Testimony of

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on behalf of

Free Press
Consumers Union
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before the

United States Senate
Committee on Commerce, Science and Transportation

Regarding

Universal Service Fund Distributions
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SUMMARY

Free Press[1], Consumers Union[2], and Consumer Federation of America[3] appreciate the opportunity to testify on the issue of distributions from the Universal Service Fund. As consumer advocates, we strongly support the USF programs that have delivered essential communications services to low-income households, rural areas, schools, libraries, and rural health clinics. We recognize the fiscal crisis of falling receipts and expanding expenses in the program demands reform. Yet we view USF's present predicament as both a threat and an opportunity. We believe that as communications technologies evolve, USF must evolve with it. We support the expansion of USF support to broadband as the organizing principle to overhaul its contribution and distribution systems.

The debate over USF reform is complex, and there is a danger that in the quest to iron out the details of implementation, the Congress will lose sight of the principles driving this policy. There are dozens of difficult questions to resolve, but we urge the Committee to stand firmly on the ideals articulated in the Communications Act of 1934 and reaffirmed in 1996. The cornerstone of this legislation is the commitment to providing communications services to every American household, without regard to geography or income, at an affordable rate and a robust quality of service. The legislative history of USF indicates that Congress has already committed itself to expanding universal service support to broadband networks. Not only should we do this, we cannot afford to delay.

The urgency of the "broadband problem" in the US is severe. The Committee is now familiar with the statistics of America's swift decline in the global ranks of broadband penetration. This testimony provides new evidence to understand why. The results of our study have critical implications for USF policy. Contrary to conventional wisdom, America's low population density does *not* account for our poor broadband performance. The key factors explaining our difficulties are high prices for service and a substantial low income population that cannot afford them. Other nations have solved these problems with strategic investment and comprehensive broadband policies to deliver affordable service. USF is uniquely suited to reverse our broadband fortunes, bringing affordable service and new investment where we need it most—to low-income and rural areas that have heretofore been trapped on the wrong side of the digital divide.

There is no magic formula for solving the Fund's problems. To begin, we must agree upon shared goals. To that end, we offer a set of principles for implementing a 21st Century Universal Service Fund. We support extending USF to broadband by expanding the base of contributions in a technologically and competitively neutral manner. After a transition period, USF eligible carriers should be broadband compatible. We believe the size of the Fund must be disciplined through careful oversight and accountability, market incentives, and strategic investment in infrastructure. We should support carriers without regard to technology, provided that each can meet standards for affordable broadband and telephone service at a robust quality of service. Finally, we should approach USF reform as one piece in a larger set of broadband policies that includes opening up the spectrum for innovative wireless technologies and protecting competition in Internet services.

We strongly encourage this Committee to uphold the remarkable and progressive commitment to Universal Service that is the foundation of our communications policy. Expanding USF to broadband is an essential step on our path to reforming the system by maximizing the return on public investment and regaining our position as a global leader in technology and communications.

STARTING FROM PRINCIPLE

As Congress looks to resolve the thorny problems of reforming the Universal Service system, we urge Members to start with the principles that lie at the base of the Communications Act. The purpose of the Act was to regulate communications networks "so as to make available, so far as possible, to all the people of the United States, without discrimination on the basis of race, color, religion, national origin, or sex, a rapid, efficient, Nationwide, and world-wide wire and radio communications service with adequate facilities at reasonable charges."[4]

This principle—strongly reaffirmed in 1996—is the simple, powerful, and fundamentally progressive commitment to universal, affordable access to communications services for all Americans. It is this policy that has brought telecommunications to schools, libraries, rural health facilities, low-income households, and rural areas at reasonable rates and adequate quality of service. The vital importance of this program is clear to anyone who has ever lived rural America or struggled to make ends meet. The economic case for affordable access is clear, and research produced by consumer groups has been documenting it for many years.[5]

The public policy commitment to ubiquitous communications has never been more important than now. Standing at the threshold of an information technology revolution, we cannot and should not abandon or weaken our guarantee of universal, affordable access. Granted, the communications marketplace has changed substantially since 1996—the last time USF was comprehensively addressed. The needs of our society and economy have evolved, and USF must evolve with them. The labyrinthine complexity of USF distribution—with both its successes and shortcomings—must not be allowed to blind us from the bottom line: Broadband is now, undeniably, the essential communications medium of the 21st Century. Broadband networks are the "adequate facilities" that we must provide to all Americans at "reasonable charges."

Yet, as in past technological paradigms shifts, rural communities and low-income groups have been left behind. The economic costs of this digital divide are severe—curtailing the educational, economic, and social opportunities for a significant sector of our society. It is no secret to this Committee that the United States lags badly behind other nations in broadband penetration. The longer we wait for universal deployment of broadband to every region of the country, the further behind our global competitors we will fall. Not only should we apply USF to broadband, we can't afford not to. This is the only way to get back on track toward the President's stated goal of universal affordable broadband by 2007.

The current financial crisis in the USF programs and the difficulty in ensuring USF support delivers a strong return on investment have been readily identified as threats to a successful policy. But needed reform is equally an opportunity. We should look to reform USF both to address its long term stability and to use it to bridge the broadband digital divide. The cornerstone of this policy historically, and now, must be a commitment to bringing affordable service to average citizens. At the time of the Communications Act of 1934, telephone penetration rates were around 40%—very similar to where we currently stand with broadband.[6] The vision that inspired a policy that brought that telephone penetration rate above 90% must now be applied to high-speed Internet access.

There is much debate about whether it is appropriate to expand USF to cover broadband. However, a close look at the 1996 Act makes it quite clear that Congress has already decided on this question. Many of the Senators on this Committee fought for a broad, progressive definition of the communications services that would be guaranteed to all Americans. They had it right a decade ago. They still have it right today.

In Section 254 of the 1996 Act, Congress instructed the FCC to define the services that would be supported by USF; and the Commission did not include broadband. However, Congress also instructed the FCC to base its policies on a set of explicit principles in Section 254 (b). The first called for making quality communications services available at reasonable rates. The second read: "Access to advanced telecommunications and information service should be provided in all regions of the Nation." If that statement lacks full clarity, we have the third principle as a further guide. It read: "Consumers in all regions of the Nation…should have access to telecommunications and information services, including interexchange services and advanced telecommunications and information services, that are reasonably comparable to those services provided in urban areas." There is little doubt that Congress intended to capture in this definition the evolving modes of 21st century technologies—certainly including broadband.[7]

Some would argue that we cannot apply USF to broadband because a "substantial majority" of the public does not subscribe—a condition for applying USF support to a new service under Section 254 (c). However, this misreads the statute. The "substantial majority" clause is subsequent to the Congressional commitment to covering advanced telecommunications and information services in Section 254 (b). The conditions in Section 254 (c) are not meant to modify the previously defined set of services that already fall under the principles of USF support ("telecommunications and information services, including interexchange services and advanced telecommunications and information services"), but rather the next generation of services, such as wireless telephony. In this analysis, the FCC may use its discretion to expand the scope of USF to broadband in ways it has not chosen to do in the past.

But we need not get bogged down in statutory disputes about whether broadband should be appropriately supported by USF. Broadband capable networks are already supported by USF. Many of the Local Exchange Carriers (LECs) in rural areas have built converged networks that carry both voice and broadband data. This is a sensible investment, as a converged platform is a more efficient and forward-looking infrastructure. Many rural LECs receive resources from the Rural Utility Service, a fund that has made broadband compatible plant a requirement for grants and loans for many years. The E-Rate program has explicitly invested USF resources into Internet access for schools and libraries. This is sound policy based in the clear principles articulated by Congress in 1996—and it should be formally adopted in USF reform.

The USF system does have a checkered track record and some serious problems. There is virtual consensus that we need reform. The program faces a financial crisis at present because of declining receipts and expanding outlays. If broadband becomes an explicit part of USF, these issues must be immediately addressed. To do this, there will be a significant number of tough questions this committee will face in an effort to overhaul the system of contributions and distributions. But this is no time to turn from the principles that have proven so successful. Nor is it time to lose sight of the real problems that USF is meant to solve—our communications inequalities.

<u>Diagnosing the US Broadband Problem</u>

The crisis in USF is severe, but the crisis it is intended to address is arguably much worse, and certainly portends more dire consequences to the health of the US economy. As this Committee has heard ad nauseum in hearing after hearing this year, the US has fallen out of the top 15 nations in broadband penetration. It bears repeating here because this testimony will bring new data to the question. This new research directly ties our global broadband rank to the issue of Universal Service.

Defenders of current broadband policy have argued that America's low global ranking is misleading because our population density is so low compared to smaller nations such as Japan, South Korea, and Sweden.[8] Noting that Canada outperforms us in broadband penetration despite its size and population density, we investigated this question. We analyzed the data from the OECD study of broadband in 30 nations and specifically controlled for population density. The results are striking. [See Appendix.] Population density turns out to have very little impact on our relative broadband performance compared to other nations. Far more important are median household income, the poverty rate, and exposure to Internet technologies inside and outside the home.

Rural areas are indeed underserved—broadband penetration rates in urban areas are nearly double those of rural areas. Yet, our research indicates that geography is a factor in depressed broadband penetration because of two higher order causes that are characteristic of rural areas—the price of service and the low income levels of potential subscribers. It costs more to build rural infrastructure, which raises prices, and the disposable income of the average rural family is lower than average. Additionally, rural areas tend to have a disproportionate number of retired Americans on fixed incomes. These factors result in depressed broadband penetration. These conclusions comport with the findings of a study by the Pew Internet and American Life Project.[9] Our research also confirms a recent survey showing that over 45% of broadband *non-subscribers* in the US do not subscribe because of high prices. A further 10% report that service is unavailable.[10] The combination of high prices and poor people results in lower technology exposure and adoption in rural America.

On the question of exposure to the Internet, another key factor in promoting broadband penetration, Pew found that 32% of the adult population does not use the Internet—a figure that held steady for the first half of 2005.[11] But our problem is not only with adults, it is also children. Of the 30 nations in the OECD study, the US ranked 26th (ahead of only Mexico, Turkey, and Slovakia) in the percentage of 15-year olds that have used a computer. Other nations are winning the broadband race because they are bringing technology and services to low-income areas.

