Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of The D.C. Circuit Court of Appeal Decision in *Verizon v. FCC*, and What Actions the Commission Should Take, Consistent with its Authority under Section 706 and all other Available Sources of Commission authority, in Light of the Court's Decision	GN Docket No. 14-28

Declaration

of

LEE L. SELWYN

on behalf of NASUCA

September 17, 2014

DECLARATION OF LEE L. SELWYN

EXECUTIVE SUMMARY

A June 2014 paper authored by University of Pennsylvania Law School Prof. Christopher Yoo, "U.S. vs. European Broadband Development: What Do the Data Say?" has been cited by a number of the larger broadband access providers and their trade associations in support of the proposition that the current treatment of broadband access as "information services" subject to limited regulation under Title I of the *Communications Act* has resulted in greater investment in broadband infrastructure and greater availability of high-speed broadband services in the United States than has been experienced in Europe, where Title II type common carrier regulation has remained in effect. Prof. Yoo presents various data that purports to provide comparisons of conditions extant in the US and in Europe to support this proposition, as well as econometric analyses consisting of several multiple linear regression models that purport to demonstrate a statistically significant relationship between the type of regulatory treatment and the overall extent of "Next Generation Access" ("NGA") high-speed broadband coverage. The operative distinction between the US and European regulatory treatment of broadband is the requirement under European-style regulation, that incumbent providers make access to elements of their broadband infrastructures available on an unbundled basis for use by rival providers to promote "service-based competition" for broadband access. In the US, incumbent broadband providers (cable and telco) are not required to, and generally do not, make components of their broadband networks available to rivals, thus limiting competitive entry into the broadband access market to companies that are prepared in invest in their own facilities-based networks.

I have been asked by the National Association of State Utility Consumer Advocates (NASUCA) to review Prof. Yoo's data and regression analyses and to assess the extent to which they actually support his core conclusion – i.e., that the apparently greater extent of broadband development extant in the US vis-à-vis Europe is, and from a policy perspective should be, attributed to the specific regulatory approach being applied to broadband in the US. From my review of Prof. Yoo's analysis, I have identified a number of serious flaws in his regression model specification, such that the model and results cannot support the conclusions he purports to have reached. Apart from issues of methodology, there are questions about the accuracy and comparability of the data presented by Prof. Yoo, which questions are noted below.

Perhaps the most glaring deficiency in Prof. Yoo's regression model stems from the fact that the analysis he used to conclude that US-style "facilities-based competition" results in greater NGA coverage does not actually include any US data. In reaching his conclusion, Prof. Yoo relies exclusively upon observations drawn from European countries, all of which have adopted the "service-based competition" regulatory regime. The US is not included in Prof. Yoo's regression analysis at all. As such, it is simply not possible for Prof. Yoo's model to have

demonstrated the relationship he claims to have identified. This error by itself provides a fully sufficient basis to dismiss Prof.Yoo's contentions.

However, the flaws in Prof. Yoo's analysis do not end with this already-fatal defect. The Yoo model suffers from a number of other data and model specification problems that render the analysis completely unreliable.

- **The model fails to adequately account for the passage of time.** Prof. Yoo has constructed a so-called "panel model" that combines cross-sectional and time series data for two consecutive years (2011 and 2012) in an effort to overcome the limited number of observations (countries) in his dataset. However, he fails to demonstrate that these two years are representative of a long term pattern or trend. Nor do these data allow Prof. Yoo to account for the lag in time between the effectuation of regulatory policy and investment in the marketplace. These two years of data may actually be anomalous: While Prof. Yoo finds that the US is ahead in broadband deployment in 2012, his data show just the opposite for 2011, with Europe leading the US.

- **The policy variables upon which the model is based are misspecified.** The explanatory variables in the model that purportedly account for regulatory policy do not provide valid indicia or representations of the regulatory distinction and nuance that Prof. Yoo seeks to examine. It is not apparent why "new entrants' market share of DSL lines" is or should be a valid indicator of the regulatory regime in a country and/or that country's level of service-based competition. Prof. Yoo provides no evidence to support this presumption.

