household size | -10.95 | | 9.31 |
| | (2.23) \| 0.05 | | (2.91) \| 0.01 |
| OECD per capita penetration in 2002 | -2.001 | | -1.21 |
| | (3.37) \| 0.01 | | (6.09) \| 0.00 |
| Over/under count in 2002 | -3.96 | | |
| | (2.14) \| 0.06 | | |
| GDP per capita (00000s) | | | -2.5 |
| | | | (2.77) \| 0.01 |
| Constant | 34.73 | | 0.69 |
| | (2.68) \| 0.02 | | (0.07) \| 0.94 |
| R-squared | 0.61 | | 0.77 |
| number observations | 14 | | 28 |

Note: t-statistic in parentheses and p-value beneath coefficient estimates.

This analysis shows that rank and change in rank are largely determined by factors that have little to do with broadband or broadband policy. Instead, they are affected by factors such as a country's average household size and changes in methods of counting broadband in different countries over time.

In short, simplistic rankings, per se, mean little and thus provide little guidance about either a country's relative broadband position in the world or what policies might be successful. The next section explores more rigorous methods of evaluating factors that may affect broadband adoption.

## Broadband Speeds

In addition to penetration, many U.S. policymakers and other groups are concerned that available broadband speeds in the U.S. are too slow. Much of this concern is based on OECD reports of advertised speeds in different countries. The OECD reports, for example, that the average advertised speed in Japan in October 2007 was 93.7 mbps, 44.2 mbps in France, 43.3 mbps in Korea, and only 8.9 mbps in the United States.

Discussing advertised speeds and not actual speeds presents an incomplete picture. While the OECD broadband penetration numbers reflect the intersection of supply and demand (ignoring the problems with the data themselves), the advertised speeds show the supply-side only and ignore demand. Observed speeds would reflect the intersection of supply and demand and would be the proper analog to the penetration numbers.

A narrow focus on supply can lead to poor policy decisions. For example, a mandate to increase speeds or subsidies to providers to do so would divert resources from other, potentially more valuable, uses.

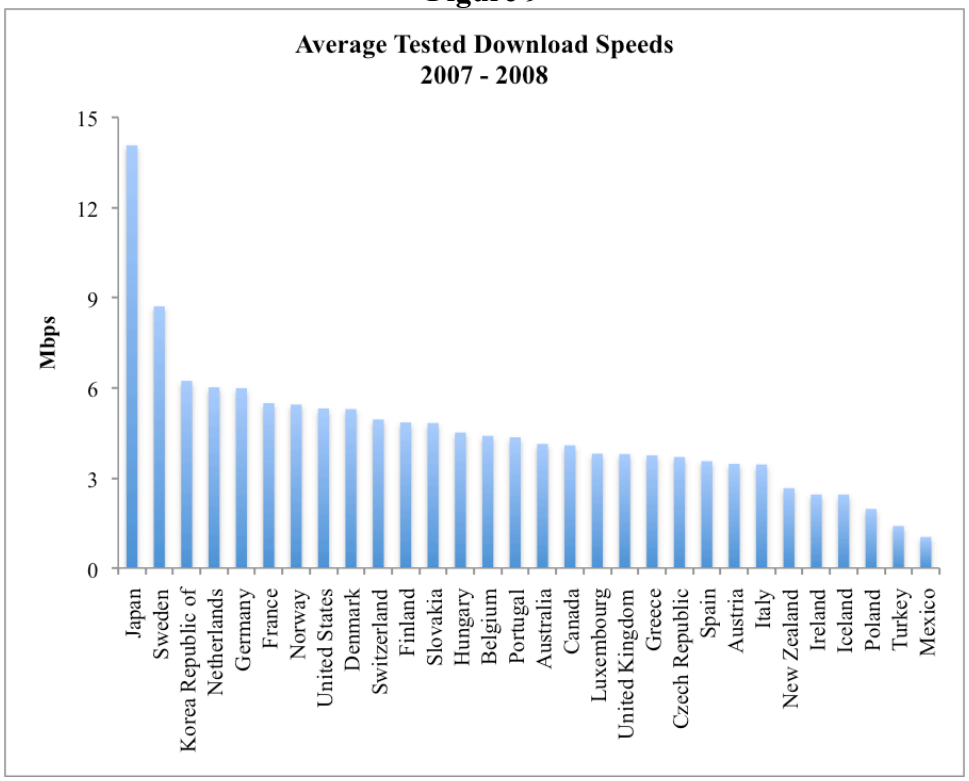
This section reviews the evidence on what speeds consumers around the world actually receive and what they are willing to pay for different speeds.

## Actual Speeds Around the World: Evidence from Speedtest.net

Several on-line utilities help consumers test the speed of their connections. One, speedtest.net, collects data on speeds around the world. Measured speed will depend not just on the subscriber's speed tier, but also on the state of the network between the subscriber and the server running the test. To mitigate this problem speedtest.net has servers in nearly every country, and multiple servers in many countries.[18]

Figure 9 shows measured speeds from speedtest.net.

**Figure 9**




Source: speedtest.net.
Note: Data for Korea are not accurate. Speedtest.net does not have a server in Korea, meaning that tests conducted by users in Korea will be subject to delays.
Averages are based on tests from nearly 25 million unique IP addresses.[19]

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[18] To calculate the country averages, speedtest.net calculates "the 95th percentile speed in each direction for every unique IP address that has tested at Speedtest.net. These numbers are then averaged together for each geographic level (both overall and per ISP)." http://speedtest.net/qna.php#q18

[19] The number of unique IP addresses tested in each country as of May 9, 2008: Australia 914,927; Austria 218,625; Belgium 180,249; Canada 1,324,390; Czech Republic 63,751; Denmark 154,204; Finland 199,317; France 589,882; Germany 1,317,631; Greece 574,058; Hungary 711,456; Iceland 8,498; Ireland 175,999; Italy 1,730,578; Japan 78,029; Korea Republic of 22,308; Luxembourg 19,293; Mexico 490,806; Netherlands 250,087; New Zealand 215,900; Norway 104,916; Poland 877,790; Portugal 360,013; Slovakia 73,297; Spain 482,560; Sweden 200,881;

## Advertised, Observed, and Consumer Satisfaction with Speeds

Little data are available regarding speed tiers to which consumers subscribe since providers are generally unwilling to share that information. A few sources provide some data. Ofcom (2007) provides survey data for seven countries, the FCC provides some for the U.S., and Speedtest.net has test data from around the world.

Advertised speeds are likely to be higher than actual speeds because many consumers are not willing to pay for the fastest available speeds and because consumers may not get the speed their subscription promises. Ofcom (2007) surveyed consumers in seven countries to determine the advertised speed of their broadband plans, the speed they think they are getting (actual speed), and how satisfied they are with their broadband speeds.

Figure 10 and Table 3 show the results of Ofcom's survey. The survey found that consumers with faster subscriptions were less likely to achieve the advertised speed on their connections. Japanese consumers observed the biggest difference between advertised and actual speeds, while U.S. consumers observed the smallest difference. These results are qualitatively identical to a 2006 study of advertised versus actual speeds (Kende 2006), which found that the difference between advertised and actual speed increased with advertised speed.

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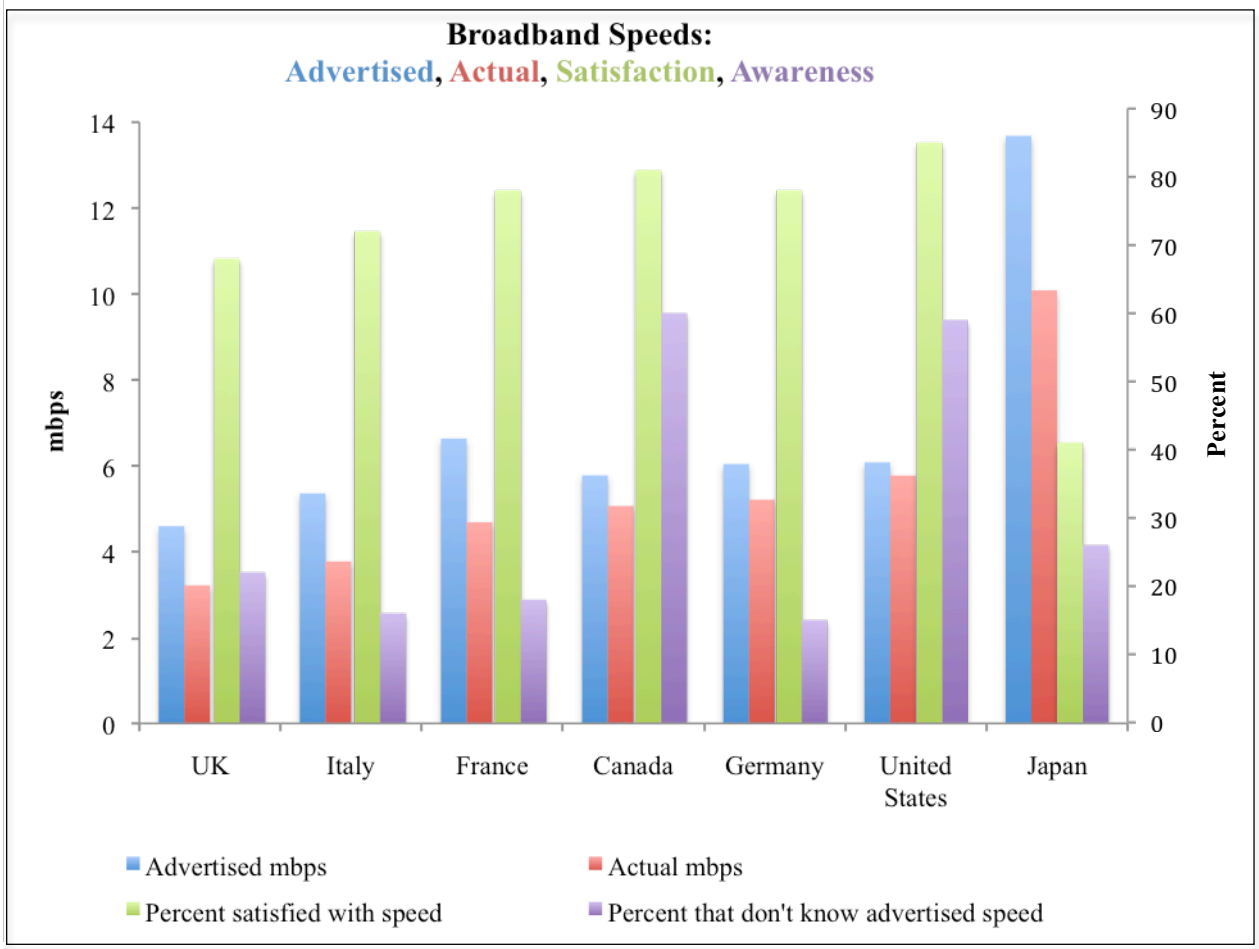
Switzerland 113,318; Turkey 276,924; United Kingdom 3,867,755; United States 9,150,872.

**Figure 10**




Source: Derived from Ofcom (2007), Figures 5.7, 5.8, and 5.9.
Note: See Table 3 for details, including how the weighted average was calculated.

