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Economics at the FCC, 2008-2009: Broadband and Merger Review

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Abstract:

Many issues have come before the Federal Communications Committee (FCC) in the last year. Some actions were taken (as with particular mergers), some actions were postponed (as with Universal Service Fund reform), and some issues are currently being tackled (the National Broadband Strategic Plan). In this paper, we focus on the topic of the National Broadband Plan, which the FCC is mandated to provide to Congress February 17, 2010, the FCC Merger Review process, and the determination of optimal penalties for violations of FCC rules or orders.

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I. Broadband

Congress, and more recently, the Obama administration have been particularly interested in the state of broadband in the United States. There is a strong sentiment that broadband availability, speed, and usage are crucial to continued U.S. growth, innovation, and welfare. There is also concern in some quarters, prompted in part by international broadband rankings computed by the OECD that the U.S. is falling behind other countries in the broadband race.[1] There are four main questions that need to be considered when determining broadband policy:

1. What is the current state of broadband deployment and adoption across the U.S.? The data to date are lacking, and it is difficult to determine if and where actions might be needed if we do not know exactly where there is a lack of broadband availability and adoption.

2. What are the economic and social impacts of broadband? Knowing the actual impact of broadband usage should guide policymakers on the potential benefits of any policy interventions relative to the costs of any particular programs.

3. What are our goals? Given the presence of multiple goals set forth by Congress, what are the priorities? Do we prioritize based on expected benefits or expected costs? Is intervention is necessary to achieve these goals? If so, then

4. How do we best to achieve these goals? (**What are the determinants of broadband deployment and adoption?)** Given what we know about drivers of deployment and

[1] There are good reasons to think that the OECD methodology does not accurately portray the progress of broadband deployment in the U.S. See Ford, Koutsky, and Spiwak (2007, 2008) and Wallsten (2008) for discussion.

adoption, what are likely to be the most fruitful interventions? Where are interventions going to have the greatest impact relative to its cost?

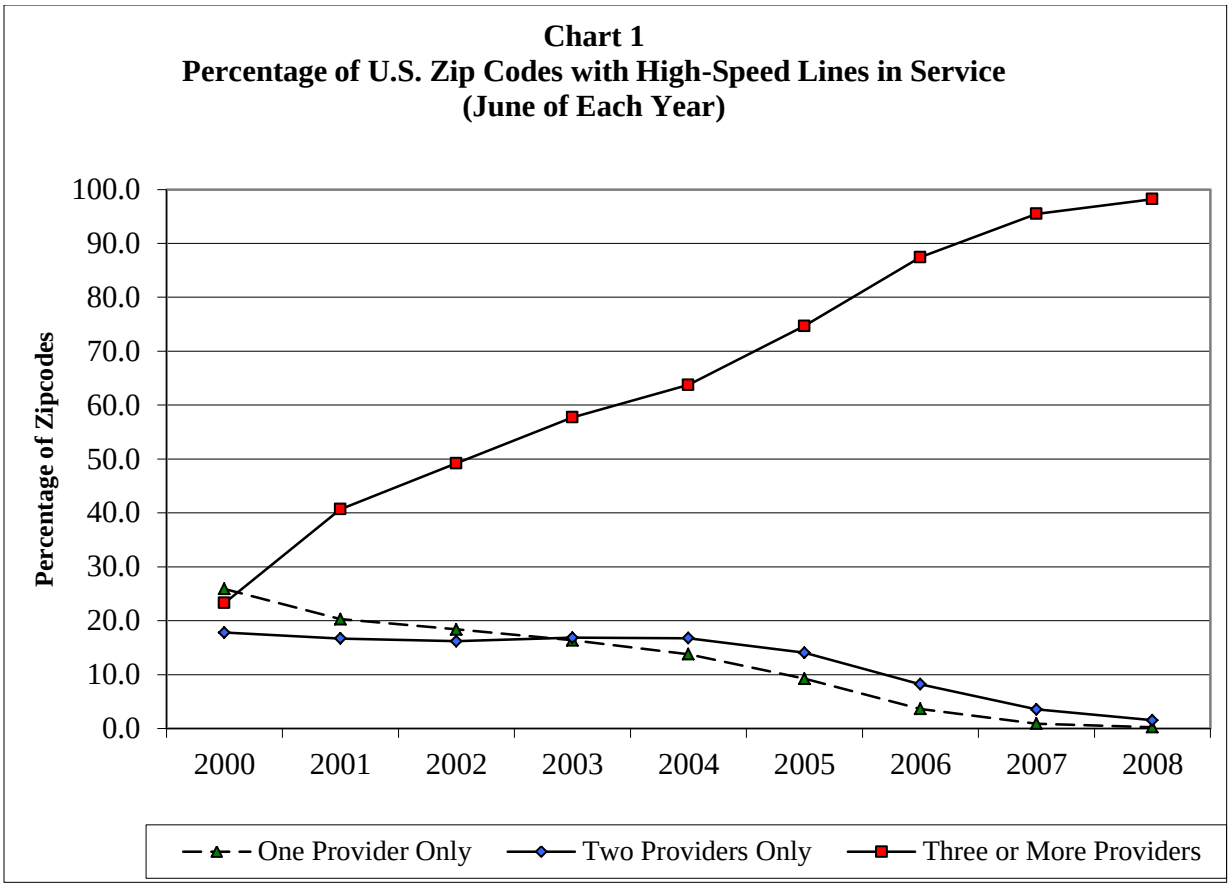
We discuss these four questions in turn.

1. What is the current state of broadband deployment and adoption across the U.S.?

According to Form 477 data collected by the FCC, as of June 2008, 100% of US zip codes have at least one broadband subscriber, where broadband service is defined as having maximum speeds of at least 200kbps in at least one direction. Moreover, 98.2% of all U.S. zip codes have three or more broadband providers with at least one broadband subscriber in them. Chart 1 shows the evolution of these statistics from 2000 to 2008.[2] We see a strong increase in numbers of providers present in at least a portion of a zip code over these last eight years. Does this mean that broadband is available everywhere in the U.S.? No. Since the old Form 477 only asked broadband providers if they have at least one subscriber in a zip code, and zip codes can be very large, the old Form 477 data are likely to overestimate the availability of broadband. Moreover, since the old Form 477 did not ask any information on total subscribers or on pricing, the data are not useful for estimating total demand for broadband.

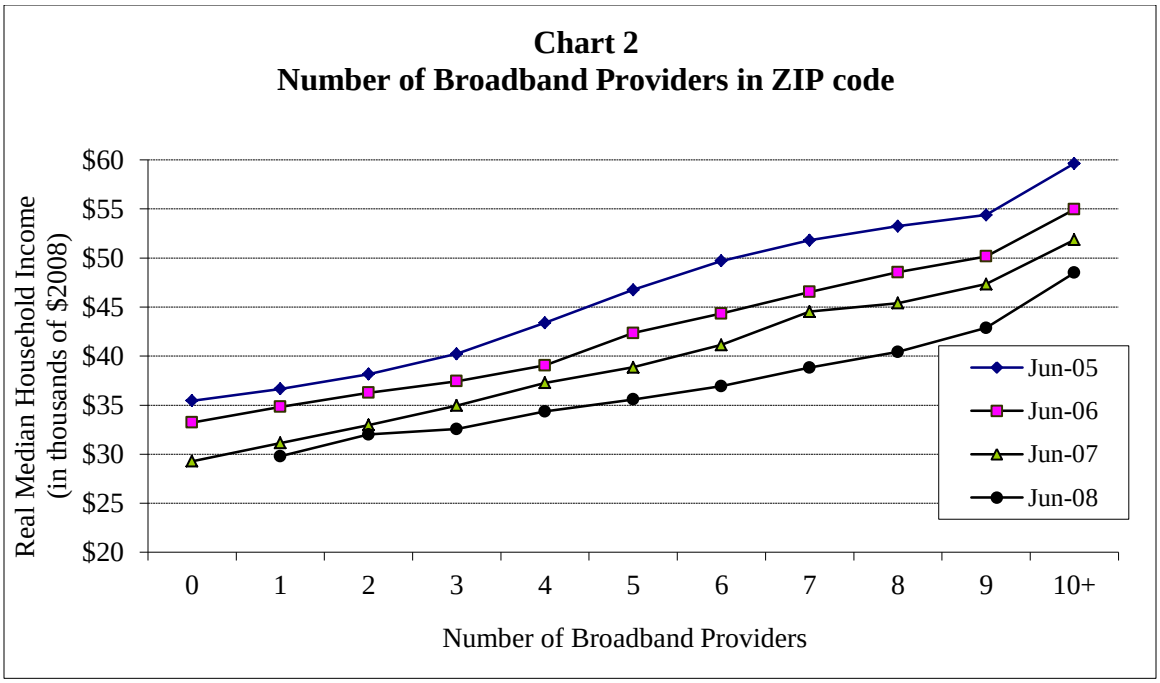
Still, in terms of historical data up to June of 2008, the old Form 477 data are the best national data that are available. And there are some things that we can learn using those data. Among the few advantages of the old data is the fact that since the form had been in use over a significant period of time, respondents were able to provide fairly accurate responses. Secondly, time series analysis of the data is possible.

[2] Table A1 in the Appendix shows the exact zip code percentages from 2000 to 2008 by number of high-speed providers.