- **The model suffers from omitted variable bias.** Prof. Yoo fails to control for the presence and magnitude of government subsidies, the specifics of the individual regulatory regimes, wireless spectrum allocation practices, the preexisting competitive landscape, the length of time a country has been subject to EU regulatory requirements, or any of the myriad of macroeconomic factors that materially impact broadband investment. In its current incarnation, Prof. Yoo's model could not actually account for all of these factors even if he had attempted to identify and acquire such additional data, since the small number of observations included in the analysis limits the number of degrees of freedom in the model, and thus the number of possible variables that can be included in the analysis. The failure to include these material variables in the model results in statistically biased and unreliable results.

- **The model fails to correctly apply the "panel data" methodology that it uses in order to overcome the small number of observations available for study.** In an attempt to overcome the limitations of using such a small number of observations, Prof. Yoo utilized a so-called "panel model" approach in which cross-sectional data for each of several time periods is examined. In this case, however, he used panel data across some 27 countries but for only two consecutive years, and failed to control either for fixed effects or for country-

specific differences. It is standard practice to control both for time and for entity (country in this case) in panel data analysis, yet Prof. Yoo controlled only for the two time points (2011 and 2012), and did not even acknowledge this defect. This failure is likely a function of the frailties of the small data set used by Prof. Yoo.

Prof. Yoo's regression analyses and comparative data do not support any of the conclusions that he claims to have reached, and for this reason should be afforded no weight by the Commission in addressing and resolving the important legal and policy matters at issue in this proceeding.

DECLARATION OF LEE L. SELWYN

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Attachment

1 Statement of Qualifications – Lee L. Selwyn

DECLARATION OF LEE L. SELWYN

I, Lee L. Selwyn, declare as follows:

Qualifications, background and experience

1. My name is Lee L. Selwyn. I am President of Economics and Technology, Inc. ("ETI"), One Washington Mall, 15th Floor, Boston, Massachusetts 02108. ETI is a research and consulting firm specializing in telecommunications economics, regulation and public policy. My Statement of Qualifications is annexed hereto as Attachment 1 and is made a part hereof.

2. I hold a Ph.D. degree in Management from the Alfred P. Sloan School of Management, Massachusetts Institute of Technology. I also hold a Master of Science degree in Industrial Management from MIT and a Bachelor of Arts degree with Honors in Economics from Queens College of the City University of New York. In 1970, I was awarded a Post-Doctoral Research Grant in Public Utility Economics under a program sponsored by the American Telephone and Telegraph Company, to conduct research on the economic effects of telephone rate structures upon the computer time-sharing industry. This work was conducted at Harvard University's Program on Technology and Society, where I was appointed a Research Associate. I was also a member of the faculty at the College of Business Administration at Boston University from 1968 through 1973, where I taught courses in economics, finance and management information systems. I founded my firm, Economics and Technology, Inc., in January 1972, and have served as its President continuously since that date.

3. I have been actively and continuously involved in the fields of telecommunications economics, policy and regulation since the late 1960s. I have provided expert testimony and analysis on telecommunications economics, technology, rate design, service cost analysis, market structure, form of regulation, and numerous other telecommunications issues before more than forty state public utility commissions, the Federal Communications Commission, the United States Congress, and regulatory bodies in a number of foreign countries, on behalf of commercial organizations, non-profit institutions, and local, state and federal government authorities. Attachment 1 to this Declaration provides a complete record of my prior expert testimony and appearances before regulatory agencies and courts.

4. I have had extensive experience with the analysis of telecommunications services costs and production processes. This work has involved detailed examinations of the nature and structure of such costs and of the types and quantities of resources that are required for the provision of these services. I have studied a broad spectrum of telecom services, including wireline local and long distance services, mass market and specialized dedicated services, retail and wholesale services, wireless (cellular) services, broadband distribution and delivery services, and services provided using legacy analog and digital technologies as well as those provided via the Internet or involving Internet Protocol. I have published several articles dealing specifically with Net Neutrality and related Open Internet issues, including "Revisiting the Regulatory Status of Broadband Internet Access: A Policy Framework for Net Neutrality and an Open Competitive Internet," (with Helen E. Golding), *Federal Communications Law Journal*, Vol. 63 Num. 1, December 2010. I have also contributed chapters to two recent American Bar Association

publications, "Network Industry Markets: Telecommunications" (with Helen E. Golding), Chapter X in *Market Definition in Antitrust: Theory and Case Studies*, ABA Section of Antitrust Law (2012), at pp. 411-436, and "Economic Underpinnings: The Economics of Communications Networks, Market Power, and Vertical Foreclosure Theories" (with Helen E. Golding et al), Chapter I in *Telecom Antitrust Handbook, Second Edition*, ABA Section of Antitrust Law (2013), at pp. 1-61.