Figure 10 also shows the percentage of survey respondents who did not know what speed their subscription was supposed to provide.[20] Americans and Canadians seemed to be the least aware of their speeds, with 60 and 59 percent reporting that they did not know the advertised speed. Residents of other countries paid closer attention: only 15 percent of Germans, 16 percent of Italians, 18 percent of French, 22 percent of British, and 26 percent of Japanese subscribers did not know their advertised speeds.

It is reasonable to assume that people who do not know the speed promised by their provider would be relatively unconcerned about speeds. The combination of the relatively high share of people who do not know their promised speeds and the small gap between advertised and actual (as recorded by those who *do* know their speeds) likely explains why 85 percent of U.S. residents and 81 percent of Canadians report being either "fairly" or "very" satisfied with their broadband speeds. Similarly, perhaps because of the large gap between advertised and actual speeds, only

[20] The numbers for advertised and actual were recorded only for people who knew what their advertised speeds were supposed to be.

41 percent of Japanese respondents reported being satisfied with their connection speed, despite having the fastest connections. Europeans range from 68 percent of British satisfied, 72 percent of Italians satisfied, to 78 percent of French and Germans satisfied.

**Table 3**
**Speeds Reported by Survey Data**

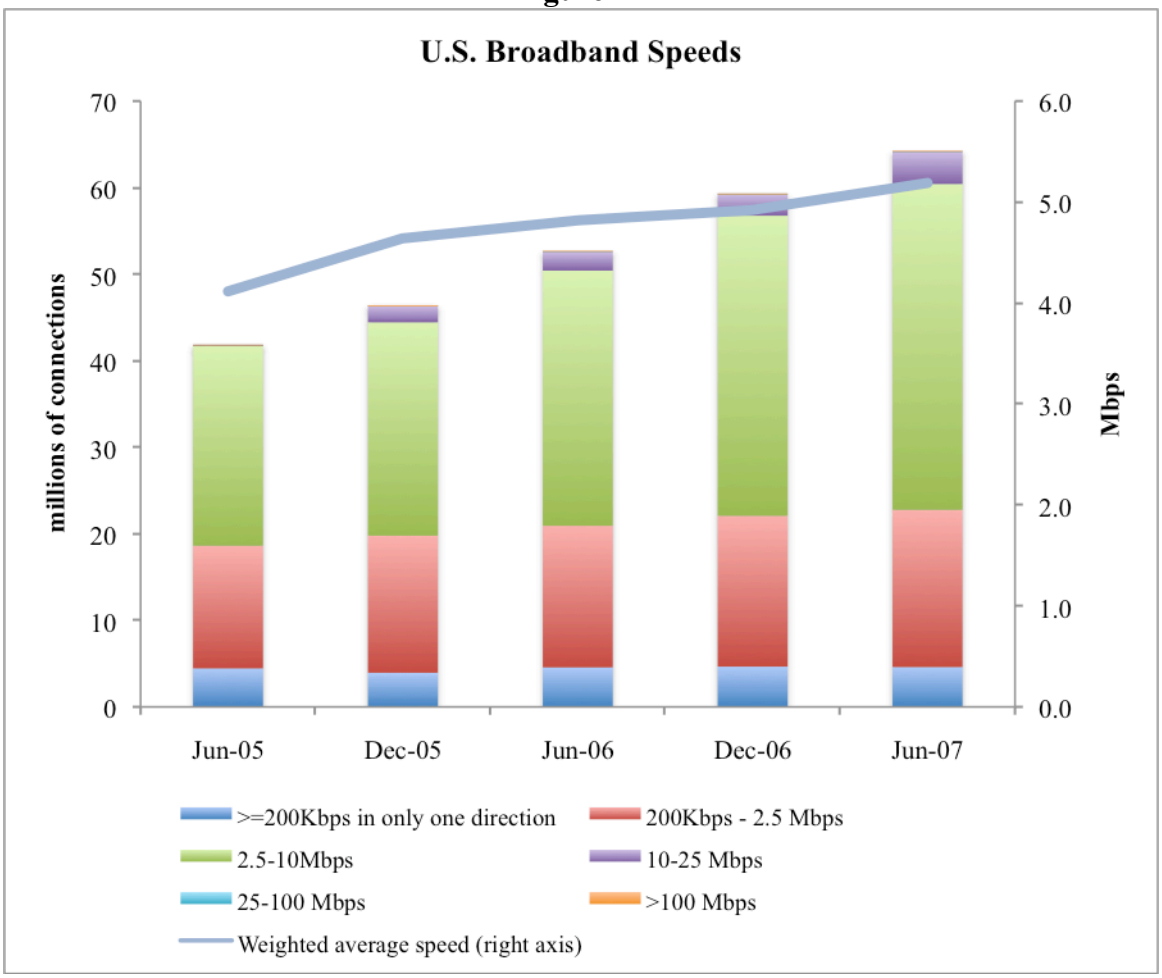
| | | percent of respondents who knew their subscription speeds who had speeds | | | | | | | weighted average mbps | percent who don't know advertised speed of their connection |
|---|---|---|---|---|---|---|---|---|---|---|
| | | up to 512 kbps | 512kbps - 1 mbps | 1 - 2 mbps | 2 - 4 mbps | 4 - 8 mbps | 8 - 16 mbps | >16 mbps | | |
| UK | Advertised | 4 | 8 | 30 | 10 | 38 | 4 | 5 | 4.5 | 22 |
| | Actual | 6 | 22 | 31 | 19 | 17 | 3 | 3 | 3.2 | |
| France | Advertised | 10 | 14 | 15 | 7 | 30 | 7 | 17 | 6.3 | 18 |
| | Actual | 13 | 18 | 18 | 17 | 19 | 8 | 8 | 4.5 | |
| Germany | Advertised | 4 | 9 | 28 | 15 | 18 | 20 | 8 | 5.9 | 15 |
| | Actual | 5 | 11 | 28 | 16 | 18 | 16 | 6 | 5.1 | |
| Italy | Advertised | 5 | 4 | 28 | 36 | 8 | 6 | 13 | 5.1 | 16 |
| | Actual | 11 | 21 | 29 | 18 | 9 | 7 | 6 | 3.7 | |
| United States | Advertised | 15 | 12 | 12 | 21 | 17 | 9 | 15 | 5.8 | 59 |
| | Actual | 18 | 13 | 16 | 16 | 15 | 8 | 15 | 5.5 | |
| Canada | Advertised | 22 | 15 | 6 | 16 | 17 | 13 | 12 | 5.5 | 60 |
| | Actual | 23 | 16 | 11 | 18 | 12 | 10 | 11 | 4.8 | |
| Japan | Advertised | 4 | 4 | 2 | 4 | 22 | 8 | 56 | 12.6 | 26 |
| | Actual | 4 | 9 | 11 | 13 | 18 | 8 | 37 | 9.3 | |

Source: Ofcom (2007).
Note: Weighted average is author's derivation and is the sum of the percentage of consumers in each speed category times the midpoint of the category. For the "up to 512 kbps" category I used 512 kbps as the speed, and for the ">16 mbps" category I used 18 mbps as the category. Using higher speeds for the ">16 Mbps" category has the biggest effect on the weighted average for Japan: the averages and the gap between advertised and actual speeds increase.

## Speeds in the United States

The FCC collects data on broadband speeds (though recall that these are nearly all residential connections). Figure 11 shows speed categories to which consumers subscribe as reported by providers to the FCC. The figure shows that most of the growth has been in the 2.5 – 10 Mbps category, followed by the 10 – 25 Mbps category. The figure also shows steady growth in a weighted average speed.

**Figure 11**

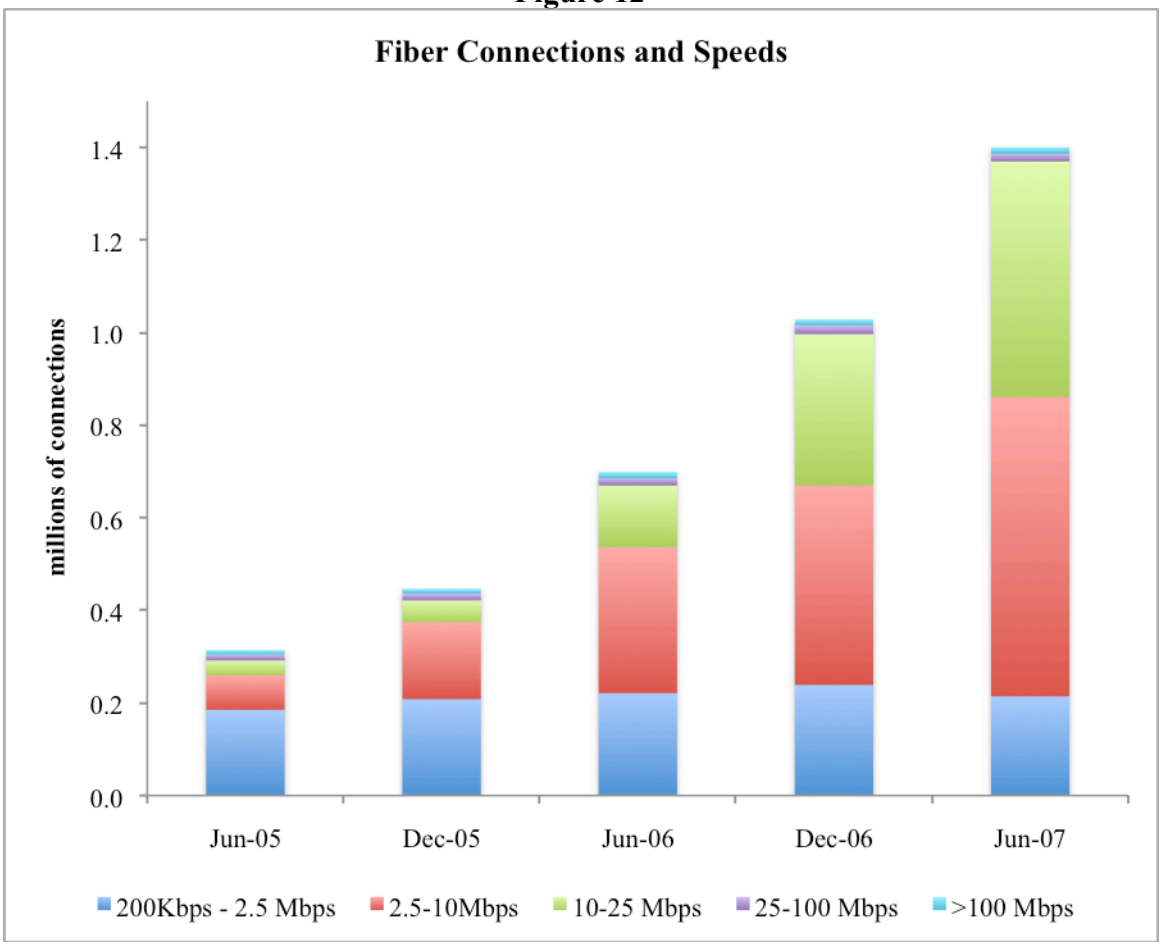



Source: Federal Communications Commission (2006a;2006b;2007a;2007b;2008), Table 5, wireline connections only.
Note: Weighted average is author's derivation from FCC data. The weighted average is the sum of each category's midpoint multiplied by the share of connections in that category. I used 0.765 Mbps for the slowest category.