The USF program is specifically designed to address these problems and is uniquely suited to do so if we apply its support to broadband. There are plenty of rural communications providers. The issue is finding the right balance of subsidies to incent investment and to make their products affordable to low-income Americans. Expanding USF support to broadband is a logical step to correcting the negative trends in our broadband markets. First, USF brings service to rural and low-income areas at affordable rates. Perhaps no other single policy is more important to our long term broadband prospects. Second, USF supports discounted Internet access in schools and libraries, which frees resources to buy PCs for the computer labs that connect to these lines. These public institutions serve to expose our young people to technology and catalyze the residential market for home computers and broadband services.

Other nations have used strategic direct investment in broadband infrastructure in low-income and rural areas to outperform us across the board. We should take note and plan accordingly. Policies that stimulate low-income consumer demand will improve the U.S.'s broadband situation. Universal Service policy applied to the broadband market will play a positive role in bridging the economic and rural digital divides. This in turn will significantly improve U.S. broadband performance relative to other leading nations.

General Principles of Implementation for USF Reform

As consumer representatives, we look to USF reform as an opportunity to extend the burden of contributions more equitably *and* to broaden the scope of distributions more effectively. The principles for implementing USF reform in 2006 must carry the same spirit as the principles for implementing USF in 1996. The functions, however, must be more forward looking. USF reform should:

- Explicitly expand USF to broadband and set a level of service and a target price comparable to dominant technology in urban areas. The FCC's broadband definition of 200 kbps is unacceptable and backward-looking. It must be revised to ensure appropriate levels of service.

- Broaden the base of USF contributions, equitably assessed and technology neutral, to stabilize the financial future of the Fund.

- Tighten the reigns of oversight and control that ensure disclosure of how the Fund's distributions are spent, who qualifies to spend them, and what the results of that spending yield. Increased data collection to make these assessments, including determining the capacity of lines in service areas, will be a key component to understanding how and where to make strategic investments in infrastructure.

- Find the right balance for USF subsidy. If the subsidy is too big, investment does not flow to the most efficient provider and rate paying consumers are overly burdened without a commensurate benefit. The inter-industry wrestling over revenue must be exposed to scrutiny and untangled fairly. Consumer contributions to the Fund must produce a tangible social and economic benefit in the form of a more robust network and catalyzed economic growth. We have real success stories with broadband provision by carriers of all kinds—we should identify those blueprints and duplicate them.

- Invest in a technology neutral manner that promotes the least costly, most efficient systems that meet robust quality of service standards.

- Begin a transitional phase leading to a point when all USF eligible carriers offer broadband compatible networks. The converged IP platform that carries both voice and data is more efficient, more robust, and not substantially more expensive than PSTN upgrades. As the PSTN equipment depreciates and requires replacement, it should be replaced with an IP platform.

- Discipline the size of the fund through rigorous oversight, realistic maximum allocations, forward-looking cost assessments where appropriate, and sliding scales of eligibility and reimbursement. The FCC and state utility commissions should work in tandem to develop new protocols that make sense for a USF that supports 21st Century communications services.

- Reform USF in conjunction with a comprehensive set of broadband policies. These should include:

- Opening more of the spectrum for unlicensed wireless broadband.
- Focusing on competition inducing policies that counterbalance mergers
- Strategic direct investment in rural broadband infrastructure
- Reinstatement of the Technology Opportunities Program at NTIA
- Encourage community development programs as broadband partners in order to expand access to low-cost equipment and technology training.

Conclusion

There are no easy solutions to correcting to the problems of the Universal Service Fund. But they must be addressed based on the same principles that have always guided progressive communications policy—a commitment to ubiquitous, affordable access to the most important technologies of the era. Broadband unquestionably qualifies as the dominant communications service of the 21st century. The benefits of applying USF to broadband outweigh the costs by a wide margin. Without a strong, comprehensive policy commitment to developing our broadband markets, we cannot hope to correct the problems that have plunged us down the ranks of global competitiveness. We need policies that give the "green light" to investment in communications infrastructure in rural and low-income America with a strong commitment to accountability, efficiency, and oversight. We strongly encourage this Committee to uphold the remarkable and progressive commitment to Universal Service that is the foundation of our communications policy.

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1 Free Press is a national, nonpartisan organization with over 225,000 members working to increase informed public participation in crucial media and communications policy debates.

2 Consumers Union is a nonprofit membership organization chartered in 1936 under the laws of the state of New York to provide consumers with information, education and counsel about good, services, health and personal finance, and to initiate and cooperate with individual and group efforts to maintain and enhance the quality of life for consumers. Consumers Union's income is solely derived from the sale of *Consumer Report*s, its other publications and from noncommercial contributions, grants and fees. In addition to reports on Consumers Union's own product testing, *Consumer Reports* with more than 5 million paid circulation, regularly, carries articles on health, product safety, marketplace economics and legislative, judicial and regulatory actions which affect consumer welfare. Consumers Union's publications carry no advertising and receive no commercial support.

3 The Consumer Federation of America is the nation's largest consumer advocacy group, composed of over 280 state and local affiliates representing consumer, senior, citizen, low-income, labor, farm, public power and cooperative organizations, with more than 50 million individual members.

4 *Communications Ac of 1934*, 47 USC 151.

5 See for example the work of Mark Cooper: "Disconnected, Disadvantaged, Disenfranchised: Explorations in the Digital Divide," Consumer Federation of America and Consumers Union, October 2000, http://www.consumersunion.org/pdf/disconnect.pdf; "Expanding the Digital Divide and Falling Behind on Broadband," Consumer Federation of America and Consumers Union, October 2004, http://www.consumersunion.org/pub/ddnewbook.pdf.

6 Mark Cooper, "Universal Service: A Historical Perspective and Policies for the Twenty-First Century," Consumer Federation of America and the Benton Foundation, 1996.

7 *Communications Ac of 1934*, 47 USC 254.

8 See for example, FCC Chairman Kevin Martin, "United States of Broadband," *Wall Street Journal*, July 7, 2005.

9 See Peter Bell, Pavani Reddy, and Lee Rainie, "Rural Areas and the Internet," Pew Internet and American Life Project, February 17, 2004, http://www.pewinternet.org/PPF/r/112/report_display.asp

10 Yankee Group Research, Inc. February 2006, cited at http://www.emarketer.com/article.aspx?1003833

11 See John Horrigan, "Broadband in the United States: Growing but Slowing," Pew Internet and American Life Project, September 21, 2005, http://www.pewinternet.org/PPF/r/164/report_display.asp

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APPENDIX

Broadband Penetration in the Member Nations of The Organization for Economic Cooperation and Development

Why Does the U.S. Lag Behind?

A Comparative Statistical Analysis and the Implications for Universal Service Reform

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February 2006

[1] Questions, suggestions, and comments are welcome. dturner@freepress.net

Executive Summary

It is widely known amongst telecommunications policymakers that the U.S. is falling behind other developed nations in measures of broadband penetration, speed, and price. A satisfactory explanation of this "broadband lag" is needed in order for members of Congress and the FCC to craft policies that adequately move the U.S. towards the goal of universal, affordable broadband access.

This report employs comparative statistical methods to characterize and understand the differences between the U.S. and other Organization for Economic Cooperation and Development (OECD) nations. The findings of this study have important implications for the universal service regime:

- The data suggest that the high poverty rate in the U.S. may be indirectly depressing demand for broadband. Extending universal service to unserved and underserved rural and non-rural areas, as well as lowering the cost of broadband to low-income consumers, may be an effective way of stimulating both supply and demand of broadband services.

- Data from the OECD demonstrates the importance of both home and school computer access by students on measures of academic performance. Given that both home and school computer use (and by extension, broadband use) is critical to student performance, the e-Rate program remains a vital method for directly facilitating school use, and indirectly facilitating home use (via increased demand from exposure at school).

Other important findings of this report include:

- The factors most important for predicting broadband penetration are median household income, poverty rate, and technology readiness (measured by percentage of population who use the Internet from any location and by any technology).
- Despite conventional wisdom, the difference in population density between OECD nations does not adequately explain the differences in broadband penetration.
    - South Korea's fiber and cable penetration alone drives the initial appearance of significance. When South Korea is excluded from the data set, there is very little correlation between population density and broadband penetration, and this relationship is not statistically significant
    - Population density is not significantly correlated with DSL penetration, even when including the full set of 30 countries
- The percentage of population living in urban areas is weakly correlated with broadband penetration, but the result is of low statistical significance.
- Education levels (measured as the years of formal education) are moderately correlated with broadband penetration.
- Even when controlling for income, poverty, education, population density, urbanicity, and technology-readiness, the U.S. is still outperformed by 11 countries. This suggests that the higher level of market competition in these nations is contributing to their overall superior performance relative to the U.S.

Thus Congress and the FCC should act to stimulate broadband demand via universal service policy, and act to stimulate broadband supply by encouraging facilities based competition. Policies such as allowing access to unlicensed TV-band spectrum (for wireless broadband) as well as removing any legal barriers to community provision of broadband services will lead to a better served, more competitive broadband market.

Introduction

There is almost universal consensus among U.S. policymakers that widespread availability and adoption of broadband technology is vital to the nation's continued economic growth and its global competitiveness in the developing "information economy". President Bush has articulated a goal of "universal, affordable" broadband access by 2007. In the Telecommunications Act of 1996, Congress directed the FCC to "encourage the deployment on a reasonable and timely basis of advanced telecommunications capability to *all* Americans", defining "advanced telecommunications" as "broadband" technology that "enables users to originate and receive *high-quality* voice, data, graphics, and video telecommunications using any technology" (italics added).[2]

However, despite the political will towards achieving universal, affordable access to high-quality broadband technologies, the U.S. is falling behind other leading developed nations. In 2001 the U.S. was 4th among the 30-member nations of the OECD in broadband penetration.[3] In the latest available OECD data (June 2005), the U.S. ranks 12th. The International Telecommunications Union tracks broadband development among a wider set of nations. In their latest data (2005), the U.S. ranks 15th in the world in broadband penetration (the non-OECD nations leading the U.S. in this data set are Israel, Taiwan, and Hong Kong).[4]

Figure 1: Broadband Penetration by Country and Technology

Country	Total Broadband Subscribers per 100 Inhabitants, OECD, June 2005	DSL	Cable	Other
Korea	26	14	8.9	2.7
Netherlands	23	14	8.9	0
Denmark	22	13	6.1	2.4
Iceland	22	21	0.3	0.4
Switzerland	20	13	7.2	0.4
Canada	19	9	9.7	0.1
Finland	19	16	2.2	0.2
Belgium	18	11	7.3	0
Norway	18	15	2.5	0.9
Sweden	17	11	2.7	2.5
Japan	16	11	2.4	3
United States	15	6	8	1.1
United Kingdom	14	10	3.8	0
France	13	12	0.8	0
Austria	13	7	5.4	0.1
Luxembourg	12	10	1.3	0
Australia	11	9	2.4	0.1
Germany	10	10	0.3	0.1
Italy	10	9	0	0.6
Portugal	10	5	4.7	0
Spain	9	7	2.2	0.1
New Zealand	7	6	0.3	0.3
Hungary	5	3	1.6	0.1
Ireland	4	4	0.4	0.5
Poland	3	3	0.7	0.1
Czech Republic	3	2	1	0
Slovak Republic	2	1	0.3	0.1
Turkey	1	1	0	0
Mexico	1	1	0.2	0
Greece	1	1	0	0

In the policy debate surrounding broadband deployment and adoption, it is often assumed that the difference in penetration between the U.S. and other countries is a function of geographic factors (urbanicity and population density).[5] This notion is attractive, as it is usually true that the overall cost per deployed connection is lower in more densely populated areas (all other things being equal).