5. I have submitted expert reports and testimony in numerous telecommunications regulatory proceedings before the Federal Communications Commission ("FCC") and state public utilities commissions in approximately forty states dating back to the late 1960s, dealing with a broad range of ratesetting and policy matters, including switched and special access charges, price cap regulation, Sec. 251/252 interconnection and unbundling requirements, total service resale and wholesale pricing, universal service, broadband and related Internet access issues, intercarrier compensation, spectrum allocation, handset interoperability, CMRS early termination fees, and many others.

6. In addition to my various professional activities, I am an elected Town Meeting Member in the Town of Brookline, Massachusetts, and serve on the Town's Advisory and Finance Committee and on the Town's Audit Committee, and have recently served on a special Tax Override Study Committee.

Assignment

7. I have been asked by the National Association of State Utility Consumer Advocates (NASUCA) to review Prof. Yoo's data and regression analyses and to assess the extent to which they actually support his core conclusion – i.e., that the purportedly greater extent of broadband development extant in the US vis-à-vis Europe is, and from a policy perspective should be, attributed to the specific regulatory approach that has been applied to broadband in the US.

The Yoo regression analysis

8. A June 2014 paper authored by University of Pennsylvania Law School Prof. Christopher Yoo, "U.S. vs. European Broadband Development: What Do the Data Say?"[1] has been cited by a number of the large broadband access providers and their trade associations, including Comcast, Verizon, NCTA, Cox and Charter,[2] in support of the proposition that the current treatment of broadband access as "information services" subject to limited regulation under Title I of the *Communications Act* has resulted in greater investment in broadband infrastructure and greater availability of high-speed broadband services in the United States than has been experienced in Europe, where Title II type common carrier regulation has remained in effect. Prof. Yoo

1. Yoo, Christopher S., *U.S. vs. European Broadband Deployment: What Do the Data Say?* University of Pennsylvania Law School, 2014 ("Yoo paper"), available at https://www.law.upenn.edu/live/files/3352-us-vs-european-broadbanddeployment . The paper states that financial support for it was provided by Broadband for America, an organization opposing reclassification of broadband Internet access as a Title II telecommunications service. The Broadband for America website identifies only one specific member, the U.S. Cattlemen's Assn. See, http://www.broadbandforamerica.com/about/mission (visited 9/9/14). There may be others, but their identities are not disclosed. The Yoo paper itself does not appear to have been submitted for the record in the FCC's *Open Internet* docket.

2. Comcast *Comments*, at 47-48; Verizon *Comments*, at 14; NCTA *Comments*, at 9, 12, 21, 24; Cox *Comments*, at 35; Charter *Comments*, at 8.

presents various data that purports to provide comparisons of conditions extant in the US and in Europe to support this proposition, as well as econometric analyses consisting of several multiple linear regression models that purport to demonstrate a statistically significant relationship between the type of regulatory treatment and the overall extent of "Next Generation Access" ("NGA") high-speed broadband coverage. The operative distinction between the US and European regulatory treatment of broadband that is being examined by Prof. Yoo is the requirement, under European-style regulation, that incumbent providers make access to elements of their broadband infrastructures available on an unbundled basis for use by rival providers in their offering of retail services to consumer and commercial end users, thereby promoting "service-based competition" for broadband access. In the US, incumbent broadband providers (cable and, with limited exceptions, ILECs) are not required to, and generally do not, make components of their broadband networks available to rivals, thus limiting competitive entry into the broadband access market to companies that are able to build their own facilities-based networks.[3]

The data underlying the Yoo paper and regression model is extremely limited and, as such, provides overly simplistic, inconsistent and selective comparisons of conditions extant in the US and Europe.