It is possible to derive some information about U.S. consumers' demand for speed from this information. It is not possible to know from the FCC data what speeds all the DSL and cable platforms offer. We do know, however, that fiber currently offers the fastest maximum speeds.

Figure 12 presents the number of fiber connections from June 2005 through June 2007 by speed tier. The figure shows that the majority of consumers choose speeds either in the 2.5 – 10 Mbps or the 10 – 25 Mbps category. Very few fiber customers choose speeds higher than 25 Mbps.

**Figure 12**




Source: See Figure 11.

Because Verizon is the primary supplier of fiber connections to the home, we can (imperfectly) combine the FCC data with pricing information available from Verizon.[21] Figure 13 presents this information graphically for June 2007.[22] These data will allow us to glean some information about demand. In particular, we know approximate speed categories, the number of subscribers, and prices.

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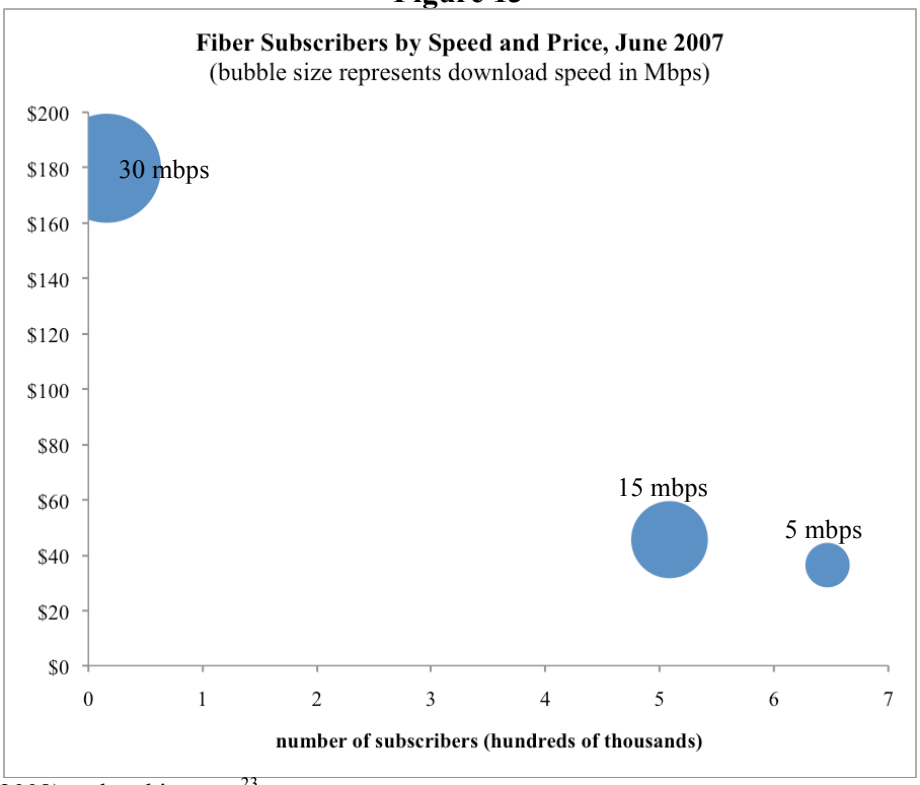
[21] Verizon reported about 1.1 million FiOS Internet customers in the second quarter of 2007. The FCC counted about 1.4 million fiber customers in all, implying that Verizon served about 90 percent of all fiber customers.

[22] Plan data are also available for June 2006, which in theory makes it possible to hold constant speed and see how price changes affect subscriptions. Unfortunately, prices appeared to be largely identical in June 2006 and June 2007 when accounting for the signup offer of a free month's service.
Speed and prices for June 2006: $34.95 for 5/2, $44.95 for 15/2, and $179.95 for 20/2 with one month free when signing a one-year contract.
http://web.archive.org/web/20061215183200/http://www22.verizon.com/content/consumerfios/packages+and+prices/packages+and+prices.htm (last accessed May 8, 2008).

The figure reveals limited willingness to pay for higher speeds. Out of more than one million subscribers, only about 16,000 subscribed to the fastest tier. More than half of all subscribers chose the least expensive and slowest plan.

**Figure 13**




Sources: FCC (2008) and archive.org.[23]

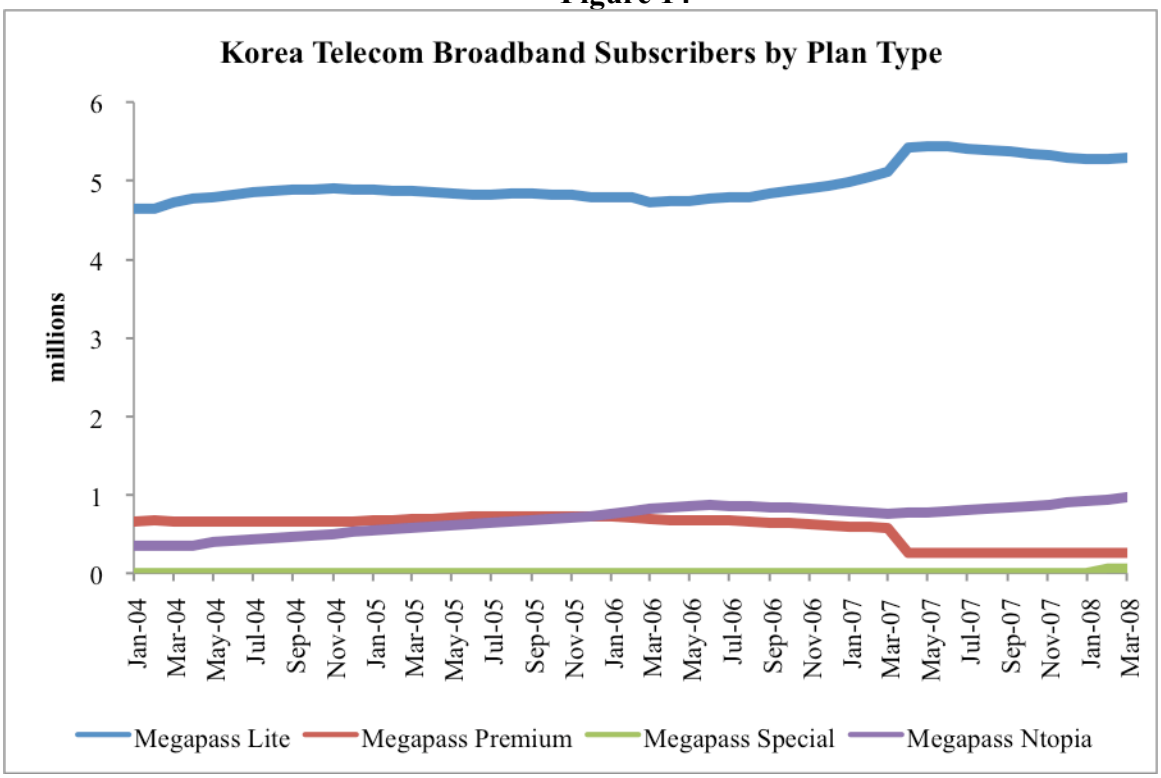
In sum, U.S. data reveal a steady increase in speeds to which consumers subscribe, but only limited willingness to pay for faster speeds.

## Questionable Demand for More Bandwidth: Even Koreans Choose Slowest Plan

Some information about consumers' willingness to pay for different broadband speeds is available in Korea. Figure 14 shows the number of subscribers to different broadband plans offered by Korea Telecom. The figure shows that about 80 percent of Korea Telecom's subscribers choose the plan with the slowest available connection, even though upgrading to the next highest speed tier costs only 3,000 KRW (about USD3.00) more per month, and upgrading to the fastest tier costs only 10,000 KRW (about USD10.00) more per month.

[23] Verizon FiOS speed and price plans for June 2007: $39.95 for 5 Mbps down / 2 Mbps up, $49.99 for 15/2, and $179.99 for 30/2. These prices are for standalone Internet service and do not include bundles. http://web.archive.org/web/20070607004754/http://www22.verizon.com/content/consumerfios/packages+and+prices/packages+and+prices.htm (last accessed May 8, 2008).

**Figure 14**




Source: Korea Telecom http://event.kt.com/kthome/download.jsp?num=3&filename=6_75_1.xls.
Note: In July 2007, the "Lite" plan offered 4Mbps down and 640kbps-4Mbps up; "Premium" offered 13 Mbps down and 4 Mbps up; "Special" offered 20 Mbps down and 4 Mbps up; and "Ntopia" offered 50 Mbps down and 4 Mbps up. KT has upgraded all plans, and currently a one-year contract, the "Lite" plan offers 8-10 Mbps down and 10-640 kbps up for 28,500KRW per month; "Premium" offers 50 Mbps down and 10-50 Mbps up for 31,350 KRW; "Ntopia" (only in residential complexes) offers 100 Mbps down and 100 Mbps up for 34,200 KRW; and "Special" also offers 100 Mbps down and 100 Mbps up for 38,000 KRW.[24]

These data suggest that even in Korea, a country frequently cited as a world leader in broadband adoption and speeds, consumers are not willing to pay much for faster connections. To be sure, the connection speeds available from Korea Telecom are faster than those most in the U.S. can get, but even in July 2007 Korean consumers appeared to be unwilling to pay even a small amount more to get speeds faster than 4Mbps of downstream capacity.

## Defining a "National Broadband Policy"

In part because of the OECD rankings, calls for a U.S. national broadband policy have become louder. Even though the rankings are misleading, broadband is important for our economy and, thus, so are policies that may affect broadband. One problem with the debate so far is that there is little agreement about what a national broadband policy should do.

[24] http://www.kt.com/eng/pro/dome_internet.jsp?pageNum=1&subNum=3.

The underlying assumption in calls for a broadband policy is that some aspect of the market is failing. If so, a broadband policy should specifically target that market failure. Atkinson (2008) attempts to provide a theoretical justification for a market failure and thus government intervention by noting that broadband may exhibit externalities. His argument is partially correct.

Broadband exhibits both direct and indirect externalities in the sense that a given user does not reap the full benefits of connecting (though no studies have estimated this externality). It is not obvious, however, that the effect is external to the network. If the effect is not external to the network then it is not an externality from a policy perspective.[25]

Even if one accepts the argument that broadband exhibits true externalities, the argument does not help indentify a way to make up for the suboptimal investment implied by those externalities. Before intervening in such a dynamic industry we should be reasonably sure that the benefits of the intervention exceed the costs. Although one might believe it is acceptable to sacrifice efficiency for some other goal we should still know what the expected costs of a proposed policy are likely to be in order to make an informed decision. To date, few specific proposals have attempted any estimate of costs or benefits.