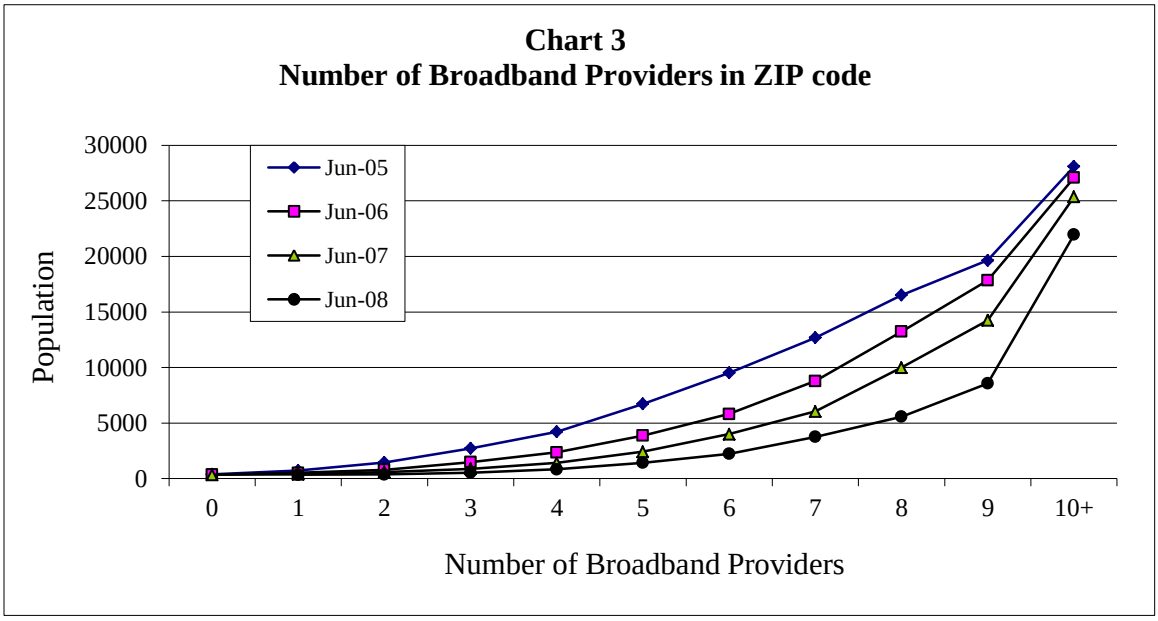


Source: FCC (2009). Until 2005, only providers with 250 or more lines per state were required to file.

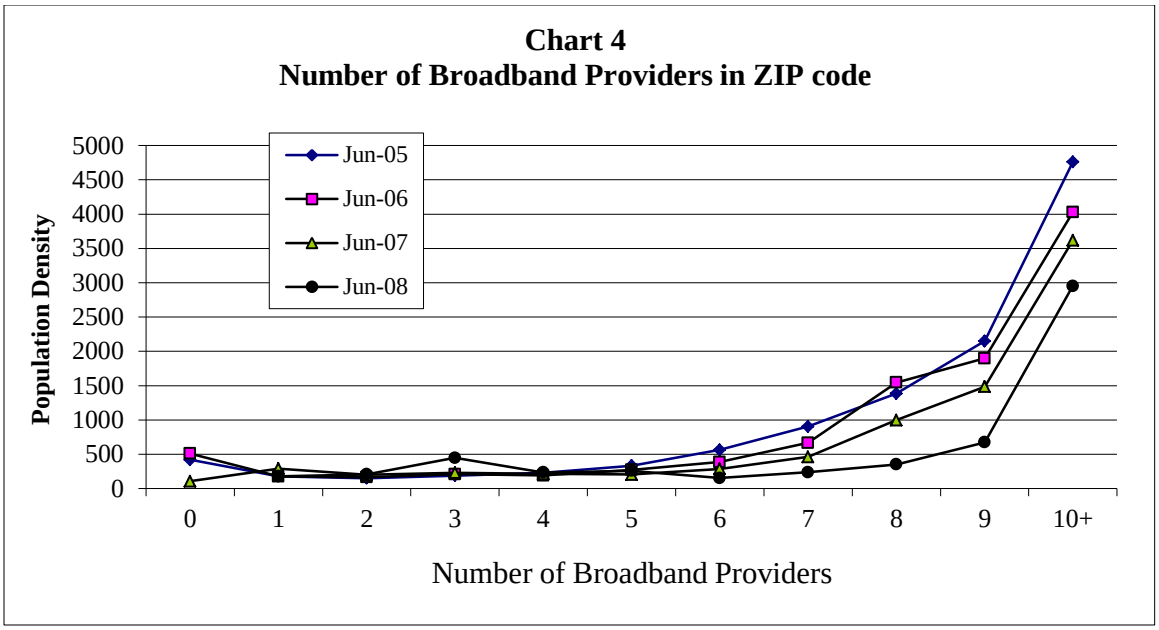
For example, Charts 2-4 present the old Form 477 data with respect to median household income, population, and population density, respectively. We see in these figures that for each annual cross-section more "desirable" zip codes have more broadband providers and thus have experienced more entry, as predicted by standard IO models such as Bresnahan and Reiss (1987). Zip codes with larger populations and higher incomes have greater expected total demand, and those with higher population density have lower deployment costs. Hence it is not surprising that such zip codes would experience both earlier entry and greater entry. The charts also suggest that the thresholds for entry in general are falling; the size of household income or population that is needed to encourage a given amount of entry has been falling over time.



Source: FCC Form 477.



Source: FCC Form 477



Source: FCC Form 477

In an attempt to improve the usefulness of the data being collected, in December 2008 the FCC began using a revised Form 477 questionnaire, which for simplicity we will refer to here as the new Form 477. Two of the more important changes in the new form are that it now asks for information at the level of the census tract which is a smaller geographic area than a zip code, and it asks for the total number of subscribers in a tract.[3] Both of these changes will yield more informative data and will give us a much improved sense of the actual amount of broadband penetration. The new form additionally asks information on the maximum speed offered to these subscribers.

These changes make the new Form 477 data far more informative and useful in any serious analysis of the broadband market. There are still however some limitations:

- The data are still based on subscribership, which is only a proxy for availability.

[3] The Census Bureau of the U.S. Department of Commerce originally delineates a census tract as a geographic area with an average of 4,000 individuals (approximately 1,500 housing units). Moreover, when first delineated these tracts are "designed to be homogeneous with respect to population characteristics, economic status, and living conditions." The geographic size of a census tract varies based on population density. Still, the largest a Census tract is allowed to be is a full county. Tracts usually have between 2,500 and 8,000 persons. "Census tract boundaries are delineated with the intention of being maintained over a long time so that statistical comparisons can be made from census to census. However, physical changes in street patterns caused by highway construction, new development, etc., may require occasional revisions; census tracts occasionally are split due to large population growth, or combined as a result of substantial population decline." http://www.census.gov/geo/www/cen_tract.html

- Census tracts can still be quite large in rural areas. Census blocks[4] are subdivisions of census tracts and would give more granular data. These block level data would not only be more useful for economic analysis, but would also be more informative for the National Telecommunications and Information Administration (NTIA) and the Rural Utilities Service (RUS) grant process.
- Initial passes at the first round data suggest that too many speed blocks have been included in the questionnaire. Combined with the fact that this question is new to the providers, the speed data appear at first pass to be rather unreliable.
- The newness of the questions in general means that it will take a few rounds before respondents become sufficiently familiar with the information being requested to organize their internal data and respond accurately.
- Form 477 still does not ask what prices subscribers are paying for their broadband services. Future consumer surveys (including that of the FCC) may ask this question, but with bundling, consumers are often uncertain what portion of their overall bill is for broadband service. Hence, asking the providers would yield more accurate pricing data.
- There is still no formal enforcement or penalties for firms who either do not provide data or provide clearly inaccurate data.

Given the previous lack of disaggregated data on the availability of broadband in the U. S., Congress passed the Broadband Data Improvement Act (47 U.S.C. 1301 note) in October 2008. This Act places requirements on several government offices and agencies. Here we focus on the three main requirements that fall under the purview of the FCC.

First, the FCC is required annually to compile information on unserved areas. The FCC must match this information with Census Bureau data to determine the population, population density, and average per capita income for these unserved areas. The act allows the FCC to determine how to define an unserved area. Second, the FCC must collect data on transmission speeds and prices of broadband service in a total of 75

[4] A census block is a subdivision of a census tract and is the smallest geographic unit for which the Census Bureau does 100 percent surveys, as opposed to sampling.

communities in at least 25 countries. Third, the FCC must conduct periodic consumer surveys of residential consumers, large businesses, and small businesses in urban, suburban, and rural areas. The surveys are being designed to collect information on

- The broadband technologies to which consumers subscribe.
- How much consumers pay for their subscriptions.
- The data transmission speeds of their subscriptions.
- The types of applications and services that consumers use most often that require broadband.
- Other locations or means of accessing broadband that are used regularly by consumers. [5]

As part of the American Recovery and Reinvestment Act of 2009, Congress passed the Broadband Technology Opportunities Program. In a later section we discuss the goals of the program. Here we simply want to mention that part of the Program is to require and fund a national mapping of broadband availability in the U.S.

2. What are the economic and social impacts of broadband?

There is a substantial amount of empirical evidence that suggests positive effects of information communication technology on labor productivity and on growth of per capital gross domestic product (GDP). More disaggregated studies suggest that these observed aggregate effects are specific to particular communities and industries. In other words, the observed positive effects of broadband appear to occur in particular industries and/or communities with specific traits and do not appear to lead to productivity and growth effects in other industries/communities. From the consumer side, gains are not region-specific, but are likely affected by network effects.

Review of Academic Literature on Broadband

[5] 122 Stat 4096, p. 2-3.