9. Prof. Yoo has compiled certain data that, he claims, demonstrates that the development of high-speed broadband access ("Next Generation Access" or "NGA") has progressed further in the US than it has in Europe. Using a set of multiple linear regression models that he developed

3. In certain situations, large ILECs may be required to provide unbundled *copper* loops that have no fiber segment to competitors for the provision of DSL. However, given the speed and distance limitations for DSL provisioned over all-copper loops, this rarely occurs in practice.

based upon data that he has deemed relevant, Prof. Yoo attempts to ascribe the apparently superior level of broadband deployment and availability in the US that his data suggest exists specifically to the approach to broadband regulation that has been adopted in the US. Prof. Yoo explains that the US regulatory model requires that competition for broadband service be "facilities-based," where the new entrant is required to acquire the investment capital necessary to fund the construction of a broadband network infrastructure that the provider will use to deliver broadband Internet access services to consumers and businesses within its operating territory.

10. Facilities-based broadband providers in the US are generally not required to, and do not, make elements of their network available to rival providers on an unbundled basis. The US experience, according to Prof. Yoo, is in stark contrast to the regulatory regime extant in Europe, where entrants may engage in "service-based" competition by leasing elements of the incumbent facilities-based provider's network for resale to end-user customers. Prof. Yoo concludes that:

> Disparities between European and U.S. broadband networks stemmed from differing regulatory approaches. Europe has relied on regulations that treat broadband as a public utility and focus on promoting service-based competition, in which new entrants lease incumbents' facilities at wholesale cost (also known as unbundling). The U.S. has generally left buildout, maintenance, and modernization of Internet infrastructure to private companies and focused on promoting facilities-based competition, in which new entrants are expected to construct their own networks. Regression analysis indicates that the U.S. approach has proven more effective in promoting NGA coverage than the European approach.[4]

4. Yoo, at 1.

11. The Yoo paper itself did not reproduce any of the underlying data upon which the regression analysis was based, nor did it provide the model specifications themselves. On August 19, 2014, I contacted Prof. Yoo and requested this material, which he graciously provided. Exhibit 1 hereto contains the dataset that he had used for the four different regression analyses that he describes, and Exhibit 2 provides the model specifications themselves. Using this data and model specifications, I have been able to reproduce Prof. Yoo's results for Models (1), (3) and (4), but the results I have obtained with respect to his Model (2) do not match the results reported in the paper.

12. Reduced to its essentials, the Yoo paper presents two main conclusions:

(1) Broadband development and availability in the US, both with respect to coverage and bandwidth, has outpaced that of Europe; and

(2) The higher level of broadband availability in the US is specifically attributable to the regulatory environment in the US, which relies exclusively upon "facilities-based" competitive entry, vs. the European "service-based competition" approach in which entrants are enabled to obtain wholesale unbundled access to the incumbent provider networks, thereby enabling them to compete at the retail level without the massive facilities investments that are necessary under the US approach.

The data upon which Prof. Yoo bases his various conclusions provides "apples-to-oranges" comparisons that are often inapposite to the specific claim that his paper is seeking to support.

13. I have not undertaken a detailed examination of the comparative data upon which Prof. Yoo relies in support of his first conclusion – that US broadband development and availability has outpaced Europe – to verify its accuracy or consistency; however, from my review of the summary charts and data provided in the paper, I have concerns as to the specific consistency and comparability of the US and European data that he has compiled.

14. Prof. Yoo presents as Figure 5 a comparison of "Investment per Household in the Electronic Communications Sector in the U.S. and Europe, 2007–2012,"[5] but then goes on to treat that *Electronic Communications Sector* data as if it is confined strictly to *broadband*. Then, based on that mischaracterization, Prof. Yoo leaps to the conclusion that "[t]he data on broadband investment reveals a stark disparity between the U.S. and Europe," claiming that "[f]rom 2007 to 2012, per household investment in the U.S. more than doubled per household investment levels in Europe."[6] But as Prof. Yoo also readily notes, "the electronic communications sector ... includes fixed-line telecommunications, mobile telecommunications, and pay television, among other things"[7] It includes broadband, but in an unknown amount, and it is thus not possible to use this Sector-wide data to reach *any* valid conclusion as to the relative level of *broadband-specific* investment in the US vs. the EU. Moreover, from his descriptions, it is not

5. *Id.*, at 13.