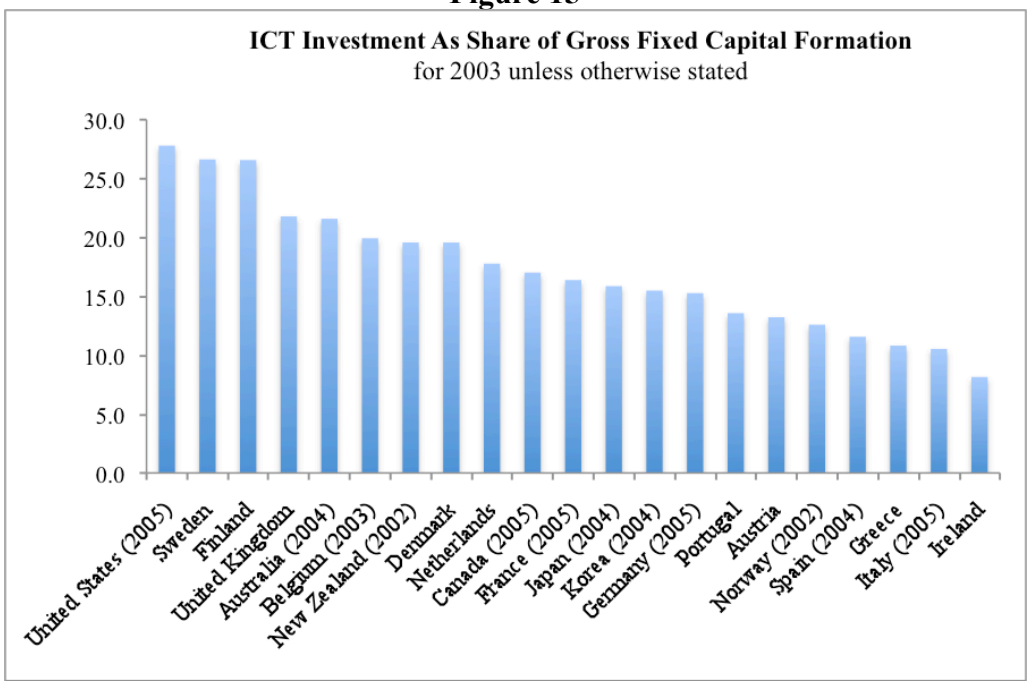
## U.S. At or Near the Top of Several ICT Indicators

Broadband is but one component in the makeup of a country's information and communications technology (ICT) landscape. Rather than focus on a single variable (broadband, in this case), it is useful to examine a range of ICT indicators. These indicators tend to put the United States at or near the top.

The OECD itself compiles data on investment in ICTs. Figure 15 presents the OECD's estimates of ICT investment as a share of gross fixed capital. The most recent data show the U.S. leading the OECD in this investment. Figure 16 breaks ICT investment into investment in software, communications, and IT equipment.

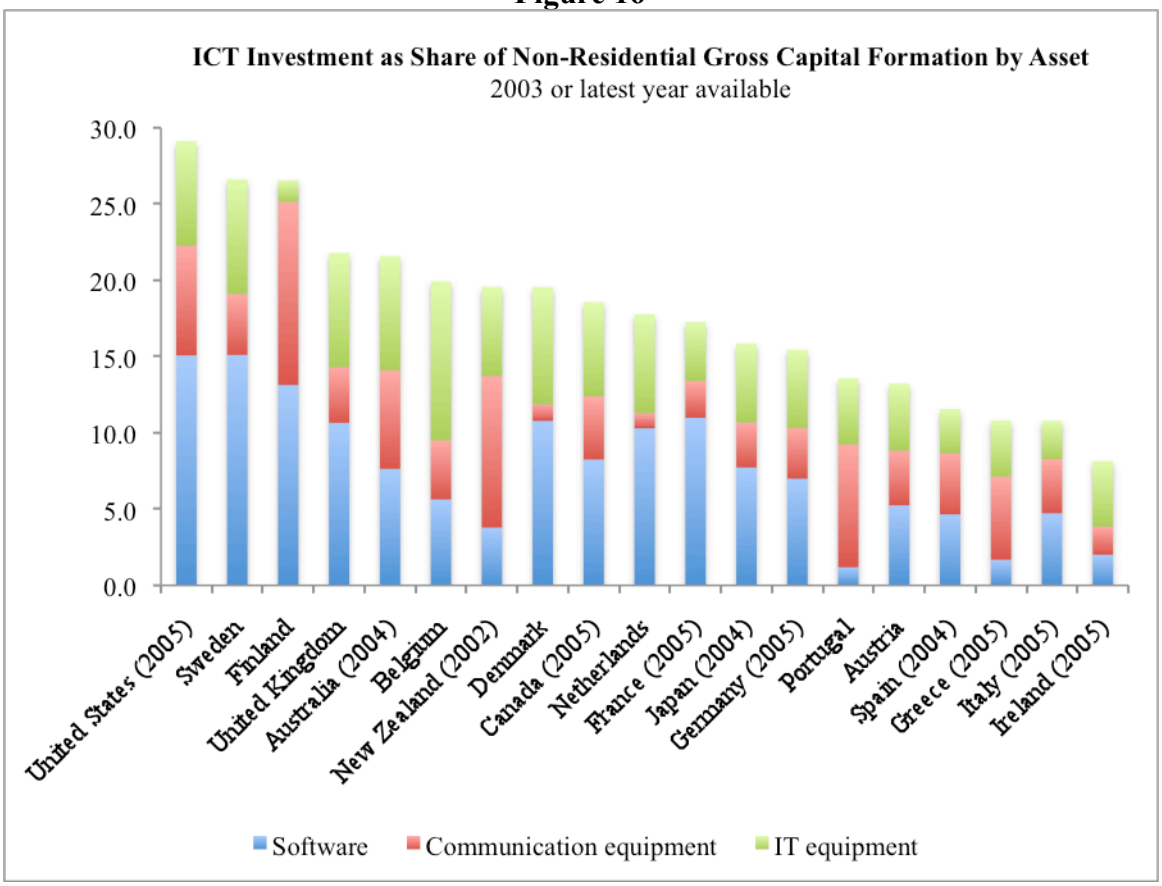
[25] See Noll and Wallsten (2006).

**Figure 15**




Note: ICT equipment is defined here as computer and office equipment and communication equipment; software includes both purchased and own account software. Software investment in Japan is likely to be underestimated, owing to methodological differences. Data are for 2003 or the latest year available.
Source: OECD database on capital services. www.oecd.org/statistics/productivity

**Figure 16**




Source: OECD database on capital services.
ICT equipment is defined here as computer and office equipment and communication equipment; software includes both purchased and own account software. Software investment in Japan is likely to be underestimated, owing to methodological differences.[26]

Some sources combined various measures to create indices to compare countries' connectivity ratings. Table 4 shows the "e-Readiness Rankings" from the Economist Intelligence Unit (2007), the "Connectivity Score" calculated by Waverman, et al (2008), and the "Networked Readiness Index" compiled by the World Economic Forum (2008).

[26] http://caliban.sourceoecd.org/vl=848647/cl=18/nw=1/rpsv/sti2007/ge1-2.htm

**Table 4**

| Economist e-Readiness Rankings | | Waverman Connectivity Score | | WEF Networked Readiness Index | |
|---|---|---|---|---|---|
| Denmark | 8.88 | **United States** | **6.97** | Denmark | 5.78 |
| **United States** | **8.85** | Sweden | 6.83 | Sweden | 5.72 |
| Sweden | 8.85 | Japan | 6.80 | Switzerland | 5.53 |
| Hong Kong | 8.72 | Canada | 6.50 | **United States** | **5.49** |
| Switzerland | 8.61 | UK | 6.10 | Singapore | 5.49 |
| Singapore | 8.60 | Finland | 6.10 | Finland | 5.47 |
| UK | 8.59 | Australia | 5.93 | Netherlands | 5.44 |
| Netherlands | 8.50 | Germany | 5.52 | Iceland | 5.44 |
| Australia | 8.46 | France | 5.07 | Korea | 5.43 |
| Finland | 8.43 | Korea | 4.78 | Norway | 5.38 |
| Austria | 8.39 | Hong Kong | 4.46 | Hong Kong | 5.31 |
| Norway | 8.35 | Italy | 3.85 | United Kingdom | 5.30 |
| Canada | 8.30 | Spain | 3.56 | Canada | 5.30 |
| New Zealand | 8.19 | Hungary | 3.18 | Australia | 5.28 |
| Bermuda | 8.15 | Czech Republic | 3.11 | Austria | 5.22 |
| South Korea | 8.08 | Poland | 2.18 | Germany | 5.19 |
| Taiwan | 8.05 | | | Taiwan | 5.18 |
| Japan | 8.01 | | | Israel | 5.18 |
| Germany | 8.00 | | | Japan | 5.14 |
| Belgium | 7.90 | | | Estonia | 5.12 |
| Ireland | 7.86 | | | France | 5.11 |
| France | 7.77 | | | New Zealand | 5.02 |
| Malta | 7.56 | | | Ireland | 5.02 |
| Italy | 7.45 | | | | |
| Spain | 7.29 | | | | |
| Portugal | 7.14 | | | | |
| Estonia | 6.84 | | | | |

Indices are inherently problematic. First, they are comprised of underlying variables, all of which are measured with error.[27] This measurement error means that it is usually not possible to know whether index scores are statistically different from each other. Second, whoever creates the index must weight the underlying variables in order to combine them into an index. Many indices do not explicitly assign weights, but the failure to do so means that all variables are weighted equally, implying that they are all equally important. It is unlikely that all variables in an index truly are equally important. Waverman, et al (2008) are an exception. Perhaps the biggest contribution of their index is their careful construction of economically sensible weights.

The OECD's broadband rankings are flawed and cannot be a basis for sound policymaking. A broader range of indicators suggests little reason to believe there exists some general market failure in the U.S. Rather than forging ahead with ill-conceived and poorly studied policies, it is crucial to consider carefully how policies already affect broadband and how new proposals are likely to affect the market.

[27] These indices use the OECD broadband penetration estimates, presumably lowering the U.S. score.

## Study Existing Policies to Learn Which Ones Work and are Cost-Effective

Our *de facto* national broadband policy is a collection of policies that affect broadband investment—both content and infrastructure—and adoption. The following is a partial list of policies and programs that affect broadband:

- Spectrum policy;
- Video franchising rules;
- The U.S. Department of Agriculture Rural Development;
- The Schools and Libraries program component of our universal service program;
- Rights-of-way laws;
- Exclusive rights to serve large buildings;
- Network neutrality;
- Network management.

In addition, states have implemented their own policies intended to promote broadband.[28] In short, many policies already in place affect broadband investment and others are being debated, even if not under the guise of a national broadband policy. Little empirical research has been done on the range of existing broadband policies. Flamm (2005) found that the eRate program, intended to help connect schools and libraries to the internet, had little effect on broadband penetration.[29] Wallsten (2006) found that few state-level policies had any impact on broadband penetration. Some subsidies for providers in rural areas may have contributed somewhat to broadband expansion, but from the available data it is impossible to determine whether those investments were cost-effective.

Early broadband research also confirms that competition across platforms (i.e., facilities-based competition) strongly affects penetration. Access competition (i.e., reselling another firm's services via unbundling laws) does not generally seem to have a positive impact on penetration, though that conclusion is controversial. Maldoom, *et al.* (2003) confirm the important role of cross-platform facilities-based competition in a report on broadband in OECD countries. Distaso, *et al*. (2004) also conclude, in an empirical study of European Union countries, that inter-platform competition drives broadband adoption. Wallsten (2007) reached similar conclusions, finding no positive effect of unbundling policies. These results support policies that encourage inter-platform competition.