It is a widely held belief that access to broadband is crucial for individuals, firms, and nations. Beyond the general intuition that broadband matters, there is an existing literature that is relevant in the discussion of: 1) the importance of broadband to a nation's economy, 2) the effects of broadband on employment, 3) the linkage of these growth effects to specific geographic areas within a country, and 4) the value of broadband to consumers (Intern-based telephony, retail, gaming, entertainment, job searches, networking (social and professional), access to government services, etc.)

Aggregate Growth Effects of Broadband.

While we are inherently interested in the productivity effects of broadband, much of the existing literature has focused on information communications technology more generally. In part this is due to the fact that growth estimates need a reasonable number of years of data in order to separate trend growth effects from business cycle fluctuations. For example, Roller and Waverman (2001) consider the impact of telecommunications infrastructure investments on GDP growth in 21 OECD countries from 1970 to 1990. They find that one third of the per capita growth they measured during this time period could be attributed to telephony investments. Moreover, they find strong evidence of network externalities. When they separated countries into groups according to telephony penetration rates, those with currently high (greater than 40%) penetration rates gained the most from further investments. The marginal gains for these countries were more than twice that for countries with low- or mid-level penetration rates.[6]

Using a different methodology, Jorgenson (2001) estimates that information technology (IT) added 1.18% points to total GDP growth in the U.S. during the second half of the 1990s. This is particularly impressive given that at the time information technology assets were less than 5% of the capital stock. Jorgenson further estimates that in the second half of the 1990s, two-thirds of total factor productivity growth and approximately two-thirds of average labor productivity growth is attributable to a combination of IT capital deepening and IT productivity growth. Similarly, Oliner and Sichel (2000) estimate that IT contributed to 56% of labor productivity growth in the U.S.

[6] Waverman, Meschi, and Fuss (2005) find that for low income countries, 10 percent higher mobile phone penetration rates were associated with 0.59 percent higher growth.

from 1996 to 1999. Of particular interest is Stiroh's (2002) finding that IT-producing and IT-using industries were *fully* responsible for the large increase in U.S. aggregate productivity from 1995-2000 relative to the 1987-1995 period.[7]

Using more recent data, Jorgenson, Ho, and Stiroh (2008) estimate that Information Communications Technology (ICT) contributed to 59% of labor productivity growth from 1995 to 2000 and 38% of labor productivity growth from 2000 to 2006. Although the contribution of IT to further productivity growth does appear to be decreasing, it is nonetheless still substantial.

Employment Effects of broadband

Communities are particularly interested in the relationship between broadband availability and employment growth. There has been mixed evidence on this. Using the old Form 477 data, Gillett, Lehr, Osorio, and Sirbu (2006) find that communities with broadband in 1999 experienced faster job and firm growth from 1998-2002 and had higher rental rates in 2000 than did communities without broadband. Using the same data, Tolko (2008) also found positive correlations between broadband service and both employment and the number of establishments in California zip codes. However, Tolko found that the direction of causality may be from economic growth to broadband availability since the growth seems to have preceded broadband availability in California.

Industry- and/or Community-Specific Growth Effects of Broadband

More disaggregated data studies appear to reveal differences in the growth and productivity effects of broadband on different community types. A multitude of papers find a link between local skills, or types of work and workers, or intensity of ICT usage and positive gains from ICT.[8] This literature echoes work on skill-biased technological

[7] Other papers demonstrating positive effects of ICT include Brynjolfsson and Hitt (2003), Bloom, Sadun, and Van Reenen (2007), and Greenstein and Spiller (1995).

[8] Bresnahan, Brynjolfsson, and Hitt (2002), Autor (2001), Corali and Van Reenen (2001), Beaudry, Doms, and Lewis (2006), Kolko (1999, 2002), Autor, Levy, and Murnane (2003), Byrnjolffson and Yang (1997), Koellinger (2006), and Yildmaz and Dinc (2002). Jorgenson, Ho, Samuels, and Stiroh (2007) estimate that

change, whereby technological innovations that require skilled labor lead to increased wage gaps between skilled and unskilled labor.

Forman, Goldfarb, and Greenstein (2009) analyze the use of "advanced Internet technology" by businesses and wage growth from 1995 to 2000 by county in the U.S.[9] They find that the use of advanced Internet technology is only associated with wage growth in 180 counties that were, as of 1990, already well off in terms of income (top quartile), education (top quartile), population (over 100,000), and fraction of firms in IT-intensive industries (top quartile). There was no evidence of impact in rural areas. Hence, advanced Internet technology can explain only one percent of wage growth for the average county, but it does explain one quarter of the differences in wage growth between well-off counties and others. One insight of this paper that is particularly interesting is that the observed gains were not limited to counties with technology production agglomeration. Instead, high-skill counties must also have high population, income, and particular industry composition to gain from advanced Internet technology use.[10]

Value to Consumer

There are many ways in which broadband can be useful to consumers. Using Voice over Internet protocol (VOIP), broadband can be used as an alternative to traditional telephone services. Through the Internet, broadband can help with both social and professional networking. It is also a tremendously important source of information. This information can vary widely from news, to job postings, to information on hobbies. Increased information lowers search costs, and potentially leads to better matches in jobs,

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"… much of the post-2000 gains reflect faster TFP growth in industries that were the most intensive users of information technology."

[9] They define advanced Internet technology as "frontier applications such as e-commerce or e-business, as opposed to basic applications like e-mail or web browsing."

[10] Note also that this paper focuses on effects at the county level; hence, relative to papers on skill-biased technological change, this paper is not able to determine whether advanced Internet technology usage affects high- versus low-skilled occupations and cannot determine how wage distributions change within a given community.

goods, services, community activities, and dating.[11] Broadband increases the geographic market for goods and services.[12] It can also be used for gaming and entertainment.[13]

3. What are our goals?

The Congressional goals set forward in the Broadband Technology Opportunities Program (Title VI. Sec. 6001) are to:

- provide broadband access to unserved areas;
- improve broadband access to underserved areas;
- improve access and usage by public safety agencies; and
- increase broadband access, education, training, and support to:
    - schools, libraries, medical and healthcare providers, educational institutions and community organizations;
    - low-income, unemployed, aged, and otherwise vulnerable populations; and
    - strategically chosen facilities.

This program provides grants for broadband deployment through the NTIA and RUS, and mandates that the FCC create a National Broadband Plan by February 17, 2010. The primary goal of the plan is "… to ensure that all people of the United States have access to broadband capability and shall establish benchmarks for meeting that goal." The plan must focus on:

- ensuring availability to the entire population;
- achieving affordability and maximum adoption;
- assessment of both deployment and the progress of projects supported by program grants; and

[11] Forman, Ghose, and Goldfarb (2009).

[12] Arora and Gambardella (2005) and OECD (2006) examine lowered costs of retail shopping for isolated consumers and Stevenson (2006) studies job searches.

[13] Goolsbee and Klenow (2006) estimate large consumer welfare gains from the Internet, using wage data to proxy for the opportunity cost of people's time.

- using broadband to enhance "… consumer welfare, civic participation, public safety and homeland security, community development, health care delivery, energy independence and efficiency, education, worker training, private sector investment, entrepreneurial activity, job creation and economic growth, and other national purposes."

The FCC is currently working hard to create the National Broadband Plan. As part of that process, it has been holding numerous workshops (29 in total) on topics relevant to the plan and has created a website www.broadband.gov to facilitate communication with the FCC on broadband issues. The FCC has also issued a Notice of Inquiry to solicit comments on broadband issues.

Important Issues for the National Broadband Plan

Among the key difficulties in creating a National Broadband Plan are:

- Definitional issues:
    - **Should we define broadband based on speed? Latency? Applications?** This may seem to be a trivial question, but it is tremendously difficult since whatever definitions are chosen will affect which technologies might be considered as broadband or not. If some technologies are not considered as providing broadband, this will affect whether a region is deemed unserved or underserved. For example, if the definition has a minimum latency requirement, then satellite will not be able officially to provide broadband. Or if the definition of the minimum speed required to be considered broadband is sufficiently high, then mobile broadband might not qualify. Whatever the final definition, it will not only determine what technologies, but also, what regions might be able to qualify for any possible future grants/subsidies.
    - **Should we define unserved and underserved areas based on availability? Speed? Adoption/usage?** If the definition is based on

consumer usage rather than availability, then resources would need to be focused on demand factors over supply factors.

- Data limitations: Based on the old form 477 data, we have limited information as to the full availability of broadband in the nation. With the new form 477 data we will have much better data, but it is still at the somewhat aggregative level of census tracts (which can be extremely large in rural states), is still based on subscribership (and hence is only a proxy for availability) and is still sufficiently recent that the level of reporting errors are likely to be high. The FCC is gathering as much data as possible, from as many sources as possible. However, given the current state of available data, it is unlikely that the FCC will have full information as to the exact locations of all unserved and underserved areas before the February 2010 deadline for the National Broadband Plan.
- Choosing appropriate benchmarks: The plan will likely set certain goals. What these goals will be is still being determined. Whatever they turn out to be, they will need to have quantifiable benchmarks. This will then allow the FCC to measure any future progress towards the goals stated in the National Broadband Plan.
- Interventions: Deciding if and where government intervention might be needed, both on the deployment side and on the adoption side. The literature on the determinants of broadband penetration and broadband adoption is limited but can provide some guidance.
- Funding: The Universal Service Fund (USF) is already requiring over $8 billion in taxes every year. If this fund is to be used to provide support for broadband, will the FCC reform the current USF, or will it seek other sources of funding for any programs/initiatives/subsidies that it might suggest in the National Broadband Plan.
- Prioritization: Given the multiple goals that were put forth by Congress and also given the agency's limited resources, should the FCC prioritize areas that are underserved based on availability or based on adoption by consumers?