6. *Id.*, at 14.

7. *Id.*, at 13.

at all clear that the US and European data have even been obtained from consistent or comparable sources, or that the definitions of "electronic communications" are comparable as between the US and the EC. As noted, Prof. Yoo concedes that the EC's electronic communications sector definition "includes ... pay television [and] other things."[8] He explains that, "[a]lthough the U.S. government does not collect similar data, the U.S. Telecom Association compiles total broadband investments based on financial reports filed by leading providers."[9] There is no basis to assume that these disparate data sources are comparable, that the same types of asset categories and companies have been included in each data series, that comparable accounting treatments have been utilized on both sides of the Atlantic, that the scope of the "leading provider" data compiled by USTA mirrors that of the EC, or that the manner in which government subsidies are treated in the valuations has been reconciled so as to make the US and European investment data directly comparable. And the chart itself does not even identify the currency unit being displayed or the manner in which the different currencies (US dollars, Euros, UK Pounds, Swiss Francs, etc.) were converted (i.e., using exchange rates as of some (unspecified) date, Purchasing Power Parities ("PPPs") as of some unspecified date, or some other procedure).

15. Further compounding the potential for undocumented inconsistencies between US and EC data, and as Prof. Yoo himself notes,[10] there are widespread subsidies provided both at the national and in some cases at the municipal level in Europe to support broadband infrastructure

8. *Id.*, citations omitted.

9. *Id.*, citations omitted.

10. See, e.g., Yoo, at 25, 29, 34, 43 and 44.

development;[11] yet if the European data compiled by Prof. Yoo is limited to private sector investment, such subsidies may not have been fully reflected in the US/European comparisons. Indeed, inasmuch as download speeds (Figure 6) and broadband adoption rates (Figure 7) are roughly comparable for the US and Europe, it is difficult to see how the Europeans could have achieved this outcome at levels of investment that, according to Prof. Yoo's Figure 5, are running at less than half of those in the US.

16. As another example, Prof. Yoo's Figure 11 presents a "European Study of Pricing of Standalone Broadband in the U.S. and Europe, 2012." He notes that the study "attempts to take into account contract length, data caps, nonrecurring costs, promotions, differences in volume and other services, VAT, and purchasing power parity" but does not specify how, precisely, such factors were actually "taken into account." In the US, broadband Internet access is exempt from all local sales and federal excise taxes under the federal *Internet Tax Freedom Act* ("ITFA").[12] In most, if not all, European countries, Internet access is subject to a Value Added Tax ("VAT") that varies from country to country and can range as high as 15% to 25%.[13] Simply eliminating the VAT from the European prices is not a sufficient solution either, since corporate tax rates are considerably higher in the US than in Europe,[14] a potential source of price differences as well,

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11. Some government subsidies may occasionally be available in the US, but to a far more limited extent than in Europe.

12. P.L. 105-277, 112 Stat. 2681-719.

13. European Commission, *VAT Rates Applied in the Member States of the European Union, Situation at 1st July 2014*, Ref. Ares(2014)2087537 - 25/06/2014, at 3.

14. VAT is an alternative approach to taxation that is widely used outside of the US. In countries with VAT-based tax structures, income taxes are typically lower than in the US especially when both federal and state income

(continued...)

and we have no information as to the tax treatment of infrastructure assets as between the US and Europe, not to mention across the individual EU countries themselves. Moreover, a direct comparison of "Standalone Broadband" prices is in itself of dubious merit, since most US broadband services are being provided and purchased in bundles together with video and/or voice telephone service. European broadband services may similarly be offered in bundles, with the prices for such bundles on both sides of the Atlantic being influenced by such things as retransmission fees and other content costs.

17. Another problem in Prof. Yoo's data is that he does not take account of the differences *within* the European market. As one of the EC reports (on which Prof. Yoo relies) states:

> Broadband markets in Europe are fragmented. Looking at any of the key indicators measuring coverage/availability and take-up of fixed, NGA and mobile broadband, there are significant differences across Member States.[15]

Although Prof. Yoo runs through a selection of European countries, he does not mention this caveat of the EC reports, nor does he discuss in sufficient detail the differences extant across the EC and, given their common regulatory model, offer any explanation as to why such differences are present.[16]

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14. (...continued)
taxes are considered, and produce a commensurately lower share of total tax revenues.