Yet that research sheds little light on most existing policies. Before proposing new ones we should carefully study what has and has not been effective to date.

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[28] See http://docs.cpuc.ca.gov/published/COMMENT_DECISION/43588.htm for a list of some state-level broadband policies.

[29] This result should, perhaps, not be surprising since the Universal Service Program overall seems to have had little effect on telephone penetration (Rosston and Wimmer 2000).

The data necessary to conduct such evaluations, however, is largely unavailable. Thus, the first step in this process should consist of carefully considering what data would be useful for evaluating proposed policies. Collecting data of the sort that the Broadband Data Improvement Act directs (e.g., at the 9-digit zip code level) may prove helpful.

Existing data sources, however, should not be overlooked. The FCC, for example, has more broadband data than it makes public. On its Form 477 the FCC asks providers to list the number of connections by zip code.[30] The FCC currently releases only the number of providers in each zip code regardless of the number of subscribers to protect company data that might be competitively sensitive. The Commission and firms that respond to the FCC's surveys should carefully review the FCC confidentiality policies to determine whether some data collected but currently withheld is, in fact, sensitive.

The U.S. Census should also play a key role by routinely collecting data about broadband adoption and use in the annual Current Population Survey. In addition to the data on adoption that it collected in October 2007 it should consider collecting information on how much people pay for their connections and the speeds they obtain. Such well-done surveys will always provide a more accurate picture of the state of residential broadband than will attempts to count every connection.

Those and other data will then allow us to study the effects of existing programs and policies. Many programs exist whose effects have not been rigorously studied. For example, some policymakers and others want to expand the Universal Service Fund to include broadband. Before considering expanding what we already know to be an inefficient program or find other ways to subsidize rural broadband, we should learn more about similar programs that already exist.

USDA Rural Development, for example, reports that though 2006 it had "invested $5.7 billion to provide high-speed Internet access to more than 1.9 million rural homes and businesses," according to its 2005-2006 annual report (Rural Development 2007). No research has tried to determine whether those subsidies were, in fact, required, or if those connections would have been built anyway. Moreover, by the agency's own report, it spent about $3,000 per connection if we assume that none of the funds supported projects that would have been done anyway. Is that cost-effective for those areas?

ConnectKentucky—and now ConnectedNation—maps broadband availability and then works with local groups and broadband providers to bring access to certain areas. This approach has potential benefits because it can identify market failures at the local level and tailor specific solutions that address those failures. We currently know little about the effectiveness of these initiatives, however, and should conduct rigorous evaluations of programs like

[30] The FCC's Form 477 is available here: http://www.fcc.gov/Forms/Form477/477.xls.

ConnectKentucky, which has received a great deal of praise. Unfortunately, ConnectedNation's first attempt at evaluation was less than rigorous (Connected Nation 2008).[31]

Other important issues have also not been rigorously evaluated. How do laws regarding rights-of-way affect the ability of providers—especially new entrants—to serve business and residences? The National Association of Regulatory Utility Commissioners noted in 2002 that "the rights-of-way practices of certain governmental entities have emerged as a barrier to the deployment of advanced telecommunications and broadband networks" (National Association of Regulatory Utility Commissioners 2002). The U.S. established guidelines for federal agencies to follow in granting access to rights-of-way in 2004. To my knowledge, neither the degree to which rights-of-way impede entry into the broadband market nor any policy responses to the 2002 NARUC report or the 2004 federal guidelines have been studied.

## Focus Policies Primarily on Low-Income People, Not on Rural Areas

Many existing policies focus on expanding service in rural areas. Yet, existing data do not support the assertion of a general market failure in urban areas. Consider data from the U.S. Census more carefully.

Figure 17 shows urban, rural, and total household broadband penetration by income. Figure 18 shows household penetration by state. The figures show that while rural penetration is lower than urban penetration, income matters more than geography in determining household broadband penetration. Indeed, Figure 17 shows that urban households with incomes of about $35,000 and less are less likely to have a broadband connection than the typical rural family. The figure also shows that wealthy rural residents are well connected.

The income effect also helps to explain why famously rural Alaska, where median household income is about $10,000 more than the U.S. median household income, has the second highest household broadband penetration rate in the country (following New Hampshire).

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[31] ConnectedNation's report contends that household broadband adoption in Kentucky increased from 24 percent in 2005 to 44 percent in 2007 (an 83 percent increase) while in the U.S. it increased from 30 percent in 2005 to 47 percent by 2007 (a 57 percent increase). Therefore, they conclude, ConnectKentucky (as it was called then) was effective in promoting broadband use. The data do not justify this conclusion, which is based on a combination of comparing unequal time periods and misleading statistics.

The report measures the change in household penetration in Kentucky from March 2005 to September 2007, but uses household penetration in the U.S. from March 2005 to February 2007. In other words, the measurements give Kentucky an extra seven months of growth in household penetration. Given very fast growth rates across the country, seven months could make a big difference.

In Kentucky, 24 percent of households subscribed to broadband in March 2005 and 44 percent subscribed in September 2007, according to the report. According to the Pew estimates, in the U.S., 30 percent of households subscribed to broadband in March 2005 and 50 percent of households subscribed in September 2007 (John Horrigan, personal communication).

In other words, broadband penetration in the U.S. and in Kentucky increased by about the same amount -- 20 percentage points in both cases.

In addition, the report shows the percentage growth in the percent of households with broadband. Since Kentucky started at a lower level than the U.S. overall, any given increase will seem larger when measured as a percentage increase. Kentucky's improvement from 24 to 44 percent is an 83 percent increase. The U.S.'s increase from 30 to 50 percent is only 67 percent. Yet that comparison is misleading since the increases are essentially identical.

**Figure 17**

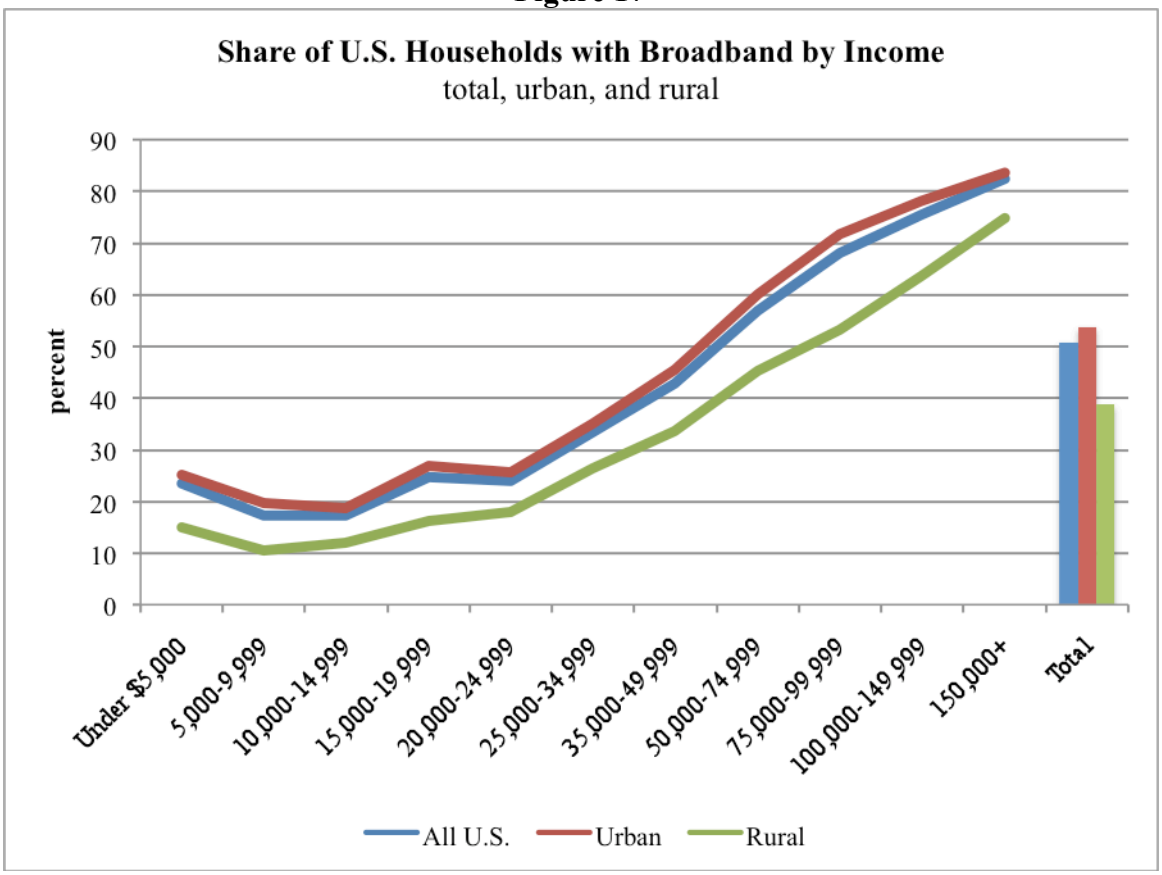
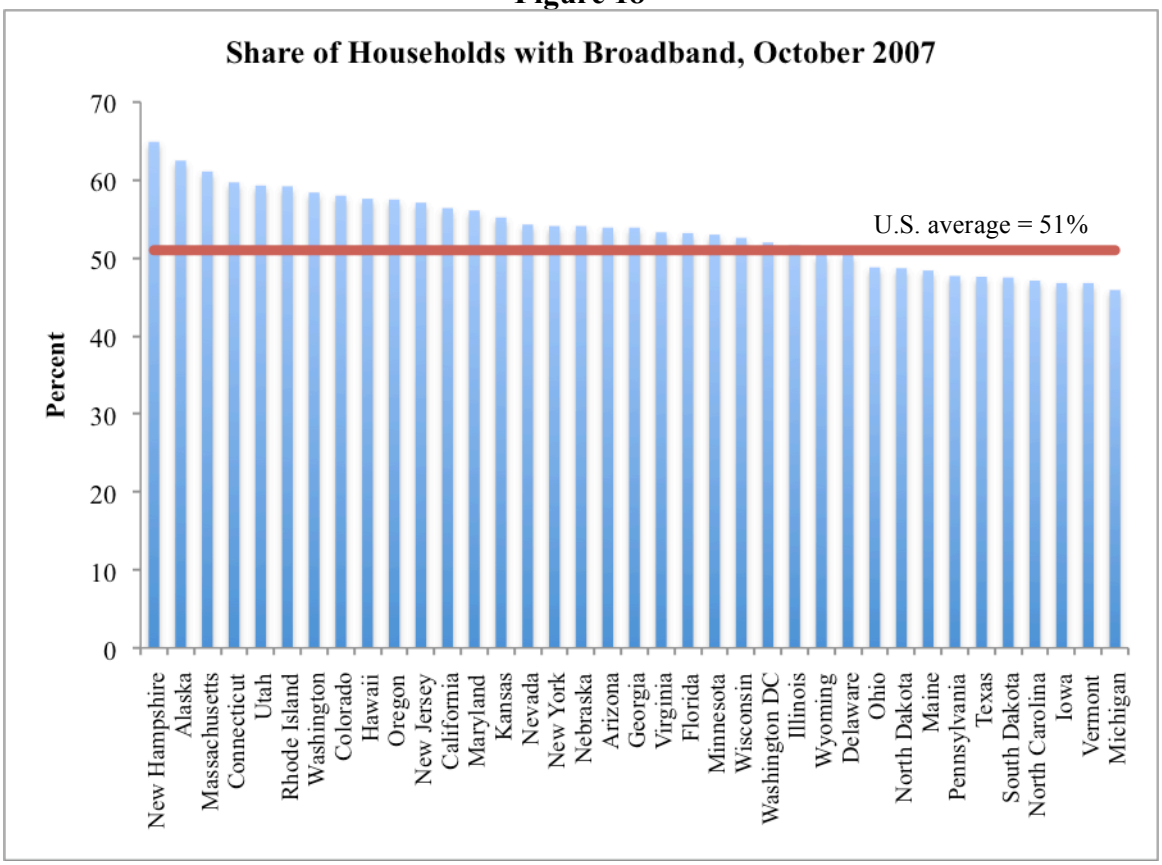

Share of U.S. Households with Broadband by Income
total, urban, and rural
percent
90
80
70
60
50
40
30
20
10
0
Under $5,000
5,000-9,999
10,000-14,999
15,000-19,999
20,000-24,999
25,000-34,999
35,000-49,999
50,000-74,999
75,000-99,999
100,000-149,999
150,000+
Total
All U.S.
Urban
Rural

**Figure 18**




Source: U.S. Census Current Population Survey, as reported in NTIA (2008).