4. How do we best achieve these goals? What are the determinants of broadband deployment and adoption?

Given the goals of availability for the entire U.S. population, deployment is at issue. Given the goal of maximizing adoption, consumer demand is at issue. Existing literature on the determinants of broadband penetration and consumer demand are therefore relevant to policymakers when considering these goals.

Determinants of Broadband Penetration

Firm entry into a market is influenced by both demand and cost variables. On the demand side, income, market size and composition, commuting distance, age, gender, and education of population are among those shown to affect broadband penetration.[14] On the cost side, population density, the quality of existing telecommunications (including cable) infrastructure, fixed costs of deployment (affected by rural location, topography, etc.) are among the relevant cost determinants for broadband penetration.[15]

A few papers have analyzed competition, and as importantly, types of competition, as factors influencing overall broadband penetration. Studying 14 European countries in 2001, 2002, and 2004, Distaso, Lupi, and Manenti (2006) find that the number of access lines that had been upgraded to broadband depended primarily on intermodal/inter-platform competition. Similarly to Prieger and Lee (2008), they additionally find that lower unbundling prices for the local loop also increase broadband uptake (and the effect is greater when there is more inter-platform competition).[16] The key intuition from their paper is that while competition between DSL firms (through unbundling) can promote "…broadband diffusion, this effect seems to be completely

[14] Prieger and Hu (2008a) find that once income is controlled for, race does not appear to be a determinant in supply of broadband in the U.S.

[15] Prieger (2003), Prieger and Lee (2008), and Prieger and Hu (2008a).

[16] Prieger and Lee (2008) use the Form 477 data to show that areas with lower rates for unbundled network elements (UNEs) are correlated with more broadband availability. Although their results are statistically significant, the magnitudes of the effects are small.

overwhelmed by the negative 'indirect' effect of increased inter-platform concentration induced by promoting entry into the DSL segment of the market."[17]

Denni and Gruber (2006) examine FCC data from 1999-2004 and find that U.S. states with greater *inter*-platform competition have low initial availability of broadband, but have faster rate of penetration/diffusion (i.e., growth in subscribership/population). States with greater *intra*-platform competition (whether intra-cable or intra-DSL) showed higher initial levels of broadband subscribership but a slower rate of penetration. They found a similar result for States with a higher market share of "competitive local exchange carriers (CLECS).

Determinants of Broadband Adoption

On the demand side, factors such as education, income, age, networking opportunities, owning a computer, and price greatly influence adoption by individuals for whom broadband is available.[18] While many have focused on price as a key factor that drives (or impedes) adoption by consumers, it appears from several Pew Internet Project surveys that for the average individual who does not have broadband, price is not the primary deterrent. The most recent April 2009 Pew Internet Project Survey found that 63 percent of adult Americans use broadband and 7 percent use dial-up. The most common reason (cited by 50 percent of dial-up and non-internet users) for not using broadband was that the Internet was not relevant to them. Only 19 percent cited price. Seventeen percent said it was not available where they live, and 13 percent cited usability. The survey also found that certain demographic groups such as senior citizens, low-income Americans, and rural Americans had rapid growth in home broadband adoption from 2008 to 2009. However, African Americans experienced a second consecutive year of below-average growth in broadband adoption.[19] Prieger and Hu (2008b) have studied adoption rates and find that even controlling for income and education, race remains as a factor that affects demand for broadband services. They find that a lack of competition is an important factor for African Americans and service quality is an important general

[17] Distaso, Lupi, and Manenti (2006, p. 102).
[18] Flamm, Chaudhri, and Horrigan (2005), Flamm and Chaudhri (2007), and Prieger and Hu (2008b).
[19] Horrigan (2009).

determinant of demand, but particularly so for Hispanics. Social and professional network effects may also play a role for demand from specific demographic groups.

Broadband Conclusion

The existing broadband research suggests that the importance of broadband is real and quantifiable. The gains from broadband do not, however, appear to be evenly spread across firms, industries, regions, or individuals. Consequently, policies that target specific regions may not have the desired economic impacts if those regions do not have complementary characteristics. The value to individuals is perhaps harder to quantify, but is nonetheless significant. The goal of reaching the entire population is dependent not only on broadband availability but also on adoption on the part of the individual. Price does not appear to be the most important driver for a majority of those who do not currently have broadband, so other demand side factors will need to be considered in the National Broadband Plan if increased usage is a goal.

The goal of increasing availability focuses attention on a few areas, whereas the goal of increasing consumer demand is more geographically spread. Goolsbee (2001) proposes a model for the impact of different broadband subsidy types (consumer or investment subsidies) based on a consumer's willingness to pay for broadband. In his model, the presence of fixed costs for broadband deployment in unserved areas implies that subsidies to consumers will attract marginal users who do not greatly value broadband, whereas subsidies to investment in unserved markets would give access to new consumers who value broadband more highly.

This result echoes the Pew Survey findings: Half of consumers who do not currently have broadband at home state that the primary reason they don't is that they simply do not find broadband to be valuable to them. For low income households, price may be the primary deterrent. For those households, consumer subsidies could bring in users who might value broadband highly, but were previously simply unable to pay for it. Still the Pew Survey suggests that this is likely to hold for only 7% of the total U.S. population. Hence, blanket consumer subsidies would be wasteful. Targeted consumer subsidies, however, could potentially aid disadvantaged groups and help reduce the

digital divide. Prieger and Hu (2008)'s work suggests that even controlling for income, there are racial components that affect adoption by certain households that are not likely to be fully addressed through a price subsidy.

While Goolsbee's model makes a strong argument for favoring deployment in currently unserved areas first because of the presence of high valuation consumers, it does not take into account the potential impact of broadband on productivity, wages, and output growth. From that perspective, rural areas are the regions likely to have the smallest marginal gains in those dimensions from increases in broadband access. Hence, depending on whether the priority is on the economic performance of the aggregate economy, or on consumer welfare from the consumption of broadband services, the type of intervention and the geographic location of that intervention will differ. It will further be important for the National Broadband Plan to estimate the marginal cost of any potential interventions, as well as any possible marginal gains from those interventions. This is by no means an easy task.

One final complication, if intervention is deemed necessary, is the need to avoid costly and inefficient duplication of fixed costs of deployment in areas that really cannot support more than one provider. The experience of the exploding costs of the Universal Service Fund is a testament to that risk. It is for this reason that many have suggested using reverse auctions to determine any investment subsidies within a given market.

II. Merger Review

The Commission has overlapping authority with the federal antitrust agencies to review proposed mergers between telecommunications carriers. Most recent years have seen applications by wireless carriers wishing to merge, and the past year was no exception.[20] The FCC approved, subject to conditions, two large mergers of providers of mobile wireless services during the past year: one between Verizon Wireless and ALLTEL and another between Sprint Nextel and Clearwire. With each merger that is approved, the stakes are raised for the next, for there are only four terrestrial mobile telephony providers left with national footprints: AT&T, Sprint, T-Mobile, and Verizon.

The FCC has a broader purview than the antitrust agencies, since the Communications Act instructs it to determine whether the merger will "serve the public interest, convenience, and necessity" without defining these terms.[21] Thus, to draw an example from another industry that the FCC regulates, the Commission has freedom to consider the impact of media consolidation on diversity of both viewpoint and ownership. Even though the antitrust laws do not permit such grounds for seeking to block a merger. In the wireless mergers, the FCC interpreted the public interest to be served by increased wireless service footprints, expanded narrowband and broadband service offerings

[20] Recent large mergers reviewed and approved (with conditions) by the FCC include AT&T and Cingular (2004), Sprint and Nextel (2005), AT&T and Dobson (2007), and Verizon Wireless and RCC (2008).

[21] See 47 U.S.C. §§ 214(a), 310(d). Another difference between merger review at the FCC and the antitrust agencies is that while the U.S. Department of Justice (DoJ) must file suit to block a merger that otherwise will be consummated, at the FCC the applicants "bear the burden of proving, by a preponderance of the evidence, that the proposed transaction, on balance, will serve the public interest." See *Memorandum Opinion and Order and Declaratory Ruling*, Applications of Cellco Partnership d/b/a Verizon Wireless and Atlantis Holdings LLC for Consent to Transfer Control of Licenses, ("*Verizon-ALLTEL Order*") FCC 08-258, Federal Communications Commission, November 4, 2008, at 26, and *Memorandum Opinion and Order*, Sprint Nextel Corp. and Clearwire Corp. Applications for Consent to Transfer Control of Licenses, Leases, and Authorizations ("*Sprint-Clearwire Order*), FCC 08-259, Federal Communications Commission, November 4, 2008, at 19.