But the question remains, can geographic factors such as population density explain the observed differences in broadband penetration rates among OECD nations? Are these factors a

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[2] Public Law 104-104, Section 706, "Advanced Telecommunications Incentives."

[3] Broadband penetration is defined as number of subscriptions per 100 inhabitants.

[4] http://www.itu.int/osg/spu/publications/internetofthings/

[5] See Kevin Martin, "United States of Broadband," Wall Street Journal, July 7, 2005.

statistically significant determinant of overall penetration, and if so, how strong are their effects? Also, what other factors are contributing to the poor U.S. performance relative to other OECD countries?

This report attempts to answer these questions via a cross-sectional econometric analysis of the 30 nations of the OECD. These are preliminary observations intended to serve as the basis for further study. The approach is somewhat similar to that of other researchers, but the differences in methodology leads, in some instances, to divergent conclusions.[6] Future work will attempt to address discrepancies and create a more robust set of results. All data presented in this report (unless otherwise noted) comes from the OECD, in particular the 2005 "OECD Communications Outlook". This report begins with an examination of the individual correlations between certain factors and broadband penetration. I then construct two predictive models based on a full set of predictors. I then examine OECD data on student computer use using similar models. I conclude with implications for universal service reform in the United States.

What factors are correlated with broadband penetration?

A starting point in the attempt to characterize and understand America's "broadband problem"[7] is to determine what factors are correlated with broadband penetration.

Likely factors include:

- Median household income
- Population density
- Percentage of population living in urban areas
- Education attainment (measured as years of formal education)
- Poverty rate
- Technological readiness (measured by percentage of the population who use the Internet)
- Broadband price

Figure 2: Population Density and Urban Population

Country	Population Density (pop/km²)	Percentage of Population Living in Urban Areas	Total Broadband Subscribers per 100 Inhabitants, OECD, June 2005
Korea	493.9	80	25.5
Netherlands	395.1	62	22.5
Belgium	339.5	97	18.2
Japan	337.2	79	16.4
United Kingdom	246.9	89	13.5
Germany	230.9	88	10.2
Italy	192.9	90	10.0
Switzerland	181.4	68	20.3
Luxembourg	181.2	91	11.8
Czech Republic	129.9	77	2.8
Denmark	126.1	72	21.8
Poland	123.3	62	3.3
Portugal	114.4	53	9.9
Slovak Republic	111.2	56	1.6
France	110.9	76	12.8
Hungary	107.6	65	4.6
Austria	97.6	54	12.5
Turkey	89.2	65	1.2
Greece	80.9	60	0.8
Spain	79.9	76	9.3
Ireland	57.1	60	4.3
Mexico	53.8	75	1.0
United States	30.7	79	14.5
Sweden	20	84	16.5
Finland	15.4	62	18.7
New Zealand	15	86	6.9
Norway	14.2	78	18.2
Canada	3.3	79	19.2
Iceland	2.9	94	21.7
Australia	2.6	91	10.9

[6] See Kim, Bauer, and Wildman, "Broadband uptake in OECD Countries: Policy lessons from comparative statistical analysis", August 29th 2003, for another econometric approach to evaluating the differences between OECD nations. See Maldoom, Marsden, Sidak, and Singer, "Broadband in Europe: How Brussels Can Wire the Information Society", 2005, for analysis of EU member nations. These studies suffer from some of the same limitations present in this report. Namely that the use of cross-sectional data brings the assumption that the relationship between the dependant and independent variables are the same in each country. A time-series approach would remedy this weakness, and future work will attempt to do so.

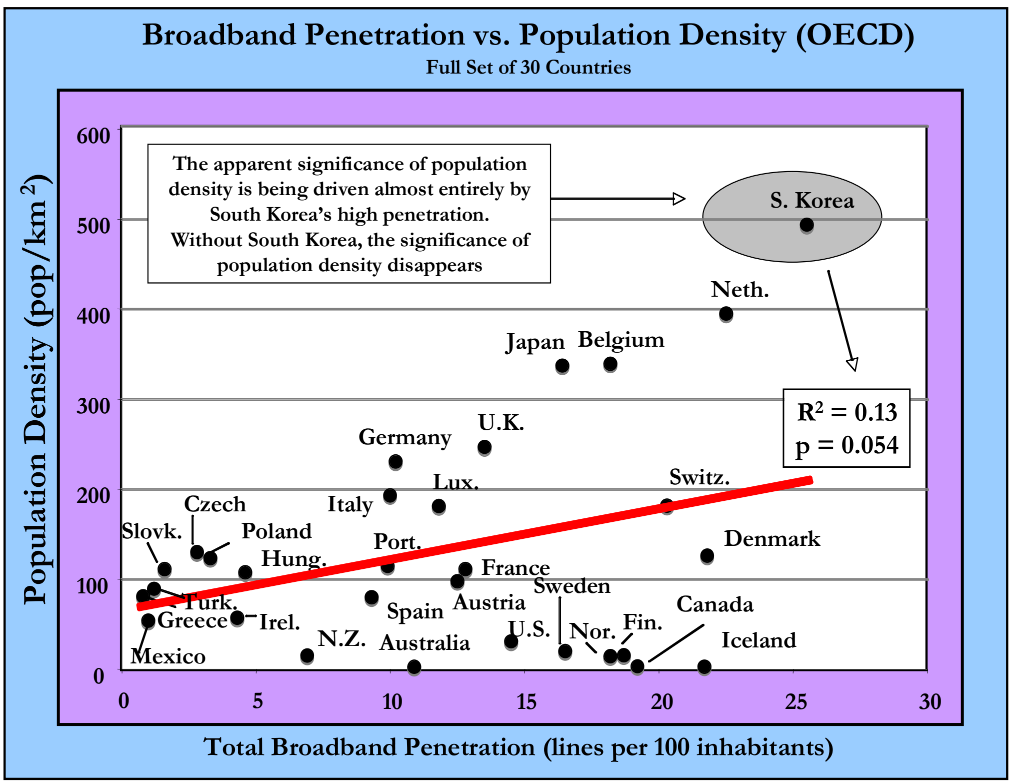
[7] This phrase was popularized by Charles H. Ferguson; see "The Broadband Problem: Anatomy of a Market Failure and a Policy Dilemma", 2002. Also see S. Derek Turner "Broadband Reality Check", (a report by Free Press, Consumers Union, Consumer Federation of America), August 2005, http://www.freepress.net/docs/broadband_report.pdf for a more recent examination of America's "broadband problem".

Other factors that could possibly be important include regulatory conditions, market competition, and government investment in, and incentives for, infrastructure development.

To begin, I examine the correlation between broadband penetration and the geographic factors of population density and urbanicity. At first glance the significance of population density seems likely (see figure 2). The top two countries in terms of broadband penetration are also the two most densely populated nations in the OECD. However, as the list continues, the apparent significance becomes less clear. Iceland, one of the most sparsely populated OECD nations, has the 4th highest level of broadband penetration.

Statistical examination of the data initially seems to confirm the significance of population density (see figure 3). Approximately 13% of the total observed variation in broadband penetration is explained by population density, and this relationship is statistically significant ($p = 0.054$).

Figure 3



However, a closer examination reveals that this apparent significance is being almost entirely driven by the high penetration rates of South Korea (in particular, high fiber-optic penetration). Dropping the two nations with the highest and lowest penetration levels (South Korea and Greece) completely eliminates the apparent significance of population density (see figure 4). In this subset, only 4% of the total variation in penetration is explained by population density, and this relationship is not statistically significant ($p = 0.27$). Furthermore, looking again at the full set of 30 countries, there is no significant relationship between population density and DSL penetration (see figure 5).