15. EC Communications Commission Report of March, 2014 (referred to by Prof Yoo as "EC (2014a)," at 6 (available at http://ec.euoropa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=4590).

16. In a similar vein, there are also significant differences in broadband availability across the US despite the common FCC-mandated regulatory model that applies uniformly throughout the US. As in Europe, the form of regulation by no means provides the predominant, let alone the sole, explanation for such differences in broadband availability as may exist at the present time.

18. Finally, throughout his paper, Prof. Yoo seems to conflate fixed-line and mobile broadband, sometimes including the latter, sometimes ignoring it. For example, his Figure 6, titled "Standard Broadband and NGA Adoption per Covered Household in the U.S. and Europe, 2011 and 2012," presents two sets of comparisons for 2011 vs. 2012. The first, labeled "All Fixed Broadband," portrays a virtual dead heat between the US and Europe for both years, with the US slightly ahead. The second comparison, titled "NGA," shows Europe slightly ahead of the US in 2011 but, for 2012, shows the US back in the lead.[17] Prof. Yoo attributes this "surge" in US NGA coverage to "an increase in the penetration in mobile wireless broadband providing NGA speeds from 0% of U.S. households [in 2011] to 7% of U.S. households [in 2012]."[18] Prof. Yoo's regression models utilize a "Total NGA" dependent variable that may or may not include any mobile broadband. But since he has omitted any US data from his regression, the Total NGA for the US, and the fact that for 2012 it is running ahead of Europe, is certainly not captured in his analysis. Wireless broadband is not equivalent to, nor is it a substitute for, fixed line broadband; wireless cannot support the bandwidths, transmission quality, and traffic volumes typical of fixed line broadband.[19]

17. Yoo, at 14.

18. *id.*, at 15.

19. AT&T and Verizon are pushing wireless – including wireless broadband – as the sole option in areas of their service territory where they seek to withdraw wireline services and not deploy advanced facilities. In many of these situations, wireless is an inferior form of broadband due to issues like topography and dense vegetation, and broadband signals cannot be received at some locations or they might be available outside a building but not inside. By conflating the two forms of broadband, Prof. Yoo seems to be suggesting that all broadband – and broadband investment – is of equal quality and value to the customer. That is clearly not the case.

19. I leave it to others to dissect Prof. Yoo's data in more detail. However, from my limited examination of the data underlying the regression models as well as the various comparison charts contained in the Yoo paper, the data upon which Prof. Yoo bases his various conclusions provides overly simplistic, and in many cases "apples-to-oranges" comparisons that are, in certain cases, inapposite to the specific claim that his paper is seeking to foster. For example, Prof. Yoo specifically recognizes that "[i]n terms of standard broadband, household adoption numbers in the U.S. and Europe are very high and very similar, with the U.S. being slightly ahead. Given the slow growth, it would appear that standard broadband adoption was nearing saturation in 2012."[20] And, "[w]ith respect to NGA, adoption is still in its nascent stages."[21] Notably, the comparative outcomes being reported by Prof. Yoo are highly sensitive to the particular time frame selected for the comparison, and to what types of services are included. Thus, he observes that "[t]he U.S. lagged slightly behind Europe in 2011, but surged ahead in 2012, reaching 17% of households as compared with 14% NGA penetration in Europe. The primary driver was an increase in the penetration in mobile wireless broadband providing NGA speeds from 0% of U.S. households to 7% of U.S. households."[22] Notably, if Prof. Yoo had looked only at 2011 results, he would have concluded that Europe was ahead of the US in NGA development. By looking instead at 2012 figures, or by including mobile as well as fixed broadband, he would have reached precisely the opposite conclusion. Since only two years' worth of data has been selected for inclusion in the Yoo analysis, there is no direct way to tell whether the 2012 result putting the US ahead of Europe was an anomaly or a fluke – hardly a

20. Yoo, at 15.

21. *Id.*

22. *Id.*

basis for assessing the correct regulatory paradigm And as noted above, inasmuch as adoption rates and download speeds appear to be virtually the same here and in Europe and that in any event some of the results may flip from one year to the next, it is difficult to accept the notion that the US is lagging behind, or that the seemingly large disparities in broadband investment per household are the result of policy differences rather than the non-comparability of the data.