(particularly in rural areas), better service quality, lower costs (efficiencies), and more vigorous competition, and evaluated the proposed mergers along these dimensions.[22]

Nonetheless, a large part of each merger review at the FCC is similar to that done by the DoJ, which also reviews mergers between telecommunications carriers. Markets are defined, and then the competitive impacts of the merger are assessed with a market-by-market examination of post-merger pro forma HHI levels, pro forma increases in the HHI, and the amount of spectrum (a crucial input to provide service) that the combined entity would control. We discuss these in turn. In markets where post-merger concentration or ownership of spectrum is deemed too high, the companies are required to divest the assets of one of the firms. We discuss problems that arose with asset divestiture from a previous merger in Section III.

a. Market Definition

Market boundaries for wireless communications services need to be determined in both product and geographical space. In other recent wireless mergers, the FCC had defined the product market to be "mobile telephony services," which includes mobile voice and (narrowband) data services for residences and businesses.[23] The FCC declined to add wired telephony service to the market, arguing that insufficient evidence on wireless substitution exists to justify treating wired and wireless telephony as close substitutes. Satellite-based service was also excluded from the market definition, since satellite service prices are significantly higher than terrestrial mobile telephony and

[22] The FCC examined the implications of the merger for a host of other public interest issues, such as the ability to roam, exclusive contracts and handset availability, network openness, E911, and universal service. See *Verizon-ALLTEL Order*, section VIII, and *Sprint-Clearwire Order*, section VI.
[23] See, for example, *Verizon-RCC Order*, 23 FCC Rcd at 12483-84.

broadband services. However, for the new mergers, the product market was expanded to include mobile broadband service.[24]

It may appear odd to include broadband data and voice communication in the same product market, given that voice-only service is not likely to be a good substitute for broadband data transmission. However, the FCC chose not to define mobile broadband as a separate market, to avoid defining the rapidly evolving market too narrowly. If mobile broadband market shares had been separated for their own HHI calculation, the number of markets in which the merging firms had a monopoly or large degree of dominance would have been much larger than under the product market definition used. Calculation of HHI captures a snapshot of a market at a specific point in time (or an average of such points); given the rapid deployment of 3G and 4G networks, the fear was that defining the product markets too narrowly would "thwart [these] and future pro-competitive deals that take place in the context of rapidly evolving markets and services."[25] This is in accord with Gual (2003) and others who warn against defining emerging markets too narrowly, since doing so may interfere with innovation and longer-run economic efficiency.

Concerning geography, the FCC conducted analyses using both cellular market areas (CMAs)[26] and Component Economic Areas (CEAs),[27] as it had done for previous

[24] The Sprint-Clearwire merger was also evaluated with reference to the fixed broadband services product market.
[25] *Verizon-ALLTEL Order*, at 45.
[26] The FCC delineated CMAs when it first granted spectrum licenses for cellular telephony service in the 1980s.
[27] CEAs are defined by the U.S. Department of Commerce's Bureau of Economic Analysis, and are an aggregation of counties based on commuting flows and common newspaper readership. See Kenneth P. Johnson, *Redefinition of the BEA Economic Areas* http://www.csus.edu/indiv/j/jensena/sfp/ea_desc.htm.

mergers. The former market definition is more of a supply-side measure,[28] whereas CEAs capture areas with a high degree of economic integration, and thus reflect areas in which a consumer would want mobile service coverage.

b. Input market for spectrum

The FCC also examines the aggregate spectrum that the combined carriers would hold in each geographic market. Spectrum is a necessary input to offer wireless service. If insufficient spectrum is available for entrants or competitors of the merged company in an area, competitors may not be able to offer service on a scale that disciplines the prices of the dominant firm. Not all spectrum is suitable to offer mobile telephony and data services, due to the physical properties and available equipment technology at various frequencies. Also, licensing restrictions preclude the use of some bands for mobile telephony and broadband service. Thus, at the time of each merger the FCC must determine which bands it will include in the spectrum input market for its analysis. While much bandwidth can be included in this market without controversy (e.g., spectrum licensed for cellular and PCS use), other bands are less straightforward.[29] Verizon and ALLTEL argued that the AWS-1 and BRS/EBS bands should also be included in the spectrum input markets.[30] Sprint Nextel and Clearwire argued that the BRS/EBS bands should not be included. The applicants' differing positions reflect their differing portfolios of spectrum holdings. Verizon-ALLTEL hold little BRS/ESB

[28] The CMAs determined the geographic extent of the original cellular service licenses and thus defined the regions in which carriers could offer service. However, the initial license coverage has shaped the evolution of demand as well, by creating an area in which consumers face a (usually) consistent set of service choices. Later services, such as "personal communication services" (PCS), had licenses covering larger service areas.

[29] The relative non-controversial bands included in the market definition are the cellular, PCS, specialized mobile radio (SMR), and 700 MHz bands, which together amount to about 200 megahertz.

[30] The FCC designates different bands with names for purposes of licensing. AWS stands for Advanced Wireless Service, BRS is Broadband Radio Service, and EBS is Educational Broadband Service.

spectrum, thus reducing their "market share" if it is included, while Sprint-Clearwire held the lion's share of those bands in many areas. The AWS-1 band is in transition, being cleared of legacy (mostly non-mobile) governmental users so as to allow its use for commercial wireless broadband service. The BRS band is also in transition, with previous users transitioning to a new band plan, which will clear the band for wireless broadband use. The EBS band is licensed to educational users such as universities, who often lease their spectrum to commercial providers. The FCC decided to include the AWS-1 and part of the BRS bands in the input market, but not the EBS band.[31] However, only the amount of spectrum that has actually been cleared and is ready for commercial use in the AWS and BRS bands in a market was included in the analysis, which necessitated market-by-market scrutiny.

c. Competitive Analysis

The FCC has no bright-line thresholds that trigger the divestiture requirement in a market. Instead, a two-part screen is used to indicate which markets require closer competitive analysis. Such screening allows for much more efficient use of analytic resources available at the FCC, which is important given the large number of markets that are involved in mergers of major carriers. The idea behind the screens is that in a market where the merger applicants hold little spectrum and have little market share, the merger is unlikely to decrease significantly the competitiveness of the market, and it is not necessary to expend scarce staff time on (for example) determining exactly which areas within each market are served by the various competitors.[32]

[31] Included were the 45 megahertz of the AWS-1 band and 55.5 megahertz of contiguous BRS spectrum.
[32] Although licenses are awarded for geographic areas that are intended to be served as a complete market, license holders do not always build out to the maximum extent possible, or that may still be doing so at any

The initial screen is based on each market's HHI, and is a looser (i.e., allowing more post-merger concentration) screen than that suggested by the antitrust agencies' *Horizontal Merger Guidelines*.[33] To be marked for further review, a market must have a post-merger HHI of greater than 2,800 accompanied by an increase in HHI of no more than 100 points, or any post-merger HHI as long as HHI increases less than 250 points as a result of the merger. Note that the threshold of 2,800 is between the HHI of three and four firms with equal market shares but that the threshold of a 250 point increase would catch even a six-to-five merger.[34] Since the Sprint-Clearwire merger was for the purpose of creating a new fixed broadband service (WiMAX), and since there was little overlap in the broadband services already offered by the companies, the merger had virtually no immediate impact on HHI, and this first screen had no bite.

The second screen is based on spectrum holdings. The FCC totals the spectrum in which the applicants hold at least a 10 percent interest. If such aggregated spectrum is greater than approximately one-third of the total available in the market, the market is subjected to closer analysis.[35]

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given time consequently, market-level competition indicia may overstate the effective competition in some areas of the region.

[33] The *Horizontal Merger Guidelines* (sec. 1.51) set "general standards" that the following mergers "ordinarily require no further analysis": mergers resulting in post-merger HHI of less than 1000, or post-merger HHI between 1000 and 1800 when accompanied by increases in HHI of less than 100 points, or post-merger HHI above 1800 with increases in HHI of less than 50 points. See http://www.usDoJ.gov/atr/public/guidelines/horiz_book/hmg1.html .

[34] Such thresholds perhaps avoid penalizing the applicants for the outcomes of previous FCC decisions regarding mergers and spectrum allocation that allowed much concentration in many markets, while at the same time casting a finer net for increases in concentration due specifically to the merger. In previous orders the FCC had determined that even with a national HHI of over 2900 the mobile telephony market enjoys "generally effective competition". See the AT&T-Cingular merger order, *Memorandum Opinion & Order*, FCC 04-255, October 22, 2004, at 107.

[35] The precise threshold depended on whether AWS-1 and BRS spectrum was cleared and available for commercial use. In markets where neither was available the threshold was 95 megahertz, and where both were fully available it was 145 megahertz (with two intermediate levels in other markets).

In the Verizon-ALLTEL merger, 218 markets were caught by at least one of the initial screens based on HHIs and spectrum holdings. Before the FCC issued its final order on the merger, the applicants had already agreed with the DoJ to divest assets in 100 of these markets. The FCC analyzed the remaining 118 markets with multiple metrics to attempt to ascertain the incentive and ability of competitors and entrants to react to any attempts of the merged firm to exercise market power. Both unilateral and coordinated effects were considered in the choice of data to analyze. In addition to the statistics that were calculated for the screens, additional metrics included the number, service coverage, market share, and spectrum holdings of rival service providers, and the same for the subset of these that can offer national service.[36] Rather than following a decision rule based on some precise weighting or other transformation of these market characteristics, the FCC sought to "balance these factors on a market-specific basis, and consider the totality of the circumstances in each market."[37] In other words, the FCC in the end performed the quantitative analysis but allowed itself to judge the results qualitatively. Qualitative analysis, instead of blind adherence to rules based on static indicia, is recommended by Pleatsikas and Teece (2001) and others. We return to this issue below.

In nearly all of the markets so examined, the FCC found that there would be four or more established competitors with the capacity to respond to attempts by the merged carrier to raise prices. Ten markets were singled out for particular discussion in the *Verizon-ALLTEL Order*, and the FCC required divestitures in five of these. The divested

[36] Data for the calculation of market shares came from the National Resource Utilization Forecast database, which tracks phone number usage by all telecommunications services providers and thus measures the simple (head count) shares of subscribers, unweighted by revenue or minutes of use.
[37] *Verizon-ALLTEL order* at 91.

markets share the characteristic that the merger would have reduced the number of effective competitors (excluding those with little market share or ability to expand) to three or fewer, without an immediate prospect of large-scale entry. In the remaining five markets, although the number of current competitors immediately post-merger with nearly complete coverage of the market was less than four, in each case the incumbent rivals had enough capacity and coverage so that they would be able to respond to attempted dominance by the merged entity by expanding their market presence within a reasonable period of time. The FCC took seriously the notion that market analysis consists of more than merely counting firms currently in the market; potential entry played a prominent role in the analysis.