Figure 4

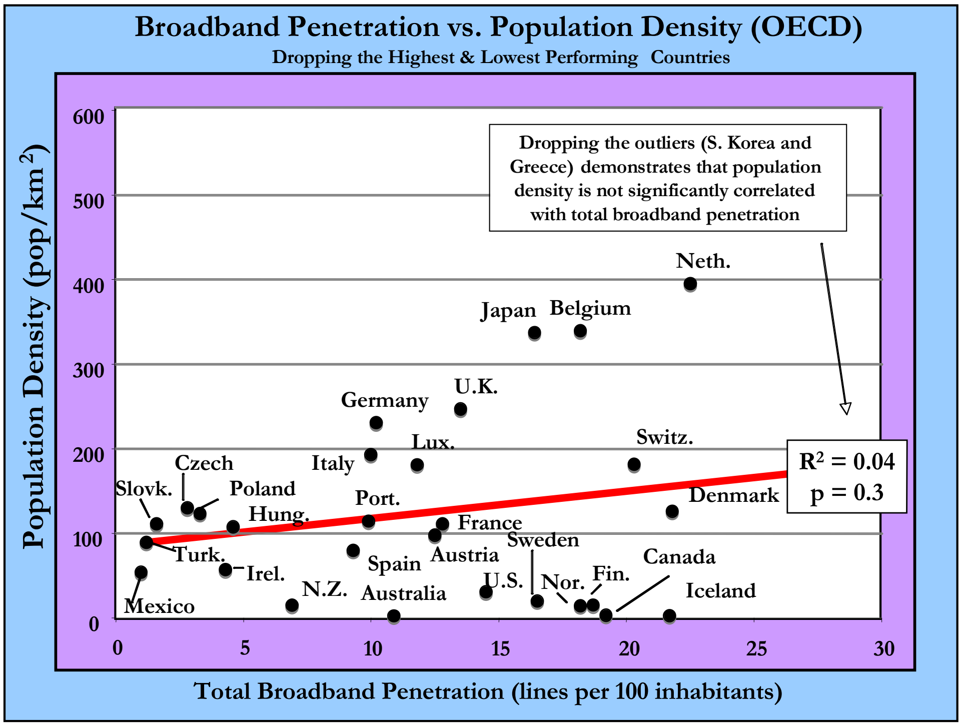
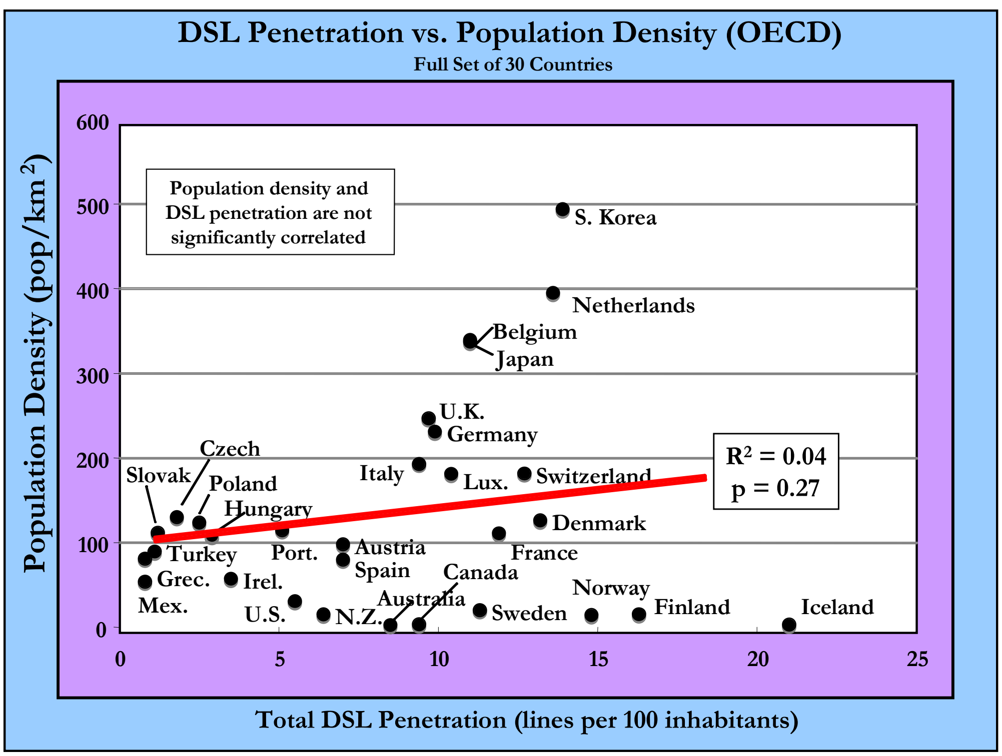
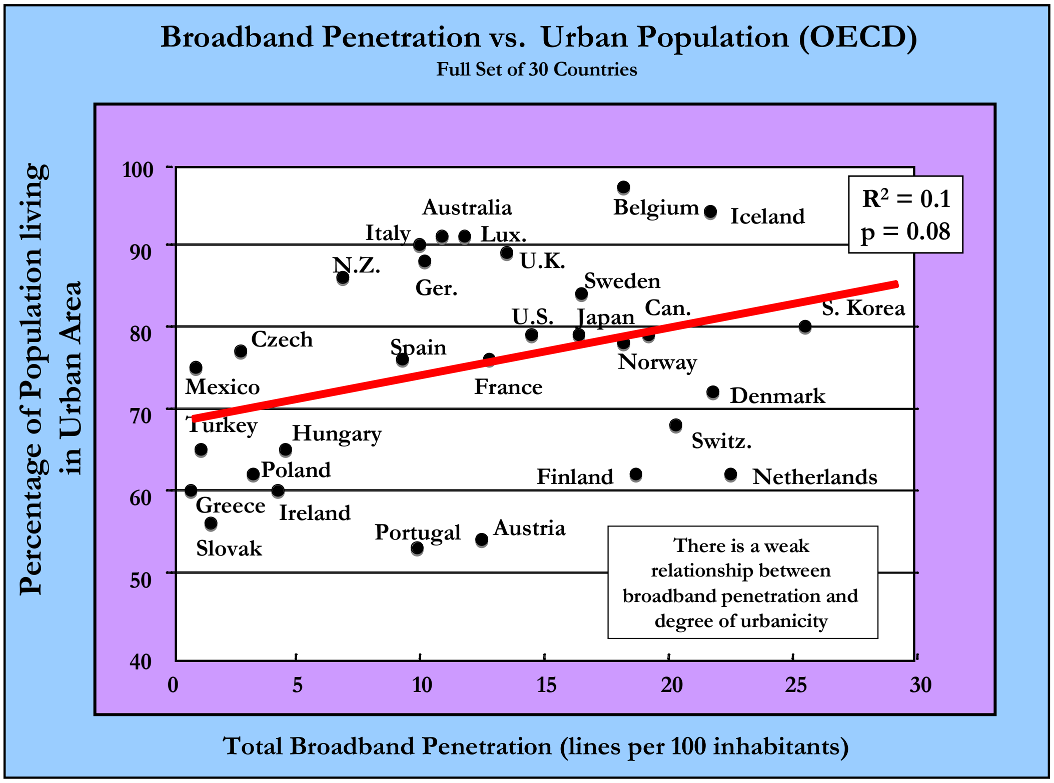


Figure 5



The percentage of a country's population living in urban areas appears to play a more significant role than population density, but the relationship is very weak. Approximately 10% of the observed variation in broadband penetration is explained by urbanicity, and this relationship is weakly statistically significant (p = 0.08, see figure 6).

Figure 6

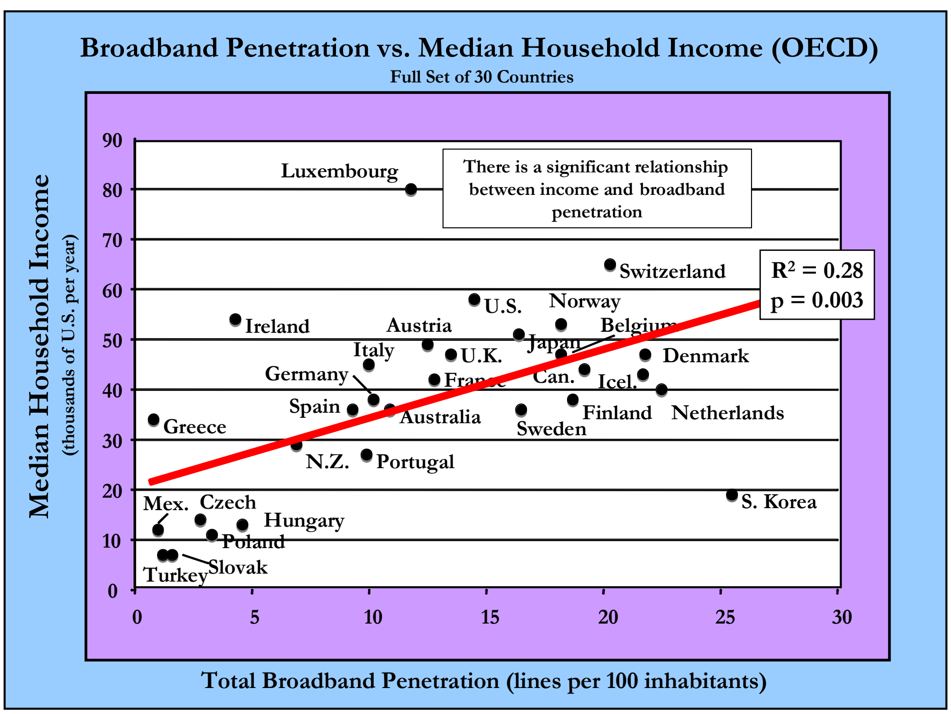


Median household income (figure 7) is significantly correlated with broadband penetration. In this bivariate linear model, median household income explains 28% of the observed variation in broadband penetration, and the result is highly statistically significant (p = 0.003, see figure 8).

Figure 7 – Income and Poverty

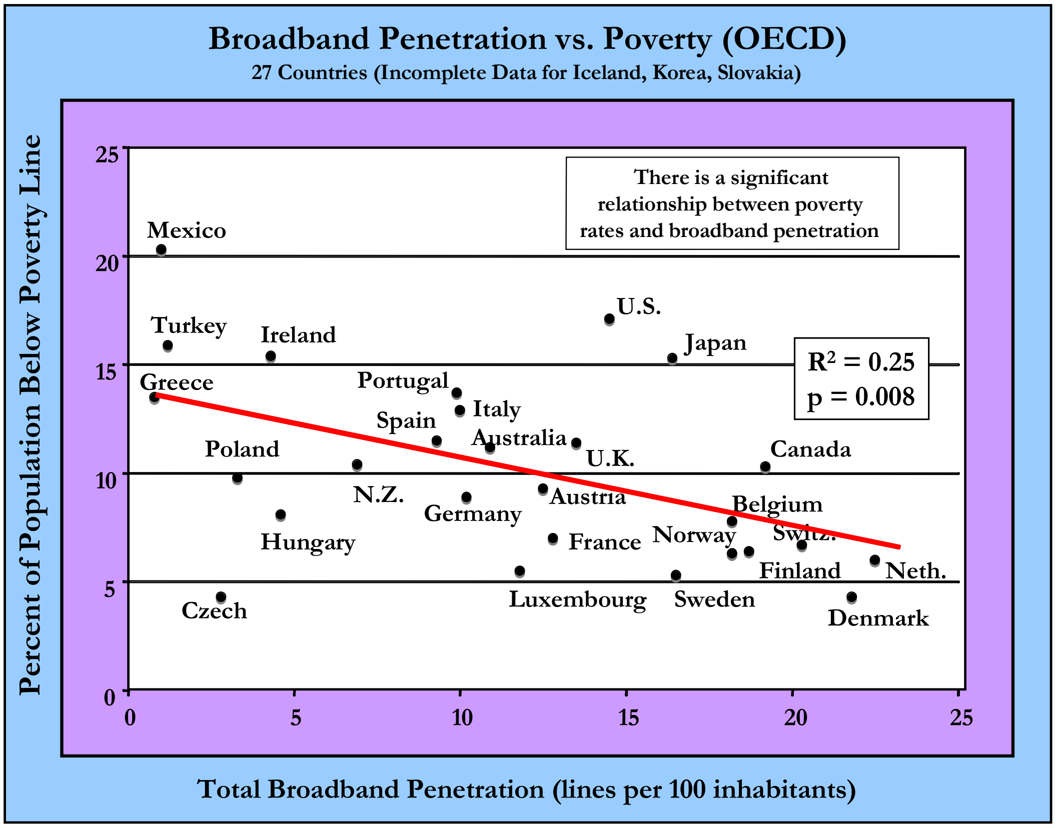
Country	Median Household Income (thous. USD, 2004)	Percent of Population Below Poverty Line
Luxembourg	80	5.5
Switzerland	65	6.7
United States	58	17.1
Ireland	54	15.4
Norway	53	6.3
Japan	51	15.3
Austria	49	9.3
Belgium	47	7.8
Denmark	47	4.3
United Kingdom	47	11.4
Italy	45	12.9
Canada	44	10.3
Iceland	43	n/a
France	42	7
Netherlands	40	6
Finland	38	6.4
Germany	38	8.9
Australia	36	11.2
Spain	36	11.5
Sweden	36	5.3
Greece	34	13.5
New Zealand	29	10.4
Portugal	27	13.7
Korea	19	n/a
Czech Republic	14	4.3
Hungary	13	8.1
Mexico	12	20.3
Poland	11	9.8
Slovak Republic	7	n/a
Turkey	7	15.9

Figure 8



There is also a significant negative relationship between poverty and broadband penetration. In this bivariate model, the poverty rate explains 25% of the observed variation in broadband penetration, and the result is highly statistically significant (p = 0.008, see figure 9).