Recall from the Parks Associates (2007) survey discussed above that 22 percent of those who had no intention of subscribing to the Internet did not subscribe because either they could not afford a computer or they could not afford access.

These data suggest that a general policy focus on rural areas may be misplaced. Instead, if the policy goal is to increase adoption then policies may be better off focusing on low-income people. Low-income people are likely to be better off receiving a direct cash transfer rather than the equivalent as a subsidy for a computer or for Internet access. Nevertheless, if policymakers' goal is to increase broadband penetration then subsidizing low-income people may help achieve that goal and at least have some distributional benefits. By contrast, many rural subsidies are likely to support investments that would take place without subsidies.

## Target Rural Subsidies Carefully: West Virginia's New Legislation

To the extent that certain areas have no service it is theoretically possible that subsidies could be efficient. In particular, if building broadband infrastructure in an area were socially beneficial but not privately profitable, then a subsidy that creates an incentive to invest in those areas could yield net benefits. Those cases would represent a classic market failure, and a subsidy could, in principle, help to solve that failure.

West Virginia is trying to target explicitly areas with no wireline service with a new law.[32] Under this legislation the state would provide partial subsidies to providers to build infrastructure in areas with no broadband infrastructure.

When service is truly completely unavailable in an area in which people are willing to pay for service, such subsidies may be efficient. Goolsbee (2002) argued that if policymakers want to employ subsidies to increase broadband penetration, then subsidies should be targeted at encouraging investment in unserved areas rather than at individual consumers. That advice may no longer be generally true, since broadband is much more widely available today than it was when that research was conducted. However, the argument may still be correct in areas with no existing infrastructure.

A potential problem with such subsidies is that they can generate perverse incentives to fund projects that the private sector would have done anyway (inframarginal projects). Programs can create these incentives if grants are cheaper to a firm than are other sources of capital and if government program managers are evaluated on the basis of how many additional connections projects that get grants provide.[33]

West Virginia's legislation includes at least one mechanism that could simultaneously help to mitigate the problem of funding inframarginal projects and to reduce the subsidies necessary to provide service. In particular, once a provider identifies an area without service and submits an application for a grant, other providers have 60 days to submit competing applications. This resulting competition can have the effect of a "reverse auction" for subsidies, potentially substantially reducing the subsidies from the state by causing firms to reveal the true cost of providing service.[34]

As with many such projects, however, the law does not appear to incorporate any evaluation mechanism. Projects should be designed with evaluation in mind from the beginning so that we can rigorously test whether the project made a difference and whether that difference was cost-effective. It is not obvious, for example, that an area should be considered "unserved" if it can be reached only by wireless technologies (including satellite). Even in those cases, direct subsidies to consumers that can be used for any broadband service could help them afford satellite or wireless while also increasing incentives for other providers to build into those areas.

## Make More Spectrum Available

Many policies require additional study. It is well-established, however, that the lack of available spectrum is a barrier to entry for potential new wireless providers and to existing wireless firms that want to expand and improve their wireless services. The $19 billion spent by companies for spectrum in the 700 MHz auction, which concluded in March 2008, reveals the relative scarcity

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[32] The text of the law is available here: http://www.legis.state.wv.us/Bill_Text_HTML/2008_SESSIONS/RS/BILLS/hb4637%20intr.htm (last accessed May 14, 2008).

[33] See Wallsten (2000) for more on this phenomenon.

[34] See Wallsten (2008) for more on reverse auctions.

of useable spectrum. The increasing demand for wireless services makes it increasingly important to make more spectrum available.

Some spectrum that should already have been made available remains unavailable. Most egregiously, the auction for spectrum for "advanced wireless services" (AWS) concluded in September 2006. Certain U.S. government agencies that were using that spectrum were supposed to relocate to other spectrum bands to make way for auction winners to offer new services.

Unfortunately, these agencies have been slow to relocate and make the spectrum available to the auction winners. As a result, companies that paid billions of dollars for spectrum licenses have had to delay launching their broadband networks.

The failure to clear the spectrum has several negative effects. The obvious negative effect is increasing the delay before additional broadband platforms become available, which also means less competitive pressure on the firms already offering wireless broadband. Moreover, the companies most affected—including T-Mobile, Leap, and MetroPCS—compete with the bigger providers using their own infrastructure.[35] Nearly all economic research agrees that interplatform competition is more effective than intraplatform competition. In other words, by failing to move federal agencies away from the AWS spectrum, policymakers have deprived consumers of additional facilities-based broadband platforms, reducing competition.

In addition to the immediate effect of the loss of at least one mobile broadband platform, investors need to believe that the government can credibly commit to following the rules it sets. Investors are less likely to risk large amounts of capital if they do not believe that the government will live up to its promises. The government's failure to follow through on its obligation to vacate the spectrum may cause future investors to reduce their willingness to invest.

## Measure Business Broadband

A general theme throughout this paper has been the lack of data on business connections. Little comparable data—either in the U.S. or abroad—exists on availability and types of data connections available to businesses. The high level of broadband adoption by business and the lack of complaints from business suggest little cause for concern.

Even without evidence of a market failure, ICT has become a crucial component of business productivity. It may be worth considering how to incorporate data on broadband into existing measures of ICT use in business.

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[35] http://telephonyonline.com/mag/telecom_no_winnertakeall_aws/.

## Conclusions

Rankings of broadband penetration by the OECD have caused tremendous angst in the U.S. about the country's declining rank. The declining rank, however, is primarily a statistical anomaly having to do with household size, since countries with larger households will ultimately have lower per capita penetration, and apparently also with changing methods of counting connections over time.

In addition, the OECD cannot count business connections to the same extent across countries due to the differing ways businesses connect to the Internet in different countries. The OECD and the FCC miss about 70 million business connections in the U.S. due to the difficulty of counting broadband connections over special access lines.

Household surveys paint a more positive picture, with U.S. household penetration at just above 50 percent as of October 2007. This penetration rate compares favorably to other wealthy countries, placing the U.S. probably about 9$^{th}$ place among OECD countries.

Broadband speeds consumers receive in the U.S. are comparable to other wealthy countries. Only in Japan are measured speeds significantly higher than in the U.S., and there the average is about twice the U.S. average—about 16 Mbps, still much lower than the 100 Mbps advertised. While U.S. speeds are increasing, consumer demand for more speed is questionable. Consumers do not appear to be willing to pay much more for faster speeds.

Because there is no obvious general market failure, policies must therefore be targeted narrowly to avoid using scarce resources in unproductive ways. Better data would be useful in evaluating proposed policies more carefully. The U.S. Census should continue to collect data on household broadband use in its Current Population Surveys, and the FCC should consider whether it could release additional data that it currently redacts from public documents. Data on business broadband is nearly nonexistent, so it is worth considering what additional data would be useful and how to obtain it.

Broadband is nearly universally available in the U.S., and data show that income is a much stronger determinant of broadband adoption than is location. Indeed, according to the U.S. Census, Alaska has the second-highest household penetration rate in the country. Policies intended to increase penetration should thus probably focus on low-income people rather than on rural areas or states. Low-income people would almost surely be better off with cash transfers than with subsidized computers or broadband, but to the extent that policymakers want to increase penetration such subsidies would at least also have some distributional benefits even if they were not especially efficient.

In short, the broadband market in the U.S. appears to be working reasonably well, and no evidence suggests a general policy failure. Policy should focus primarily on ensuring that the market remains competitive, which includes continuing to make more spectrum available for high-value uses. In order to avoid misallocating scarce resources broadband policy proposals should clearly identify the problem they intend to solve and show that the proposal is likely to yield net benefits.

# Appendix 1: Wireless Broadband

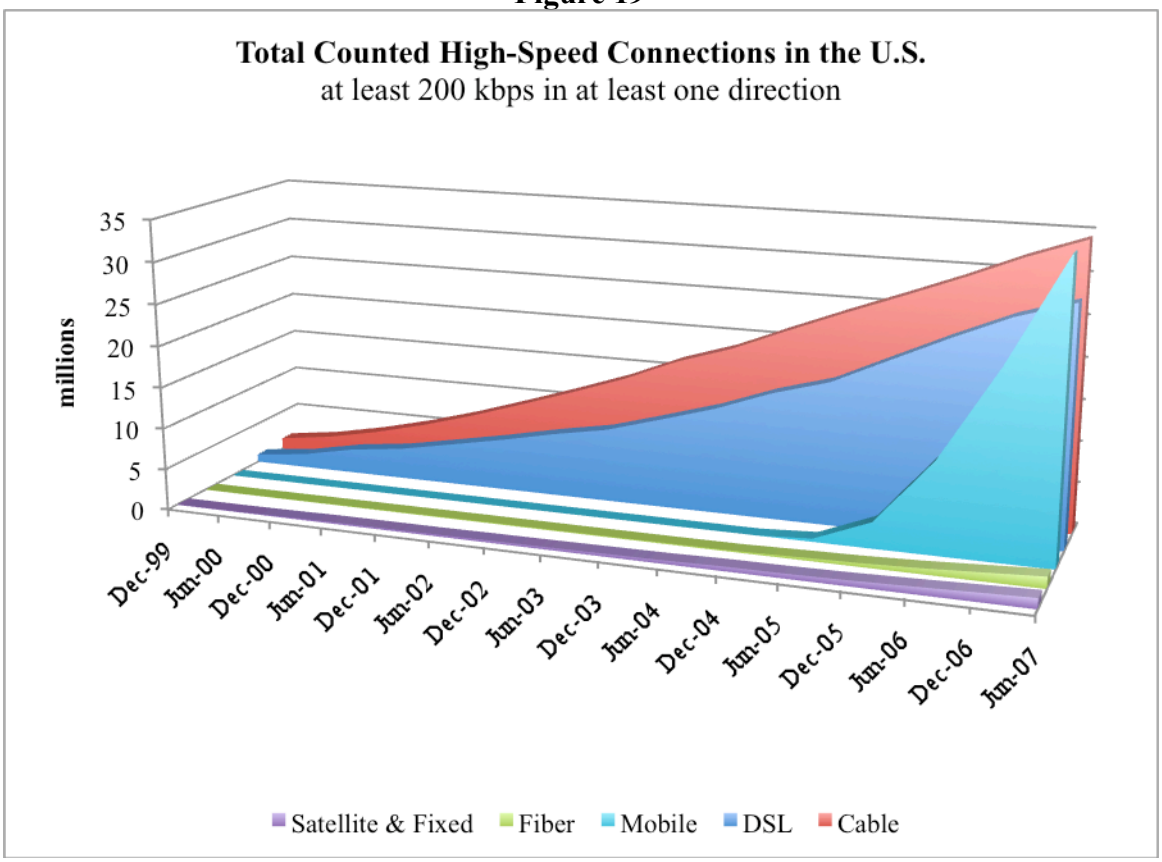
Broadband is increasingly offered over wireless technologies. Because wireless and wireline are not perfect substitutes and because little research has attempted to estimate their cross-elasticity, it is unclear how to properly compare the two and whether it is appropriate to incorporate them together into "total" counts.