In the Sprint-Clearwire merger, 43 markets were caught by the spectrum screen, which triggered further analysis of those markets. However, the FCC concluded that it was highly unlikely that the merger would lead to competitive harm in any markets. The main factor underpinning this conclusion was that since Clearwire's service offerings were still in an emergent phase, and because there was little overlap between the current broadband offerings of Sprint-Nextel and Clearwire, the merger did not increase HHI in any market or reduce the number of competitors with sufficient network coverage. Furthermore, in the markets caught by the screen there were two-to-four other providers with adequate footprint and capacity to compete effectively with the merged entity, plus the presence of other licenses holders that represented significant potential entry in the future.

d. Economic issues and questions for research

The mergers suggest several areas in which more economic research would be helpful.

i. Market definition in dynamic markets

An open question for research is exactly what is the best *practical* way for a merger authority to define markets when technology, products, and tastes are quickly changing.[38] Traditional market definition analysis, based on whether a firm's price is constrained by existing competitors, can give a "seriously misleading picture of competitive relations"[39] in dynamic markets with rapidly developing technology. Teece and Coleman (1998), Evans and Schmalensee (2001), and Gual (2003) all advocate that in dynamic high-tech markets the boundaries between markets should be set by analyzing the degree of competition among technologies. These include potentially disruptive technologies (such as broadband) that may show little current demand cross-elasticity with more established services (such as voice service). That disruptive technologies can change the boundaries of competition and alter or even reverse the results of traditional merger analysis is formally demonstrated by Adner and Zemsky (2005).

Pleatsikas and Teece (2001) warn in particular against defining markets too narrowly and point out that implementing a standard SSNIP test[40] to define a market is problematic when technology is rapidly changing, for in such markets customers often care most about the rate of change in the price-to-performance ratio, rather than in the price level alone. In other words, firms in such markets compete on increasing

[38] Gual (2003) tackles the issue of market definition in telecommunications markets directly.
[39] Evans and Schmalensee (2001), p.20.
[40] A Small but Significant and Non-transitory Increase in Price (SSNIP) test asks whether a hypothetical monopolist could profitably impose a small increase in price. If sufficient numbers of buyers would switch to alternative products or to suppliers at other locations such that the price increase is unprofitable, then the market definition must be expanded to include at least some of those substitute products or locations.

functionality just as much (and perhaps more so) as on price. Pleatsikas and Teece (2001) argue that since mechanistic application of market definition rules (such as SSNIP) in high technology industries will inevitably lead to overly narrow markets, qualitative approaches should be pursued instead. They suggest examining the level of innovative and competitive effort expended by firms to assess the competitiveness of a market. Similarly, Evans and Schmalensee (2001) caution that the analysis of market power in high-tech markets "cannot be a simple exercise in drawing boundaries and computing shares", but instead must consist of looking for potential innovative competitors and future races for dominance in a market.

Thus, a consistent theme in the literature is that push-button application of static market analysis should be traded for qualitative approaches involving more exercise of the regulator's judgment. The FCC has followed that course to a certain extent. However, it is unclear exactly how such notions should be operationalized to the numerous, relatively small geographic markets that must be analyzed in telecommunications mergers. For example, there is no feasible way to assess the level of competitive effort among competing technologies *in a particular geographic market*.

The above discussion leads naturally to Gual's (2003) call for a "broad view" of potential suppliers, including all of those that own assets (perhaps yet undeveloped) that could be used to create substitute services. The most apparent such asset is spectrum, but other such assets would include technological and marketing capabilities, which are less amenable to quantification. Further work on how to operationalize a qualitative approach to merger analysis would be extremely helpful.

ii. Input markets for spectrum

There are a number of issues that warrant further analysis regarding the spectrum screen.[41] Given that any indicia for a market reflect conditions a specific point in time, what are good rules for when spectrum should be deemed available for use? For example, if certain bands are slated to be clear of legacy government users in one month, it would seem appropriate to include that spectrum in the denominator when calculating the fraction of spectrum that is controlled by the merging firms. But what if the spectrum will not be cleared for a year? Where should the horizon be set? Authors such as Gual (2003) contend that when technology is rapidly changing, longer horizons to assess the potential response of competitive suppliers are appropriate. Or more fundamentally, should anticipated new spectrum supply be included under any circumstances, given that the FCC does not have any spectrum caps on total ownership in place to prevent the merged entity from buying the licenses when they become available?

Several commenting parties also raised the issue of whether, since not all spectrum is equally suitable for particular purposes, spectrum of different wavelengths should be weighted differently in a spectrum screen.[42] The FCC has not done so to date, although Commissioner Michael Copps (who was later the interim chairman after Chairman Kevin Martin stepped down on inauguration day and before Julius Genakowsky assumed the chair on June 29, 2009) stated that he favored a proceeding to "establish appropriate rules for valuing the relative desirability of different spectrum."[43]

However, in such cases it is not clear that if (for example) spectrum at frequency *x* allows the offering of twice as much service capacity (however measured) than does

[41] Several commenters, including some academic economists filing white papers for interested parties, took aim at the details and even the fundamental rationale for the spectrum screen. See, for example, Katz (2008).
[42] See, for example, the comments filed by Leap Wireless in the Verizon-ALLTEL merger proceeding.
[43] *Sprint-Clearwire Order*, p. 59.

frequency *y*, *ceteris paribus*, that *x* should be weighted as equal to twice *y* in a spectrum screen. The extent to which spectrum is substitutable with other inputs matters. Engineers can design networks that use spectrum more or less intensely in an area, based on the size of the cells and other factors. Thus, to at least some extent less suitable spectrum can be paired with higher amounts of other inputs to offer service that is similar to that in another area where so-called "beachfront" (i.e, highly efficient for the intended purpose) spectrum is available. Perhaps weighting the latter spectrum more is appropriate if the ultimate cost of offering service is lower. However, given that the value of the spectrum license is derived from the profits from the services it enables, one would expect that less suitable spectrum would have a lower opportunity cost of use. If spectrum were completely fungible and an efficient secondary market existed for trading licenses, then one would expect that the user cost of spectrum would fully adjust to account for quality differences. A lower user cost for lower quality spectrum levels the playing field at least somewhat. However, to the extent that the spectrum license resale market is not perfectly competitive, research is warranted to further explore the issues.

There are further issues regarding the spectrum screen: Two such issues are where the ownership threshold should be set, and exactly which spectrum should be included. Current practice assumes that spectrum can be controlled by a carrier if it owns as little as a 10 percent interest in the license. Can economic theory, drawn from the fields of contract and bargaining theory, or perhaps from the theories of joint ventures, cooperative behavior, property rights, and ownership structure, or even common property markets, suggest whether this is the appropriate threshold? An even more technical issue involves the treatment of guard bands in the spectrum screen. A guard bands is a span of

spectrum frequencies that is set aside as the electromagnetic equivalent of a demilitarized zone, to avoid interference between transmissions on either side of the band. Guard bands are not included in the amount of spectrum available or owned in a market in the screen, which appears reasonable enough at first look. However, if the same carrier holds the spectrum on both sides of the guard band, nothing (legally) prevents it from combining the guard band with its use of the other spectrum. Further research would be useful here to ascertain whether carriers are using spectrum in the guard bands in such cases or whether there are technological reasons why the carriers would choose to leave the guard bands intact.

iii. Competitive analysis

When the market is incorrectly defined, as discussed in Section 3.d.i, then any subsequent analysis of HHI may be meaningless. Even if markets are defined appropriately, however, competitive analysis based on HHI raises other issues.

Exactly how should HHI be calculated? As described above, the FCC calculates market shares as the fraction of lines served. Given that consumers of mobile telecommunications and broadband service buy not only access but also usage, it is not clear that the share of access lines alone best captures how dominant a particular carrier is in a market. Some commenting parties suggested weighting line counts by revenue or minutes of usage. Would the benefits of gathering data on revenue, usage minutes, or megabytes of data transmitted (in the case of mobile broadband) in improving the competitive analysis outweigh the costs to the firms of providing the data? Unless the customer profiles of carriers in a market differ widely (for example, firm A serves many but low-volume residential users and firm B serves few but high-volume business

accounts), we suspect that the costs to the firms of supplying the data make the endeavor not socially beneficial, especially since part of the data gathering burden falls on other firms in the industry apart from the merger applicants.

The question of what measure of market share should be used to analyze mergers is a standard issue for antitrust enforcement, of course. In principle, we seek the measure that best indicates the likelihood of coordinated effects among the firms. The best such measure may vary from industry to industry, and it may be important to consider what measures industry participants use when they monitor each other.[44] Given that the wireless carriers are likely not to have good estimates of their competitor's revenue or minutes of usage at the local market level, perhaps it would make less sense to base the HHI calculations on those measures than on subscriber counts. Additional research on identifying when such additional data would be most likely to lead to a different outcome for the competitive analysis would be helpful.

The coincidence of the two merger applications raises another issue: Both mergers were analyzed at the same time, but each competitive market analysis used existing market and spectrum shares, which is tantamount to assuming that the "other" merger would not take place. Given that legally each merger was to be evaluated on its own merits, this is an understandable procedure. However, an interesting question arises when evaluating simultaneous mergers: It is possible to imagine an outcome where merger A would be approved in the absence of merger B but not if merger B were treated as a *fait accompli* in the market analysis, and vice versa. In such cases, should the regulatory decision rest merely on which application was filed a few days earlier? Or should the regulator or antitrust authority undertake a more complete investigation than

[44] We thank the editor for raising this point.

usual, to determine not only if a merger would result in consumer harm but also to learn which merger will benefit consumers *more*? We hasten to add that although the Sprint-Clearwire and Verizon-ALLTEL mergers were not analyzed conditionally upon the other merger's being approved, it most likely would not have changed the conclusions if they were, given the largely complementary nature of Sprint Nextel's and Clearwire's pre-merger service offerings.