Figure 9



Education is also moderately correlated with broadband penetration. Approximately 22% of the observed variance in broadband penetration is explained by differences in (years of formal) education in this bivariate comparison. This relationship is highly statistically significant (p = 0.008, see figure 10).

Not surprisingly, the percentage of the population that uses the Internet (connecting via any platform from any location) is strongly correlated with total broadband penetration (see figure 11). Internet use itself picks up some of the contributions of the other factors (income, education, and poverty) on broadband penetration. This could cause multicolinearity issues in the full regression model. However, the between variable correlation is not high enough here to preclude Internet use's inclusion in the full model (see figure 12).

Figure 10

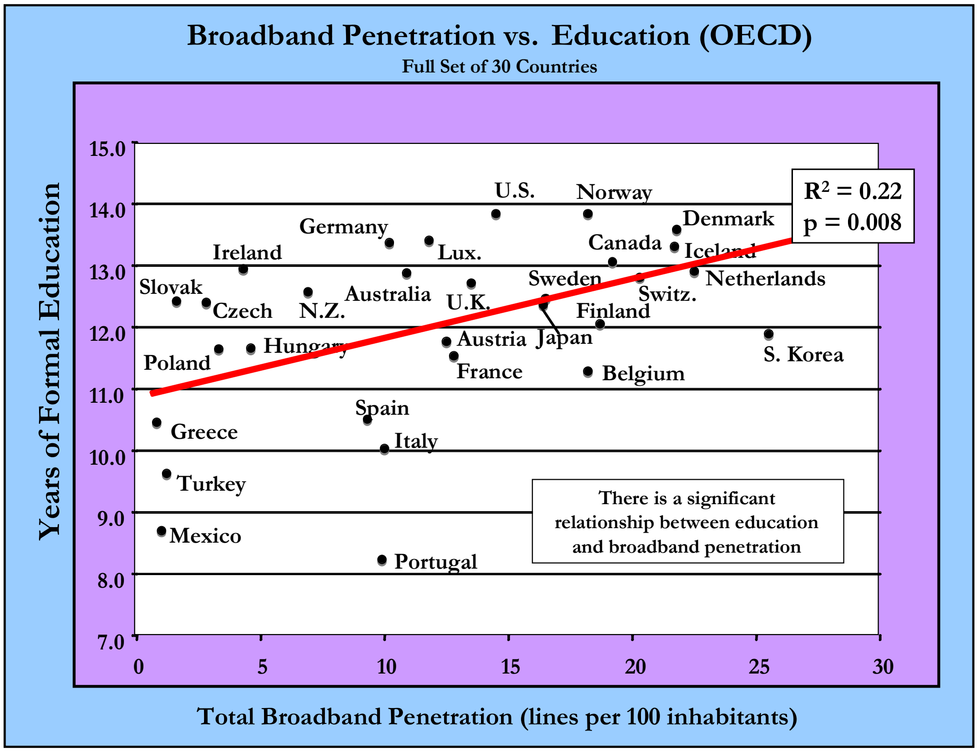
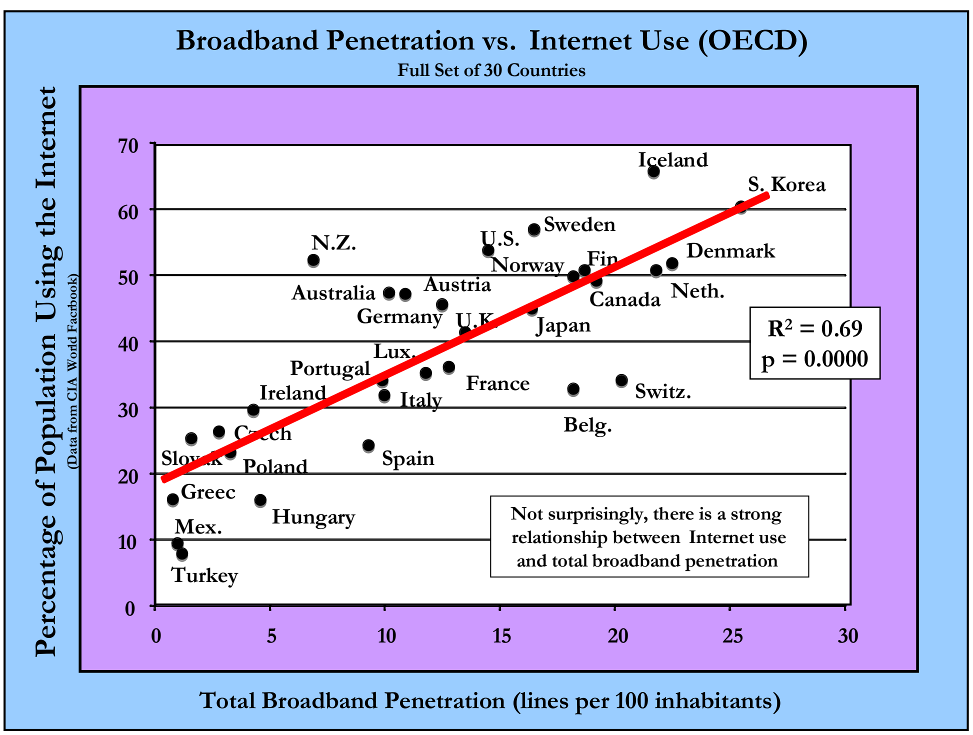


Figure 11*



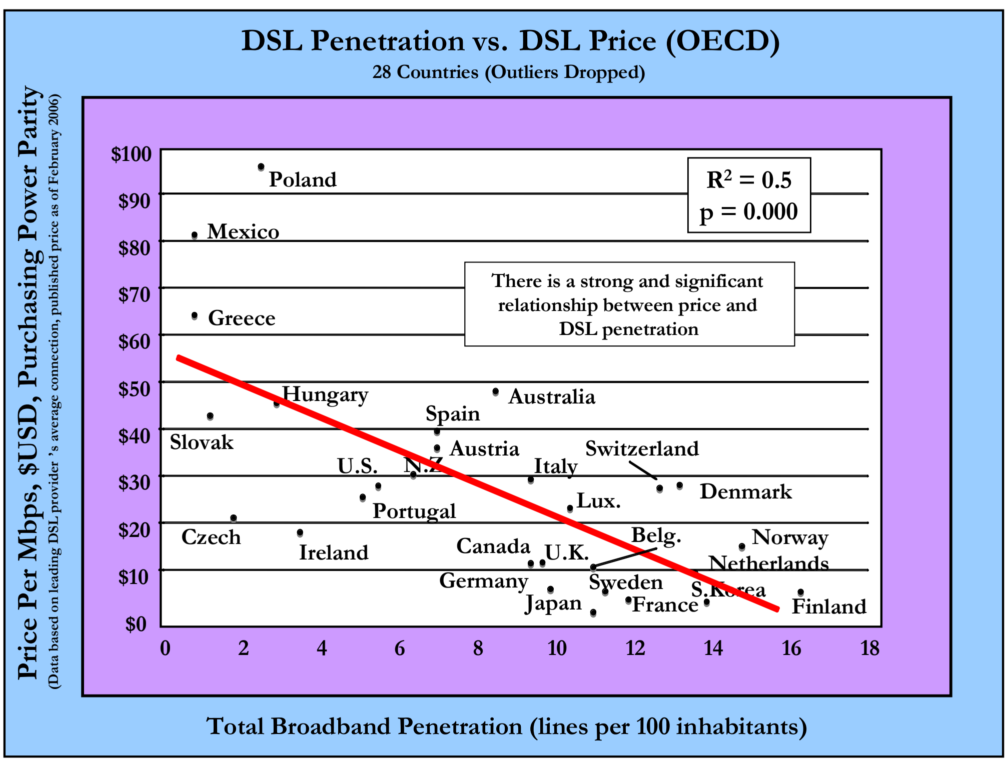
Internet use data from the 2005 CIA World Factbook

Figure 12 – Correlation Matrix

	Total Penetration	% Internet Use	Med. HH Income	Population Density	% Urban Population	Years of Formal Education	Poverty Rate
Total Penetration	1.00						
% Internet Use	0.76	1.00					
Med. HH Income	0.69	0.55	1.00				
Population Density	0.27	-0.01	0.24	1.00			
% Urban Population	0.15	0.26	0.35	0.14	1.00		
Years of Formal Education	0.57	0.71	0.55	0.04	0.36	1.00	
Poverty Rate	-0.47	-0.40	-0.28	-0.12	-0.06	-0.56	1.00

A final observation is of the strong negative relationship between DSL price and DSL penetration. After dropping two outliers (Iceland, who has the highest DSL penetration, and Turkey, whose price per Mbps is far higher than that of other nations), there is a statistically significant, negative correlation between price and penetration (r = -0.71, p = 0.000, see figure 13).

Figure 13



Modeling Broadband Penetration

To better understand how the U.S. is performing relative to the other countries of the OECD, I construct an econometric model based on the predictive factors discussed above. To explore the contribution of poverty rate (which is unusually high in the U.S.) I construct two models: one unrestricted model including poverty, and one restricted model without poverty. Both models are estimated with the full 30-nation set, as well as without the two outliers (Korea and Greece).