## Wireless Internet Access Growing Quickly

Figure 19 shows the number of high-speed lines the FCC counted from December 1999 through June 2007. The figure, which depicts the number of connections that support speeds of at least 200 kbps in at least one direction, illustrates the fast growth in mobile data connections. Figure 20 shows the number of connections that support at least 200 kbps in both directions. Together, the figures imply that most of these mobile connections are likely to be fairly slow: the FCC estimates about 35 million mobile connections that support 200 kbps in at least one direction, but only just over 9 million that support 200 kbps in both directions. By comparison, about 93 percent of all wireline connections support 200 kbps in both directions. Nevertheless, it is clear that wireless broadband is growing quickly.

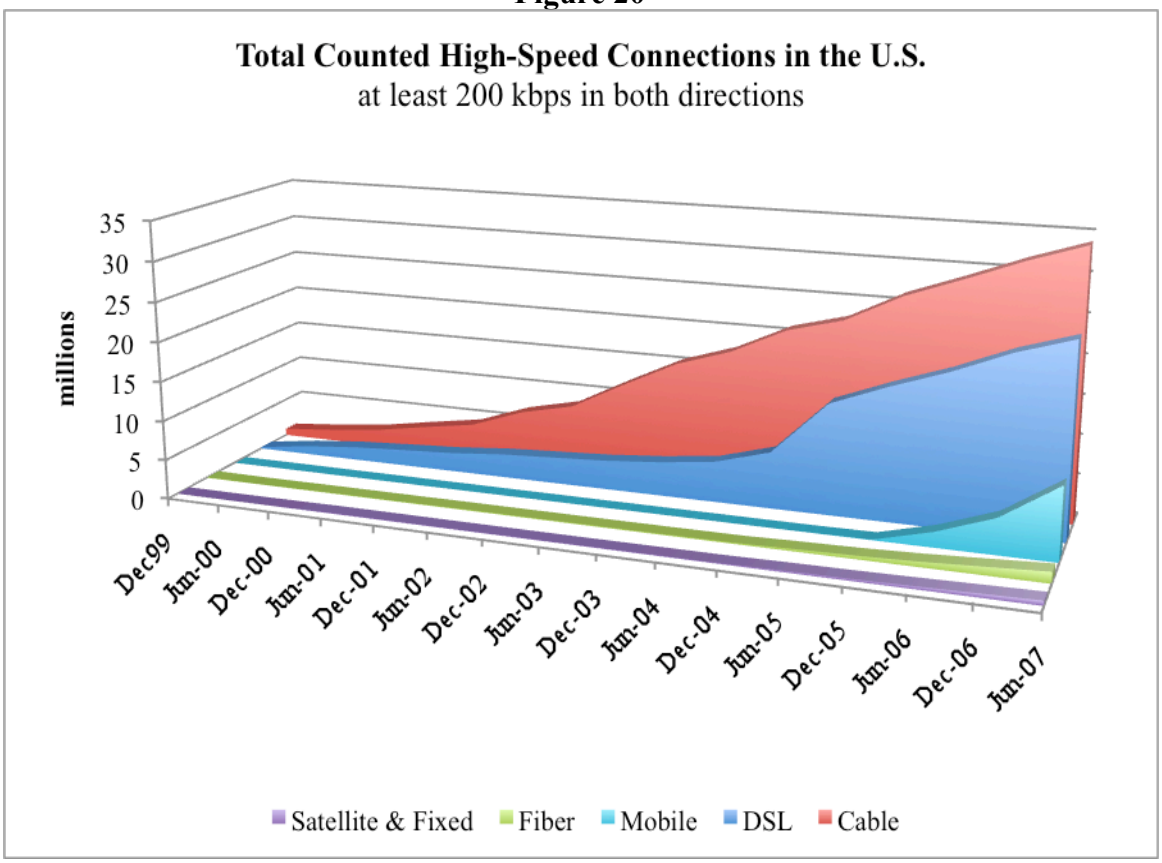
Mobile wireless is an important component of broadband penetration and is likely to become even more important. For many applications and in many places it can be a good substitute for wired broadband, but it is not a perfect substitute. To my knowledge, no empirical studies have yet examined the elasticity of substitution between wireless and wireline broadband.

**Figure 19**




Source: FCC (2008), Table 1.
Note: This figure shows the number of connections with at least 200 Kbps in at least one direction. Figure excludes "powerline and other," which totaled 5,420 in June 2007.

**Figure 20**




Source: FCC (2008), Table 2.
Note: Figure excludes "powerline and other," which totaled 5,420 in June 2007.

## Household Broadband Reported in Eurostat Includes Wireless

In addition to the E-Communications survey, the EC collects other data about broadband adoption, which is presented in a report on Europe's "i2010" program (European Commission 2008). The numbers reported from this survey, which are available in Eurostat,[36] generally show higher household penetration than does the E-Communications survey. The reason for the difference is that the Eurostat survey includes wireless as an option for household broadband while the E-Communications survey does not.

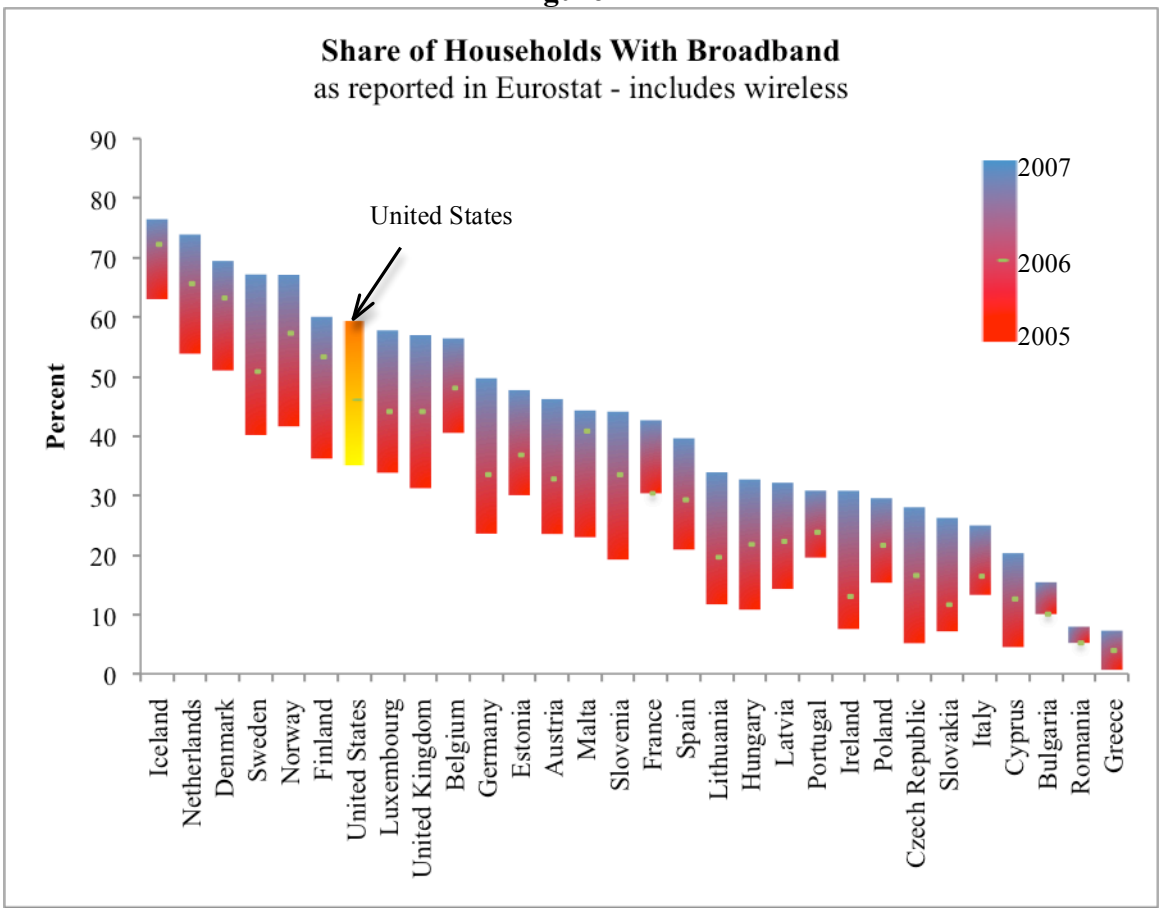
Specifically, the Eurostat survey asks households how they connect to the Internet, and for broadband gives them the choice of DSL or "other." Other includes "Cable, UMTS, etc." UMTS is a 3G (broadband) wireless technology (European Commission 2007a). As a result, the numbers reported in Eurostat are likely to include wireless as a broadband option while most other surveys do not, increasing measured household adoption.

[36] The data are publicly available here: http://ec.europa.eu/eurostat/. From that page, click on the data tab in the middle page and then click on "science and technology." In the folders that appear, expand the "science and technology folder," then the "information society statistics," then "computers and the Internet in household and enterprises," and finally "Internet-level of access, use, and activities. Last accessed April 23, 2008.

Figure 21 shows estimates of household broadband penetration—including wireless—derived from E.C. (2008), plus estimates derived for the U.S. from the FCC (Federal Communications Commission 2008), for 2005-2007. The figure shows that even under this broader definition of broadband the U.S. compares favorably to other countries. Indeed, by this comparison the U.S. has higher broadband penetration than the large EC countries.

The data in the figure for both the E.C. and the U.S., however, are problematic, so the figure must be considered skeptically. The survey instrument the EC publishes is only a "model" for member countries to use when they implement the survey.[37] As a result, some may include wireless and some may not. The data contain no notes that would shed light on whether countries did, in fact, modify the survey. In addition, the U.S. data show residential broadband use, including wireless, but are not specifically at the household level. To the extent that households in any country have multiple broadband-enabled wireless handsets these estimates may overstate household penetration.

**Figure 21**




Note: Data for EC countries from Eurostat and E.C. (2008). As explained in the text, the survey that generates these data includes wireless as an option for household broadband. Data for the U.S. is derived from FCC (2008) Table 3 and U.S. Census estimate of 113.1 million households in the U.S.

[37] Eurostat (2008) says that it "provides Member States with model questionnaires on which they can base their surveys."