III. The AT&T/Dobson Case and Optimal Penalties

One recurring task at the FCC is the determination of penalties to be assessed for violations of the Commissions rules or orders by a regulated firm. Most of these violations are instances of relatively common violations (e.g., the marketing of an unauthorized wireless device or broadcasting outside of the parameters of a radio station's license), raise no new issues, and can be penalized readily with reference to previous cases. However, at times violations become known that are novel in the economic or legal issues they raise. One example is the penalty assessed against AT&T for violations of conditions attached to the merger of AT&T and Dobson Communications, a wireless service provider.[45] In this case, AT&T was accused of targeting former Dobson customers in certain markets with account acquisition practices that violated the carrier's consent decree with the FCC. The case raises the interesting question of what an appropriate penalty should be for such violations of a regulator's orders, and how a theoretically optimal penalty can be determined practically.

e. Background

[45] See *Order and Consent Decree in the Matter of AT&T Inc.*, DA-09-26, Federal Communications Commission, January 14, 2009.

Due to concerns about the competitiveness of certain markets after the merger, before approving the merger in 2007 the FCC required divestiture of Dobson's assets in four wireless service markets in Kentucky, Oklahoma, and Texas. AT&T already had a significant market presence in each of these markets. A trustee was appointed to manage the divested assets until buyers were found. While AT&T retained temporary ownership of the former Dobson assets until sale, the trustee was directed to employ the assets to run an independent business that would compete against AT&T and other carriers in the markets. AT&T was supposed to protect the confidentiality of all operating and marketing information related to the divested assets. However, in March 2008 the FCC received allegations that employees of AT&T accessed confidential customer sales files (which typically include information such as pricing and contract renewal dates) and used the data to try to win former Dobson customers over to AT&T in the divested markets.[46] The case, pursued by the Enforcement Bureau at the FCC, concluded with a consent decree, under which AT&T agrees to pay a penalty of $2.38M but admits no wrong-doing and the FCC drops further inquiry into the case.[47] The penalty was the third largest assessed during July 2008-June 2009.

This case raises two interesting economic issues. First, what principles should guide the determination of penalties? Second, how can the theoretical notions practically be applied? With no claim that that the following discussion reflects how the penalty was actually determined, we use the case at hand to illustrate these two issues.

[46] Knowing a potential customer's past usage data and contract terms would enable a sales person to tailor a service offering designed specifically to win the customer to AT&T. Knowing when a contract was ending would further allow the sales staff to target the customer at the time of contract renewal, when it would be most likely to switch carriers. Presumably the activity was directed at high-volume business accounts, which gain the most revenue for wireless carriers.

[47] Since the DOJ also approved the merger, subject to divestiture of three of the same four markets the FCC required, the DOJ undertook a parallel investigation, which also resulted in a consent decree and fine.

f. The Economics of Optimal Penalties

Polinsky and Shavell (1998) set out the economic fundamentals of optimal penalties when a firm engages in illegal activity. On the assumption that the goal of penalizing the firm is deterrence (i.e., to provide incentives to the offending firm not to repeat and to other firms not to engage in the illegal activity), optimal penalties align the private incentives of a potential perpetrator with the social incentives. If punishment is certain, then the optimally deterring penalty is equal to the harm that the act creates for the rest of society. When it is not certain that punishment will follow an illegal act, because (for example) detection is uncertain, the optimally deterring penalty is marked up to restore incentives in expected value.

The harm from the action is measured as its external cost, net of any benefits, imposed on the economy. The external cost excludes the private costs and benefits of the perpetrator, which the firm already takes into account when making its decisions and which need not be included in the penalty.[48] The following relationship makes this notion definite:

$$\text{Harm} = -(\Delta PS_R + \Delta CS) + H \qquad (1)$$

where Δ means "change in" caused by perpetration of the act, PS_R is the producer surplus of the potentially offending firm's rivals, CS is consumer surplus in the affected markets, and H includes any other harms to social welfare that can be quantified. With the penalty thus defined, the firm faces the socially appropriate price of committing the illegal act. If the penalty is smaller than the amount of the harm, then the price of transgression is too low, and the firm will commit the act in some cases when (from the standpoint of the

[48] This is in contrast to 47 C.F.R. sec. 1.80, which lists "substantial economic gain" to the perpetrator as one of the "upward adjustment criteria" for FCC penalties (see section II of note to paragraph (b)(4) therein).

social calculus) it should not. In cases where firms can take costly internal measures to prevent illegal conduct, efficiency also requires not setting overly large penalties. An inefficiently high penalty causes the firm to overinvest in avoidance.[49] In summary: an optimally deterring penalty aligns the firm's private calculus with the social consequences of the transgression and gives firms the correct incentives for preventive behavior.

When punishment is uncertain, the optimal penalty is set so that the perpetrating firm will pay on average for the harm it causes.[50] When the chance of discovery and assessment of a penalty is low, the penalty must be set higher to ensure that the firm's *expected* penalty cost equals the harm. Marking up (1) to account for the probability of detection and punishment, *p*, accomplishes this goal:

$$\text{Optimal penalty} = \text{Harm}/p. \qquad (2)$$

g. Practical implementation of optimal penalties

Discussing the theory in light of the alleged AT&T infractions illuminates both the promise and difficulties of practical implementation. We emphasize again that the following exercise is meant to illustrate the economic approach to penalizing the firm, and does not necessarily reflect the Commission's reasoning, which was not released.

The first practical problem with the economic approach is that it is counterintuitive to the way some regulatory officials, who are typically trained as lawyers, think about penalties. Notable by its absence in the optimal penalty is the appropriation of illicitly gained profit. The profit accruing to the firm from the transgression does not appear in the penalty; because it is a private benefit, the firm

[49] If there is no cost to the firm of deciding not to transgress (i.e., the firm can ensure that no transgression occurs without using any resources), then an overly large penalty bears no welfare cost.
[50] This discussion presumes the firm is risk neutral.

already included it in its calculations. This neatly sidesteps the difficult question of calculating the illicitly gained profit of the firm. However, in such a case a lawyer may think first of the doctrine of unjust enrichment and seek to penalize the firm to remove any advantage gained by its illicit actions. This may reflect an underlying difference in goals, where punishment is sought instead of deterrence. Economists may have little guidance to give on the subject of punishment for its own sake, divorced from the goal of deterrence, since by definition such punishment is the repayment of a sunk social cost and does not affect any economic agent's future decisions.

If deterrence is the goal and the economic approach is to be followed, then the next steps are to answer the following questions to determine the social harm and arrive at an optimal penalty for AT&T in this case:

1. What is the impact on the rival's profits from AT&T's actions?
2. What is the impact on consumer welfare?
3. What is the probability of discovery and penalty?

We address these in turn.

i. The impact on the rival's profits

Although the precise nature of allegations were not released, from the information in the consent decree it is reasonable to assume that employees of AT&T tried to "poach" customers from the former Dobson accounts by making use of account data that were off-limits after divestiture.[51] Hereafter we call the alleged victim "TrustCo" as shorthand for the business concern that was using the divested assets, managed by the trustee, intended to be sold to another wireless carrier.

[51] For example, knowing the details of a legacy Dobson contract with a subscriber, including when it was up for renewal, would enable AT&T salespeople to craft customized marketing pitches to induce high-volume customers (such as business accounts) to switch to AT&T.

To know the impact on TrustCo's profit we must begin with determining how many customers AT&T poached. One could proceed with a criminal investigative approach: The evidence in the case can be examined to determine how many clear and convincing episodes of illegal customer poaching there were. The obvious defect in this approach is that probably only the tip of the iceberg is visible, and many cases of poaching may remain undiscovered.

An econometric approach is an alternative. Since AT&T and Dobson competed before the merger and divestiture in these markets, the pre- and post-merger competitive environments may not be dissimilar in the short run. In particular, both before and after the merger, in the markets at issue AT&T competed against Dobson (pre-merger) or TrustCo (post-merger) for the same group of customers. Thus, holding other factors affecting churn constant, the pre-merger period could be used to establish an estimated number of customers that under normal circumstances the rival would have expected to lose to AT&T.

The key data needed for such a calculation are the churn rates between the two companies in the affected markets, and perhaps also for other companies in these markets to use as controls, for a period spanning the onset of the illicit behavior. Such data can be requested from the carriers as part of the investigation or gleaned from industry databases.[52] If we only compare the average number of lines porting from Dobson to AT&T before and after the merger, then we cannot control for general market trends that have nothing to do with the transgression. A better approach would make use of the

[52] The Commission has data from NeuStar's local number portability database that records how many wireless numbers are ported from one carrier to another ("number ports") in each market every month. Number ports are a good proxy for the number of customers switching carriers. Although a count of ports does not include customers who want a new phone number when they switch, the approximation is likely to be good for business customers, who likely wish to keep their existing phone numbers.

technique of differences in differences (D-D). In a D-D approach, the change over time in porting to AT&T is compared between Dobson and other carriers. The D-D estimate of poaching is the change in the amount of porting from Dobson/TrustCo after the merger, net of the similar change for the other carriers in the same markets. Thus, the effects of common trends affecting all carriers equally over time are removed.[53]

The next step is to place a welfare value on a line poached. An ideal approach would require knowing TrustCo's incremental cost and revenue of serving each poached customer. Lacking such data, a proxy for the average incremental profit gained from each line can be constructed as follows. Dobson's service revenue (excluding roaming revenue) per subscriber at the time was $52.54.[54] Dobson's "network and other operating costs" per customer per month is $14.08.[55] These costs do not include marketing and advertising, which are not subscriber-specific. They may not include all subscriber-specific incremental costs, however, because they lead to a relatively high difference of $38.46 as a proxy for marginal profit per subscriber-month. Another estimate is $29.35, taken from "operating cash flow before marketing" (based on EBITDA).[56] The midpoint between these two estimates, $34, can be taken as a compromise proxy for incremental per-line profit. The proxy is necessarily rough, because the incremental economic profit of a poached line will not exactly match these estimates of accounting profits for an average line.