The restricted model (model 1) is specified as:

$$penetration_i = \beta_0 + \beta_1 (pctint) + \beta_2 (mhhinc) + \beta_3 (pdens) + \beta_4 (urban) + \beta_5 (yreduc) + \varepsilon_i$$

The unrestricted model (model 2) is specified as:

$$penetration_i = \beta_0 + \beta_1 (pctint) + \beta_2 (mhhinc) + \beta_3 (pdens) + \beta_4 (urban) + \beta_5 (yreduc) + \beta_6 (poverty) + \varepsilon_i$$

Where:

penetration = total broadband penetration as of June 2005
pctint = percentage of the population that use the Internet
mhhinc = median household income
pdens = population density
urban = percentage of the population living in urban areas
yreduc = years of formal education
poverty = percentage of the population living below the poverty line

To explore the relationship between these factors and DSL-coverage (the percent of telephone lines that are DSL-ready), a third model was also estimated:

$$dslcoverage_i = \beta_0 + \beta_1 (pctint) + \beta_2 (mhhinc) + \beta_3 (pdens) + \beta_4 (urban) + \beta_5 (yreduc) + \beta_6 (poverty) + \varepsilon_i$$

The results are summarized below.

Figure 14a – Model 1

	Coefficient	Standard Error	t	p
pctintcia	0.3541	0.0633	5.590	0.000
mhhinc	0.1237	0.0477	2.600	0.016
pdens	0.0157	0.0056	2.810	0.010
urban	-0.0525	0.0619	-0.850	0.405
yreduc	-0.4927	0.6701	-0.740	0.470
constant	1.7940	7.2501	0.250	0.807

N	29.0000
F	17.3100
Prob > F	0.0000
R^2	0.7900

Figure 14b – Model 1 (outliers dropped)

	Coefficient	Standard Error	t	p
pctintcia	0.2981	0.0733	4.070	0.001
mhhinc	0.1609	0.0537	3.000	0.007
pdens	0.0105	0.0070	1.500	0.149
urban	-0.0715	0.0624	-1.150	0.264
yreduc	-0.3928	0.6708	-0.590	0.564
constant	3.5118	7.3079	0.480	0.636

N	27
F	13.7100
Prob > F	0.0000
R^2	0.7654

Figure 15a – Model 2

	Coefficient	Standard Error	t	p
pctintcia	0.2874	0.0760	3.780	0.001
mhhinc	0.1421	0.0559	2.540	0.020
pdens	0.0121	0.0071	1.690	0.106
urban	-0.0689	0.0668	-1.030	0.315
yreduc	-0.5985	0.8110	-0.740	0.470
poverty	-0.2964	0.2167	-1.370	0.187
constant	9.4004	9.2318	1.020	0.321

N	26
F	10.68
Prob > F	0.0000
R^2	0.7714

Figure 15b – Model 2 (outliers dropped)

	Coefficient	Standard Error	t	p
pctintcia	0.2534	0.0774	3.270	0.004
mhhinc	0.1592	0.0555	2.870	0.010
pdens	0.0109	0.0070	1.570	0.134
urban	-0.0933	0.0670	-1.390	0.181
yreduc	-0.4975	0.7908	-0.630	0.537
poverty	-0.2633	0.2117	-1.240	0.230
constant	10.6848	9.0104	1.190	0.251

N	25
F	10.02
Prob > F	0.0000
R^2	0.7696

Figure 16 – Comparison of Predicted and Actual Values of Broadband Penetration

Country	Total Broadband Penetration	Predicted Total Penetration, Model 1	Difference between Actual & Predicted, Model 1	Predicted Total Penetration, Model 2	Difference between Actual & Predicted, Model 2
Korea	25.5	23.22	2.28	-	-
Netherlands	22.5	21.69	0.81	20.98	1.52
Denmark	21.8	17.08	4.72	17.81	3.99
Iceland	21.7	18.94	2.76	-	-
Switzerland	20.3	14.90	5.40	16.31	3.99
Canada	19.2	14.08	5.12	13.47	5.73
Finland	18.7	15.48	3.22	16.15	2.55
Belgium	18.2	13.90	4.30	13.85	4.35
Norway	18.2	15.32	2.88	15.92	2.28
Sweden	16.5	16.15	0.35	16.28	0.22
Japan	16.4	19.05	-2.65	16.23	0.17
United States	14.5	17.54	-3.04	14.69	-0.19
United Kingdom	13.5	15.21	-1.71	13.84	-0.34
France	12.8	11.87	0.93	12.89	-0.09
Austria	12.5	16.88	-4.38	17.10	-4.60
Luxembourg	11.8	15.63	-3.83	17.16	-5.36
Australia	10.9	11.85	-0.95	10.79	0.11
Germany	10.2	15.66	-5.46	14.47	-4.27
Italy	10	12.02	-2.02	11.27	-1.27
Portugal	9.9	12.18	-2.28	11.79	-1.89
Spain	9.3	6.94	2.36	7.53	1.77
New Zealand	6.9	13.41	-6.51	12.18	-5.28
Hungary	4.6	1.58	3.02	3.26	1.34
Ireland	4.3	-	-	-	-
Poland	3.3	4.35	-1.05	5.01	-1.71
Czech Republic	2.8	4.75	-1.95	6.53	-3.73
Slovak Republic	1.6	4.33	-2.73	-	-
Turkey	1.2	-1.28	2.48	-1.19	2.39
Mexico	1	-0.75	1.75	-1.92	2.92
Greece	0.8	4.65	-3.85	5.42	-4.62