# Appendix 2: Evaluating Critiques of Household Data

The OECD rankings have become conventional wisdom, and some dismiss data from other sources. Atkinson (2008), for example, rejects the E-Communications survey, stating that "the European Commission's data are contradicted by most other studies of European broadband penetration" (p.148). This claim, however, is based on a misunderstanding of what data the OECD and others collect. As discussed above, the problem with the OECD numbers is that the OECD cannot count all connections—especially business connections—and the share of connections it misses differs by country. Any source that relies on counts from providers will have the same flaw.

## Dividing OECD "Total" By Number of Households is not Valid

Atkinson first notes that dividing the OECD estimates by the number of households in each country yields different numbers than does the E-Communications survey (Atkinson 2008). Because the OECD combines business and residential connections, however, simply dividing the OECD's number by the number of households is not a valid estimate of household penetration, as discussed above. The E-Communications survey is explicitly a household survey and does not suffer from that problem.

## Some Surveys Include Wireless and Business Connections, Some Don't.

As a second piece of evidence, Atkinson notes a discrepancy between household penetration reported for Austria in the E-Communications survey and numbers reported by the Austrian regulator. The estimates do, in fact, differ, but they do so because the survey on which the Austrian regulator's numbers are based include wireless broadband connections as well as business connections while the E-Communications survey does not.[38] As discussed below, how to properly account for wireless broadband is an open question, but it is not appropriate to compare two measures when one includes wireless and the other does not.

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[38] Atkinson (Atkinson 2008) cites a report by the Austrian regulator (Rundfunk & Telekom Regulierungs-GmbH 2007), which notes that household broadband penetration reached 41 percent by 2007. The figure Atkinson cites appears on page 41 of the report. Below the figure is a note that reads, "Breitbandpenetration bezeichnet das Verhältnis zwischen der Anzahl der Haushalte und der Anzahl der Breitbandanschlüsse.
"In der Gesamtanzahl der Breitbandanschlüsse sind auch jene enthalten, die in Unternehmen genutzt werden." This note translates to, "Broadband penetration refers to the ratio between the number of households and the number of broadband connections. In the total number of broadband connections those that are used in businesses are also included."
The previous page of the report notes, "Zu den Breitbandanschlüssen zählen hier Anbindungen über Kupferdoppelader im Netz der Telekom Austria, entbündelte Leitung, Koaxialkabel, FWA (Fixed Wireless Access, z.B.: W-LAN, WiFi, WLL solange es sich um „fixe" Zugänge und nicht um „Hot Spots" handelt) und sonstige Infrastruktur. Breitbandinternetzugänge über Mobilfunk (UMTS) sind in diesen Werten nicht enthalten." In English, "Counted in broadband connections are connections over copper wire pairs in the network of Telekom Austria, unbundled lines, coaxial cable, FWA (Fixed Wireless Access, eg: W-LAN, WiFi, WLL as long as it concerns "fixed" access and not "hot spots") and other infrastructure. Broadband Internet access via mobile phones (UMTS) is not included."

Atkinson further argues that evidence from Ireland also contradicts the E-Communications survey, pointing out that the Irish regulatory authority notes that about 30 percent of all households had broadband in the first quarter of 2007, while the E-Communications survey estimates 11 percent.[39] As in Austria, the regulator's household estimate include wireless broadband access (Ireland Commission for Communications Regulation 2007), while the E-Communications survey does not. More detailed data on the breakdown between wireless and wireline connections are available from Ireland's Central Statistics Office (2008) discussed above. One would expect a measure that includes wireless to be higher than a measure that does not.

## Nearly Any Broadband Count Will Face the OECD's Residential-Business Problem

Finally, Atkinson notes that Point Topic's data on broadband penetration are similar to the OECD's. Point Topic's data are similar because they collect data from operators and regulators, resulting in the same problem the OECD faces: an unknown mix of business and residential connections.[40] To estimate household penetration Point Topic appears to divide the reported number of connections by the number of households in a country (see appendix section for more details). As discussed above, this method cannot give an accurate estimate of household penetration.

In sum, Atkinson's (2008) arguments highlight the importance of paying careful attention to what, exactly, is measured and reported. Failure to pay close attention leads to incorrect conclusions and, potentially, to ineffective policies that move scarce resources away from more productive uses.

## Point Topic Counts Have the Same Problem as the OECD Counts

Point Topic is a market research firm that provides data on broadband around the world, with special emphasis on the U.K. According to the website, "Point Topic Ltd is a UK-based company founded in 1998. Our mission is to provide focused information on broadband communications services. Now the www.point-topic.com website is internationally recognised as one of the best sources on broadband. It provides subscribers with regularly updated online databases and reports about broadband services around the world. Summary information is available for free to any visitor to the site."[41]

Point Topic's broadband data are available by subscription, but the website WebSiteOptimization.com routinely publishes household penetration numbers for the top 25 countries as reported by Point Topic. These numbers, combined with estimates of the number of households in each country, allows us to estimate Point Topic's total broadband count. We can

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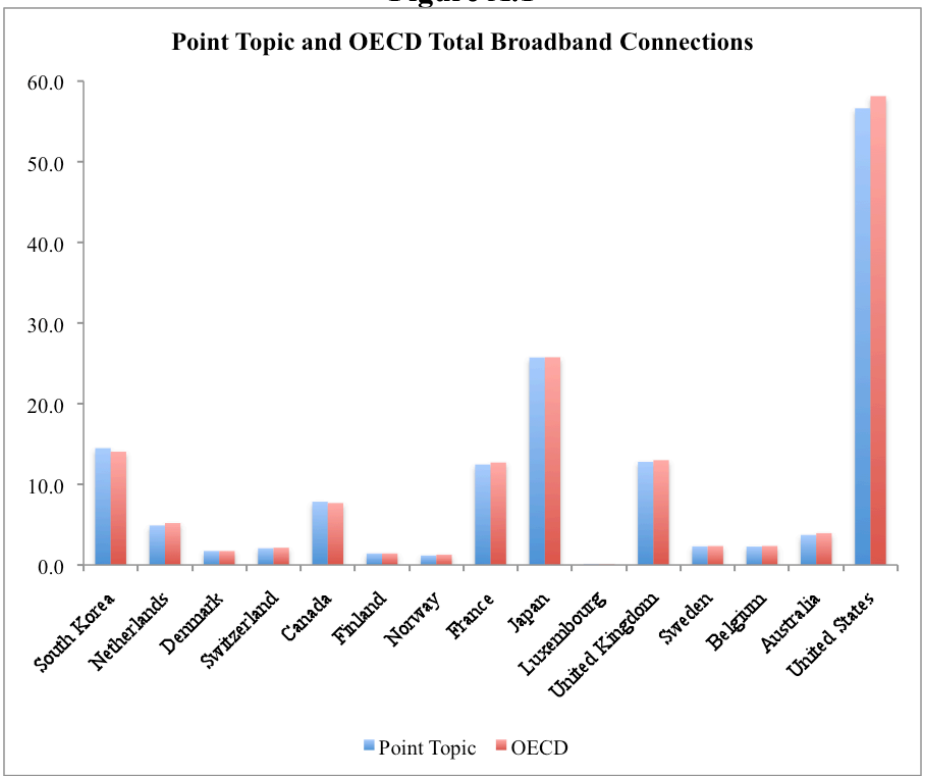
[39] See footnote 17 of Atkinson (2008).
[40] Point Topic notes on its website that it "Point Topic has a rolling research programme utilising well over 400 different sources per quarter for updating information on individual operators' and countries' broadband subscriber numbers" (http://point-topic.com/content/gbs/faq.htm#2).
[41] http://point-topic.com/content/about/default.htm Last accessed April 24, 2008.

then compare this number to the OECD estimate. Table A.1 shows the results. Figure A.1 shows this information graphically.

**Figure A.1**




The figure and the table show that the numbers are essentially identical, meaning that both sources mix business and residential. Both thus miss large numbers of business connections and it is not surprising that they show similar results.

**Table A.1**
**OECD and Derived Point Topic Broadband Totals**

| Country | Point Topic Q4 2006 Household Broadband Penetration (percent) | Total Number of Households (millions) | Point Topic estimate of total number of subscribers as implied by household penetration (millions) | OECD Broadband Subscribers Dec. 2006 (millions) | Point Topic Estimates as a Share of OECD Estimates (percent) |
|---|---|---|---|---|---|
| South Korea | 89.0 | 16.3 | 14.5 | 14.0 | -3.1 |
| Netherlands | 69.4 | 7.1 | 4.9 | 5.2 | 5.8 |
| Denmark | 69.3 | 2.5 | 1.7 | 1.7 | -0.2 |
| Switzerland | 66.5 | 3.1 | 2.1 | 2.1 | 3.1 |
| Canada | 63.0 | 12.4 | 7.8 | 7.7 | -2.1 |
| Finland | 59.7 | 2.4 | 1.4 | 1.4 | 0.2 |
| Norway | 59.7 | 2.0 | 1.2 | 1.3 | 8.4 |
| France | 55.5 | 22.4 | 12.5 | 12.7 | 1.9 |
| Japan | 54.1 | 47.5 | 25.7 | 25.8 | 0.1 |
| Luxembourg | 52.3 | 0.2 | 0.1 | 0.1 | 3.5 |
| United Kingdo | 52.3 | 24.5 | 12.8 | 13.0 | 1.6 |
| Sweden | 51.8 | 4.4 | 2.3 | 2.3 | 1.9 |
| Belgium | 51.7 | 4.4 | 2.3 | 2.4 | 3.3 |
| Australia | 50.2 | 7.4 | 3.7 | 3.9 | 5.7 |
| United States | 50.1 | 113.1 | 56.6 | 58.1 | 2.6 |
| Germany | 53.2 | 37.8 | 20.1 | 14.1 | -42.7 |

Note: Data for Germany appear to be reported incorrectly on WebSiteOptimization.com. The site reports 53.2 percent household penetration, but this estimate is inconsistent with all other data, including other Point Topic estimates. Point Topic reports on its website that as of June 2007, 39 percent of German households had broadband (http://point-topic.com/content/operatorSource/profiles2/germany-broadband-overview.htm). In addition, the German regulator reported 14.9 million broadband connections in use at the end of 2006 (http://www.bundesnetzagentur.de/media/archive/9506.pdf#search=%22haushalt%20breitband%22), while the Statistisches Bundesamt Deutschland reports 39.8 million households (http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Navigation/Statistiken/Bevoelkerung/Haushalte/Haushalte.psml), implying a 37 percent household penetration.

Sources:

Point Topic Q4 2006 household penetration estimates: http://www.websiteoptimization.com/bw/0704/

Number of households for most European countries: http://ec.europa.eu/information_society/policy/ecomm/doc/library/ext_studies/ecomm_household_study/eb07_finalrep

Number of households for Switzerland, Norway, Estonia: Eurostat (2001 estimates)

Number of households for Canada: Statistics Canada, http://www40.statcan.ca/l01/cst01/famil53a.htm?sdi=household 2006 data

Number of households for Japan: http://www.e-stat.go.jp/SG1/estat/GL36010101.do?_toGL36010101_

Number of households for Korea:www.ancsdaap.org/cencon2002/papers/Korea/Korea.PDF section 5.1

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