[53] When the scale of porting differs widely among carriers, the dependent variable can either be expressed in percentage terms or a Poisson regression with adjustment for exposure can be used to account for different number of accounts "at risk" for porting. See Winkelmann (2008), sec. 3.1.5, on the Poisson approach.
[54] UBS Investment Research, *US Wireless 411*, 3 June 2008, p.30. Figure is for 3Q2007.
[55] Dobson Communications Corp., SEC Form 10-Q, dated September 30, 2007, filed with the SEC November 9, 2007. Taken from Lexis-Nexis Academic Universe. Figure is for 3Q2007.
[56] UBS Investment Research, op. cit., p.46. Figure is for 3Q2007

Given a value of $34 per line per month to TrustCo, the approximate expected present value of losing the customer is the present value of the monthly incremental profit received until month *T*, where *T* is the remaining lifetime of a typical Dobson customer. For *T*, we calculate the lifetime of a typical Dobson customer to be the reciprocal of the churn rate (2.6%/month), which is 38.5 months.[57] However, on average the customer would have been through half of its life already,[58] and so we set $T = 19$. The approximate present value of a lost subscriber line is therefore $620.38. The present value calculation assumes a discount factor of 6.3%, taken from the rate on bonds that AT&T issued in December 2007.[59] Multiplying the per-line amount by the D-D estimate of lines poached yields a present value estimate of ΔPS_R.

ii. The impact on consumer welfare.

The other major component of harm comes from reductions in consumer surplus. Note that revealed preference arguments suggest that consumer surplus is *increased* by the illegal activity, at least in the short run.[60] If the high-volume business customers likely to be targeted for poaching are well-informed about their options for wireless service, then if they switched to AT&T from TrustCo it was because it was in their interest to do so. Apparently, the prices, perceived service quality, or terms of contract

[57] Dobson's churn rate is for post-paid subscribers, and is from their SEC Form 10-Q, op. cit. Using the reciprocal of the churn rate to estimate total subscriber lifetime is done in UBS Investment Research, op. cit., and is theoretically justified by appealing to the exponential lifetime distribution (for which expected lifetime is the reciprocal of the hazard rate).

[58] Again, we assume an exponential lifetime distribution for simplicity.

[59] One could alternatively use some estimate of a social discount rate.

[60] There may be longer-term considerations regarding consumer surplus, as in the case of predatory pricing theory: Although business customers benefit now from AT&T's lower prices, they will have to pay higher prices in the future if the firm's actions lessen competition in the market. To the extent that any such harm happens, it is necessarily in the future, and its present value may be small. There may be other factors that invalidate the revealed preference argument even in the short term, such as principal-agent problems or inefficient procurement policies within the customer's firm.

were more attractive than what they had before. We thus would need to subtract these consumers' gains from the social harm, and therefore from the penalty.

In the absence of sufficient data to estimate a complete demand system for wireless services by these customers, the size of the benefits gained by subscribers from switching must be approximated. In principle, as long as the minutes of use do not change much after the switch to AT&T, the approximate change in consumer surplus is the difference between the revenue the customer paid to TrustCo and the revenue paid to AT&T after switching. This approximation will be more inaccurate when the minutes of use changes after the switch are greater.

We have no data on the revenue of customers who switched carriers, and looking at differences between (pre-merger) Dobson and AT&T in the average revenue gained from business customers is likely to reflect mainly differences in the composition of business customers served by the two carriers. However, given that the consumer surplus of a poached customer is not being entirely destroyed, unlike the total loss of profit to TrustCo from a poached account, we expect that ΔCS is of only second order importance compared to ΔPS_R in (1).[61]

iii. The impact on other aspects of social welfare

Another factor in social welfare that is possibly affected by the transgression is the devaluation of the licenses and assets held by TrustCo that were to be sold. If potential buyers of the licenses recognize that an appropriate scheme of optimal penalties is in place, much of the market value of the license will be restored. Furthermore, to the

[61] Another component of social welfare perhaps affected by the transgression may come from any devaluation of the licenses and assets held by TrustCo that were to be sold. To the extent that the license and assets derive their value from the flow of profits that they enable, there is no need to add any devaluation into the harm calculation, because the lost profit of the rival has already been priced into the penalty.

extent that the license does drop in value, it is because of the lost profit of the rival, which has already been priced into the penalty.

iv. What is the probability of discovery and penalty?

The final piece of information required to calculate the optimal penalty is the probability that AT&T is penalized. The quantity we seek is the probability *per act*, so that a penalty per act can be determined. Since it is natural to think that upon discovery, AT&T knew with certainty that it would face specific consequences from the FCC, the question simplifies to: What was the probability that AT&T's illegal customer acquisitions would be discovered?[62] While the precise determination of quantity p in equation (2) is impossible to achieve, an estimate can be constructed from the details of the case. The longer that the illegal activity went on and the larger was the number of customers illegally acquired before discovery, the lower would be the likely value of p.

To estimate the probability p of detection of a successful illegal customer acquisition, one can take a Bayesian approach and treat detection as a Bernoulli random variable for each act, with unknown probability of "success" (detection). An investigator in such a case can begin with the estimates of how many customers were poached and approximate how many illegal acquisitions occurred before the activity was detected. If there are N illegal acquisitions by the time of detection, then the "sample" of Bernoulli random variables has N-1 "failures" and one "success". Using an uninformative uniform prior for the probability of detection, the Bayesian posterior mean of the detection probability is $2/(2+N)$. This can be used for p in the penalty formula. Given that the FCC did not begin its investigation until four months after the merger, it is likely that N

[62] Here we are setting aside the principal-agent nature of the problem by treating the firm as a unified decision maker; we would expect that the firm would claim that the illegal activity came from rogue sales staff.

could be sizeable, and that the probability of detection was low. A low probability of detection leads to a large penalty, given that *p* is in the denominator of the optimal penalty.

h. Other Issues in Implementation

Once the elements of equation (2) have been estimated, calculating the optimal penalty is straightforward. Although we cannot complete the calculation with the publicly available data, we hope that the procedure outlined above proves useful for economists working on similar enforcement cases in the future. There is a larger issue to be addressed before leaving the topic, however. The penalties suggested by Polinsky and Shavell (1998) are optimally deterring only if firms in the regulated industry know that the regulator is committed to levying them when violations come to light. A full discussion of regulatory commitment is beyond the scope of this article.[63] If the principles guiding the calculation of penalties is not made known to industry, or if the optimal penalties are merely used as the starting point for negotiations, then the resulting impact on firms' incentives to violate the rules may be far from optimal.[64]

IV. Conclusion

These are interesting times for economists at the FCC. On the one hand, the opportunity to help shape the National Broadband Plan calls for vision, the ability to synthesize lessons from the academic literature on broadband for the policymakers, and the ability to take (and communicate) a grand view of an important and wide ranging

[63] See Spiegel and Spulber (1997) for a discussion of why it is often unrealistic to assume that regulators can credibly commit to policies.

[64] The ability to commit to an enforcement framework of optimal penalties may be hampered by existing limitations on penalties. For example, federal stature proscribes penalties in excess of certain amounts, depending on the industry of the infringer and the category of the violation. See 47 C.F.R. sec. 1.80.

policy topic. On the other hand, the daily life of the agency continues, in which attention must be paid to the smallest (but nevertheless important) details of merger analysis and other regulatory "business as usual". Economists working at the FCC have the pleasant opportunity of both serving the public interest and being presented with intriguing opportunities where further economic research is vitally needed.

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Appendix

Table A1.

Percentage of U.S. Zip Codes with High-Speed Lines in Service

(June of Each Year)

# of Providers	2000	2001	2002	2003	2004	2005	2006	2007	2008
Zero	33.0	22.2	16.1	9.0	5.7	2.0	0.7	0.1	0.0
One	25.9	20.3	18.4	16.4	13.8	9.3	3.7	0.9	0.3
Two	17.8	16.7	16.2	16.9	16.8	14.1	8.2	3.6	1.5
Three	9.2	13.2	13.3	14.0	14.9	15.0	11.3	7.0	3.7
Four	4.9	8.2	9.6	10.6	11.6	12.6	12.9	11.1	7.2
Five	3.4	4.9	6.9	7.7	8.4	9.7	12.2	13.6	10.8
Six	2.5	3.6	4.6	5.3	6.1	6.8	10.4	13.0	13.4
Seven	1.7	2.8	3.2	4.0	4.4	5.3	8.7	11.6	12.7
Eight	0.8	2.2	2.8	3.1	3.6	4.0	7.1	9.1	9.9
Nine	0.4	1.9	2.4	2.5	2.8	3.8	5.8	7.4	7.4
Ten or More	0.4	3.9	6.4	10.5	11.8	17.5	19.1	22.7	33.2

Source: FCC (2009). Until 2005, only those providers with at least 250 lines per state were required to file Form 477. Figures may not add up to 100% due to rounding.