Figure 17

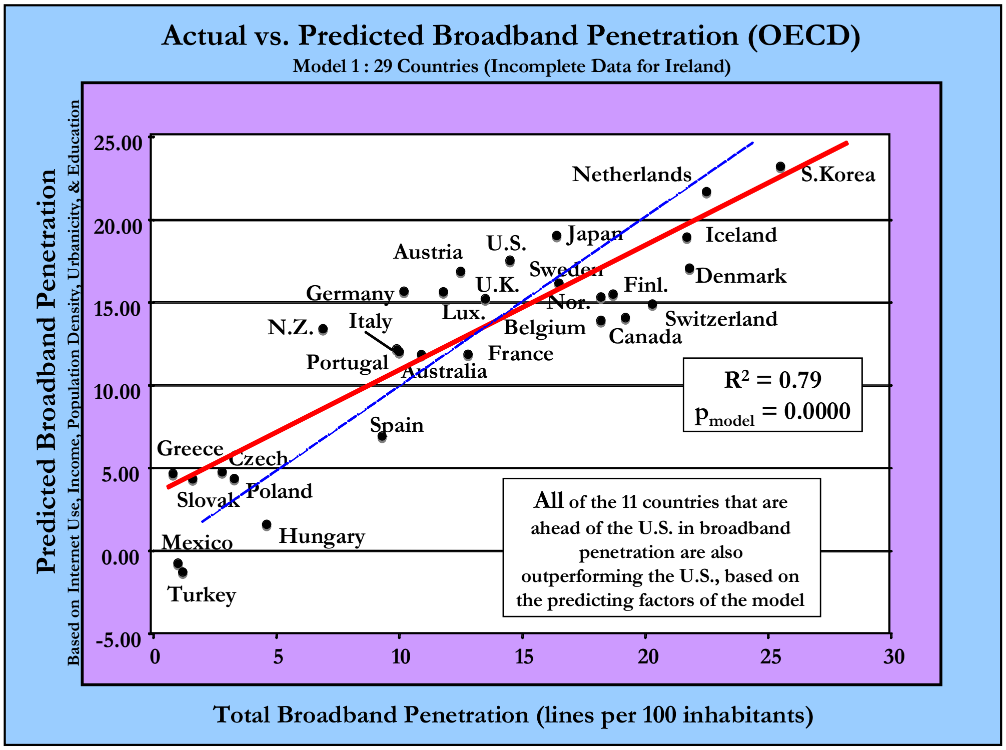


Figure 18

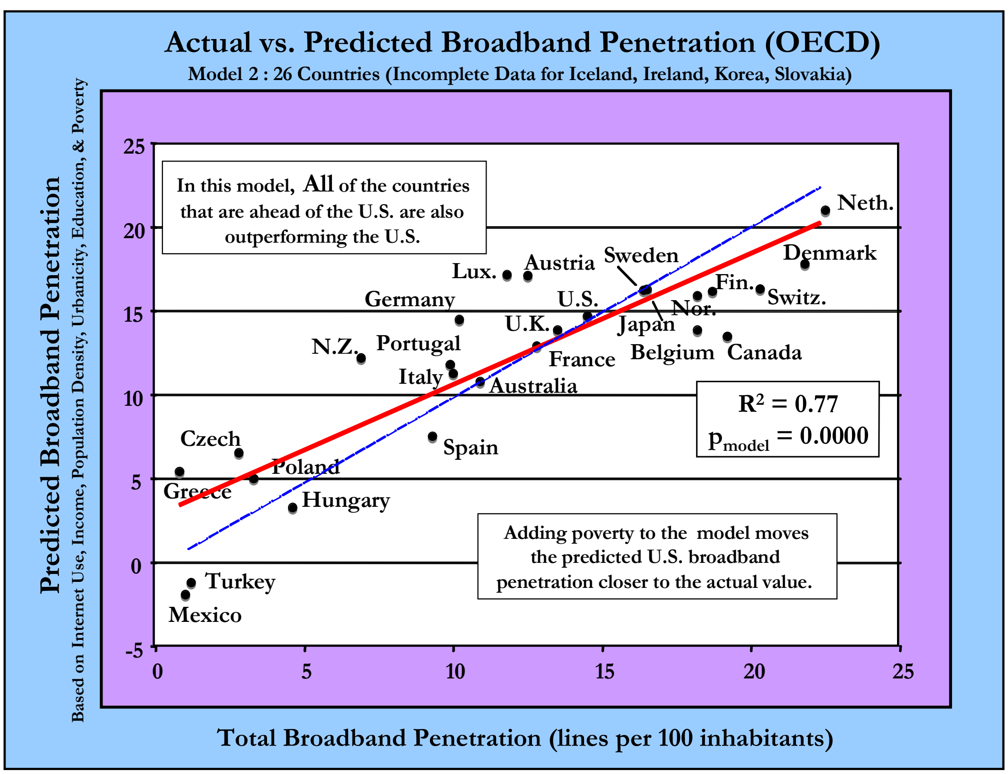
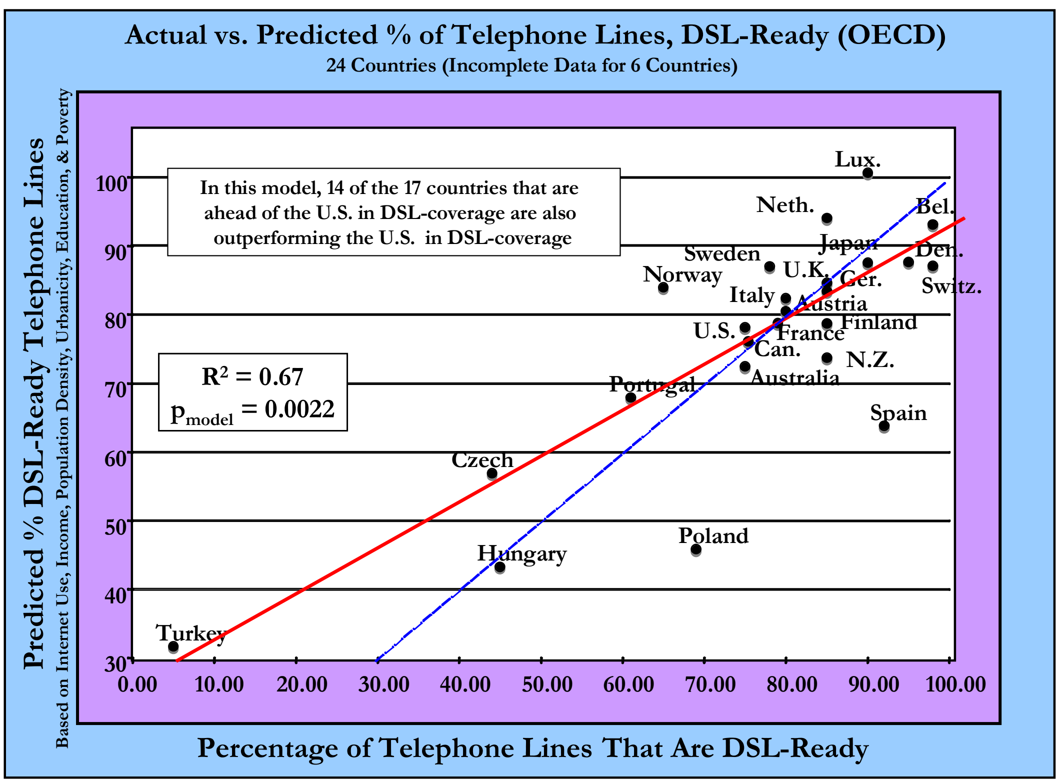


Figure 19 – DSL & Cable Internet Readiness

Country	DSL coverage, % of lines, end 2003	% Households cable passed and Internet ready 2003
Australia	75	37
Austria	80	38
Belgium	98	80
Canada	75	85
Czech Republic	44	9
Denmark	95	47
Finland	85	25
France	79	25
Germany	85	10
Greece	n/a	0
Hungary	45	n/a
Iceland	86	18
Ireland	62	4
Italy	80	9
Japan	90	27
Korea	93	57
Luxembourg	90	38
Mexico	n/a	n/a
Netherlands	85	79
New Zealand	85	11
Norway	65	28
Poland	69	11
Portugal	61	60
Slovak Republic	n/a	n/a
Spain	92	40
Sweden	78	23
Switzerland	98	76
Turkey	5	14
United Kingdom	85	45
United States	75	80

Figure 20



Discussion of Results

Both of the models presented above explain a significant amount of the variance in the observed OECD broadband penetrations. Though unrestricted, Model 2 accounts for slightly less variance than the restricted model (77% vs. 79%). This is likely due to the incomplete data set for poverty rates.

According to the results from Model 1, the actual U.S. penetration is below the predicted penetration (14.5 vs. 17.5). Also, all of the countries that are ahead in actual broadband penetration are also outperforming the U.S. based on their predicted level of penetration. For example, based on the predictors of the model, Canada's penetration should be 14 subscriptions per 100 inhabitants. However, Canada's actual penetration is 5 units higher, at 19.2 subscriptions per 100 inhabitants (see figures 16 and 17).

When poverty is added to the model (Model 2), the actual and predicted penetrations for the U.S. move much closer together (14.5 vs. 14.7). This suggests that the high level of poverty in the U.S. is contributing to the lower than expected level of broadband penetration. This is not too surprising, given that lower-income households are far less likely to consume broadband, depressing the overall demand for such services.

However, as in Model 1, all of the countries that are ahead of the U.S. in actual penetration are also outperforming the U.S., based on their predicted level of penetration (see figure 16 and 18; poverty data was unavailable for South Korea and Iceland, but it is likely that these two countries, given their high levels of penetration, are also outperforming the U.S.). Thus, it is apparent that these countries are doing something that brings their broadband performance to a higher level than that predicted by socioeconomic and technology readiness factors. According to country-level reports from the OECD, most of these nations have high levels of market competition, something that is lacking in the U.S. (see figure 21). This competitive marketplace could explain the lower prices seen in these countries (figure 13), and in turn could be contributing to the higher level of consumer adoption.

Figure 21 – Top U.S. Broadband providers

Rank (Total)	Broadband Internet Provider	Subscribers at End of 3Q 2005	Pct of Total BB
1	Comcast	8,142,000	19.0%
2	SBC	6,496,000	15.2%
3	Time Warner	4,557,000	10.7%
4	Verizon**	4,531,000	10.6%
5	Cox*	2,975,000	7.0%
6	Bell South	2,678,000	6.3%
7	Charter	2,120,000	5.0%
8	Adelphia	1,656,700	3.9%
9	Cablevision	1,600,434	3.7%
10	Qwest	1,340,000	3.1%
11	Bright House Networks*	815,000	1.9%
12	Sprint	638,000	1.5%
13	Covad	578,400	1.4%
14	Mediacom	453,000	1.1%
15	Insight	439,200	1.0%
16	ALLTEL	359,975	0.8%
17	RCN	238,000	0.6%
18	Cable One	219,900	0.5%
19	Century Tel	219,879	0.5%
20	Cincinnati Bell	153,500	0.4%
	Total Broadband lines***	42,777,647	

Sources: The Companies and Leichtman Research Group, Inc.
* Cox and Bright House Networks totals are estimates
**Total includes Fios wireline broadband connections along with DSL
Top cable and DSL providers represent approximately 94% of all subscribers
Company subscriber counts may not represent solely residential households.
*** this value is corrected to account for 100% of the market

The differences between Model 1 and Model 2 suggest that policies that stimulate low-income consumer demand could improve the U.S.'s broadband situation. Universal Service policy applied to the broadband market could play a positive role in bridging the economic and rural digital divides. This in turn would likely significantly improve U.S. broadband performance relative to other leading nations.

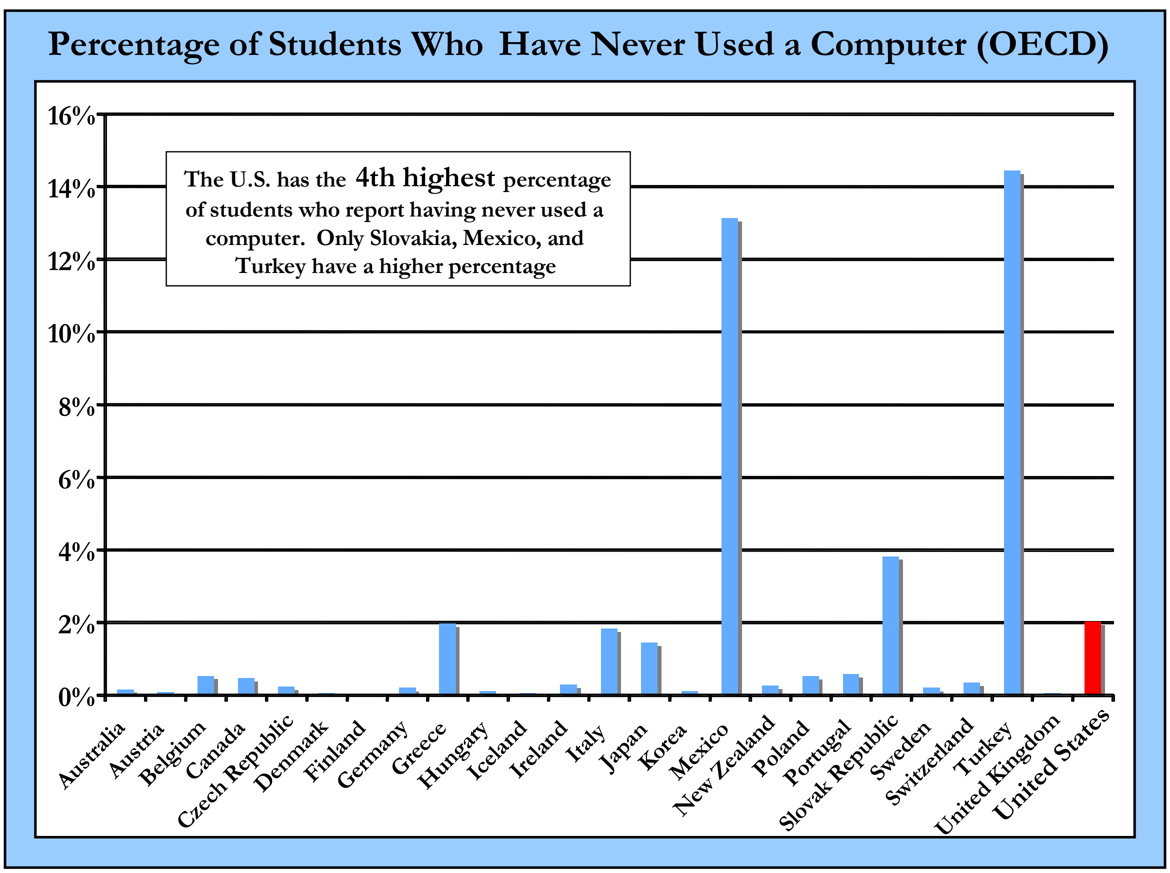
Student Access to Information Technologies

A recent study by the OECD based on data from the Programme for International Student Assessment explored the relationship between student (15-year olds) academic performance and access to computers, both at home and at school.[8] The results of this study highlight the importance of computers and information technology in adequately preparing students for the future. Highlights of the study include:

- Students who have only limited access to computers performed below the OECD average, on measures of academic performance.
- Students without access to computers at home are, on average, one proficiency level below the OECD average, even after accounting for students' socio-economic background.
- Students with the shortest experience of using computers scored poorly on average. Those with less than a year's experience can typically perform only the simplest mathematics tasks.

A striking finding is the level of U.S. students reporting never having used a computer. The U.S. has the fourth highest level of students who've never used a computer, trailed only by Turkey, Slovakia, and Mexico (see figure 22).

Figure 22



8 "Are students ready for a technology-rich world?", OECD, January 2006.

To investigate the relationship between poverty and student home computer access, I constructed models similar to those used for broadband penetration.

The restricted model (model 3) is specified as:

$$homeaccess_i = \beta_0 + \beta_1(mhhinc) + \beta_2(urban) + \beta_3(yreduc) + \varepsilon_i$$

The unrestricted model (model 4) is specified as:

$$homeacess_i = \beta_0 + \beta_1(mhhinc) + \beta_2(urban) + \beta_3(yreduc) + \beta_4\, poverty) + \varepsilon_i$$

Where homeaccess equals percentage of students reporting access to a home computer.

Results are presented below.

Figure 23 – Model 3

	Coefficient	Standard Error	t	p
mhhinc	0.4162	0.1492	2.790	0.011
urban	0.2054	0.1768	1.160	0.258
yreduc	3.9506	1.7410	2.270	0.034
constant	7.7312	19.9680	0.390	0.703

N	25
F	10.27
Prob > F	0.0002
R^2	0.5946

Figure 24 – Model 4

	Coefficient	Standard Error	t	p
mhhinc	0.6081	0.1311	4.640	0.000
urban	0.2002	0.1453	1.370	0.189
yreduc	0.5998	1.6234	0.370	0.716
poverty	-1.7510	0.4780	-3.660	0.002
constant	58.8592	20.3359	2.890	0.010

N	22
F	16.35
Prob > F	0.0000
R^2	0.7936

The results are similar to those seen in broadband penetration. Poverty appears to significantly contribute to the low (by comparison) level of student home computer access. Based on Model 3 (which excludes poverty), the U.S. should have universal home computer access (see figure 25). When poverty is included in Model 4, the actual level of U.S. student home access, 90%, is in line with the predicted value (see figure 26).

These results have significance for the design of U.S. universal service policy. Student's exposed to computers and broadband technology in schools, as a result of the e-rate program, are likely to positively influence demand for home access to broadband. If low-income and rural consumers have increased access to affordable broadband as a result of universal service policies, then student use of information technologies will likely increase. This in turn will have positive impacts on academic performance, which will create long-term benefits for the entire society.

Figure 25

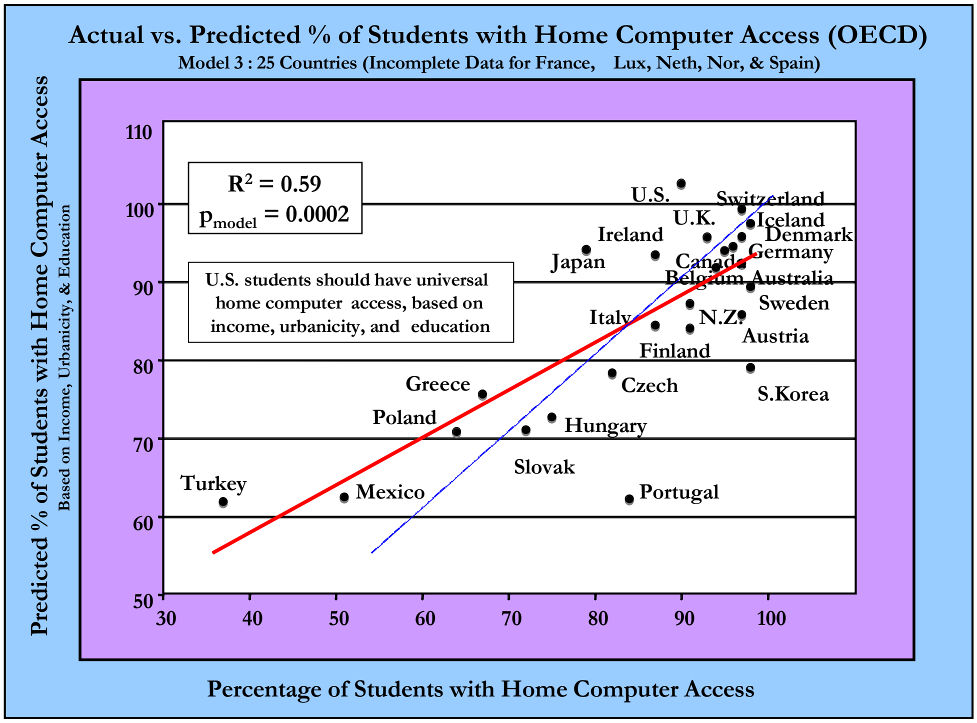


Figure 26

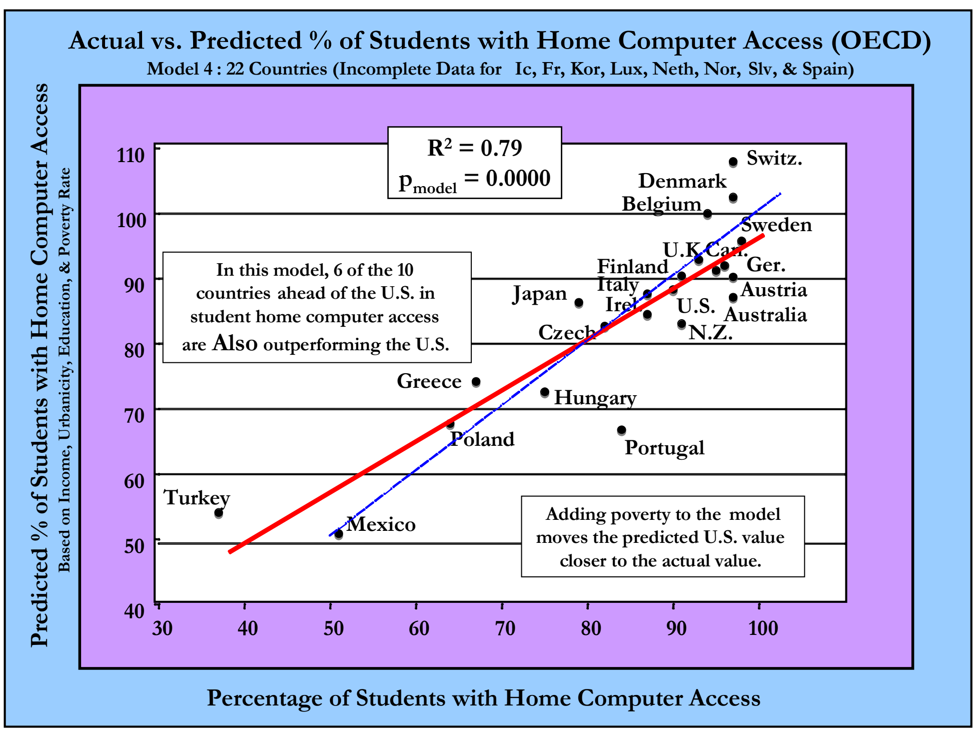


Figure 27 – Full OECD PISA Data

		Percent of Students having never used a computer, by social and cultural status (ESCS), by quartiles				Percentage of Students Having Access to a Computer							Percent of Students having home access to a computer, by social and cultural status (ESCS), by quartiles			
Country	Percent of Students having never used a computer	Bottom Quartile	Second Quartile	Third Quartile	Top Quartile	At Home	At School	Other Places	Home and School	Home, but not school	School, but not home	Neither at home or school	Bottom Quartile	Second Quartile	Third Quartile	Top Quartile
Australia	0.15	0.5	0.04	0.01	0	97	100	93	96	0	3	0	89	98	99	100
Austria	0.09	0.07	0.05	0.07	0.17	97	97	76	94	3	3	0	91	97	99	100
Belgium	0.53	1.02	0.42	0.14	0.23	94	91	85	86	7	5	2	83	95	98	100
Canada	0.47	1.2	0.36	0.15	0.13	95	99	98	95	1	4	0	86	97	99	100
Czech Republic	0.23	0.52	0.16	0.09	0.05	82	95	86	78	4	17	1	55	82	93	96
Denmark	0.05	0	0.07	0.15	0	97	100	85	97	0	3	0	92	98	99	100
Finland	0	0	0	0	0	91	97	89	88	3	9	1	76	91	97	99
France																
Germany	0.2	0.58	0.07	0.09	0.07	96	93	72	89	7	4	1	89	97	99	100
Greece	1.96	3.25	1.57	1.47	1.48	67	93	81	60	4	32	3	38	60	80	90
Hungary	0.11	0.42	0.03	0	0	75	98	84	73	2	24	1	42	73	89	96
Iceland	0.06	0	0	0.12	0.12	98	98	88	96	2	2	0	96	99	99	100
Ireland	0.29	0.9	0	0	0.14	87	89	84	78	9	11	2	67	89	95	99
Italy	1.83	4.18	2.07	0.9	0.19	87	86	62	74	12	11	2	67	87	95	98
Japan	1.44	2.22	1.59	1.03	0.86	79	89	55	69	9	20	2	54	77	89	94
Korea	0.11	0	0	0.33	0.05	98	85	88	84	14	2	1	94	98	100	100
Luxembourg																
Mexico	13.12	28.52	15.38	6.86	1.63	51	83	85	42	5	37	15	11	35	66	91
Netherlands																
New Zealand	0.25	0.3	0.3	0.09	0	91	98	92	90	1	8	0	75	94	97	100
Norway																
Poland	0.52	1.05	0.69	0.35	0	64	91	80	58	6	33	3	25	54	84	95
Portugal	0.58	1.69	0.5	0.14	0	84	98	87	81	1	17	0	60	83	94	99
Slovak Republic	3.82	10.83	2.11	1.23	0.9	72	82	84	60	9	20	10	41	69	84	95
Spain																
Sweden	0.2	0.61	0	0	0.09	98	97	91	95	2	2	0	93	98	100	100
Switzerland	0.34	0.46	0.35	0.22	0.14	97	94	70	92	5	3	1	91	98	99	100
Turkey	14.43	24.58	17.92	11.71	3.36	37	54	73	17	12	26	45	9	19	42	77
United Kingdom	0.05	0	0.19	0	0	93	99	90	93	1	6	0	83	92	98	100
United States	2.02	3.59	2.19	1.66	0.59	90	97	90	88	1	8	2	72	92	96	99