Prof. Yoo's regression analysis does not support his conclusion that US regulatory policy "explains" the purportedly greater level of US broadband development.

20. Even accepting for purposes of discussion that the data compiled by Prof. Yoo affords an accurate and directly comparable picture of conditions extant in both Europe and in the US, the regression analysis as described in the Yoo paper provides no support whatsoever for his second conclusion – i.e., that the seemingly higher level of broadband availability in the US is specifically attributable to the US regulatory policy of facilities-based competition.

21. Regression analysis is a statistical process for quantitatively estimating the relationships among variables. More specifically, regression analysis helps one understand how the value of the dependent variable changes when any one of the independent or explanatory variables changes while the other independent variables are held constant. It is a widely used and widely accepted economic analysis technique for prediction and forecasting. In undertaking a regression analysis, one begins by hypothesizing intuitive relationships as between a "dependent" variable and one or more "independent" or "explanatory" variables. Regression analysis then provides a mathematical process for testing the statistical validity of the hypothesized relationship or "model." A key element of any such hypothesis is an assumption

1 of *causality*. In this instance, Prof. Yoo was seeking, specifically, "[t]o test the impact of
2 service-based and facilities-based competition on NGA coverage."[23] He explains that, while the
3 US *Telecommunications Act of `1996* had originally provided for "service-based" competitive
4 entry by "permitting competitors to share incumbent providers' networks through local loop
5 unbundling and wholesale access, ... [t]he U.S. soon soured on this idea ... [and] abandoned local
6 loop unbundling in favor of a regulatory approach that focused on facilities-based
7 competition."[24] He explains that "European regulation, in contrast, has continued to emphasize
8 the service-based competition by requiring carriers with significant market power to share their
9 facilities through mechanisms such as local loop unbundling, shared access, and bitstream
10 access."[25] In fact, the regulatory policy regime extant throughout the EU is expressly directed at
11 facilitating service-based competition, and by an explicit Directive of the European Parliament,
12 *all* EU national regulatory agencies are *required* to adopt and to enforce such policies.[26] Thus,
13 the causal relationship that Prof. Yoo hypothesizes, and that his regression analysis undertakes to
14 test, is that US-style "facilities-based" competition produces superior NGA coverage than
15 European-style "service-based" competition.
16

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23. *Id.*, at 10.

24. *Id.*, at 9.

25. *Id.*

26. *See*, *Directive 2002/19/EC of the European Parliament and of the Council of 7 March 2002 on access to, and interconnection of, electronic communications networks and associated facilities* (Access Directive) as amended by Directive 2009/140/EC (unofficially consolidated version), *Regulatory framework for electronic communications in the European Union, Situation in December 2009*, The Publications Office of the European Union. ISBN 978-92-79-14964-1 doi:10.2759/24096, at pp. 75-84. Available at https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/Copy%20of%20Regulatory%20Framework%20for%20Electonic%20Communications%202013%20NO%20CROPS.pdf

22. In principle, that hypothesis is something that is amenable to testing via regression analysis. One would specify, as the dependent variable, an indicia of NGA coverage, for example, the number or the percentage of homes passed by NGA facilities, as Prof. Yoo has done here. Because factors other than the regulatory regime may also influence the extent of NGA development, the econometrician would undertake to identify and test, in addition to a "regulatory policy" variable reflective of the "facilities-based" vs. "service-based" approach, other explanatory variables that may also impact the dependent variable: the level of NGA coverage in this instance. One would also want to include within the data set observations associated with both of the regulatory regimes being examined, so that the outcomes of each in terms of NGA coverage, along with other contributing factors, could be evaluated.

23. Yet it is precisely in this regard that the Yoo model is fatally flawed, *because all of the observations in his sample are drawn exclusively from European countries all of which have adopted and are pursuing the same "service-based competition" policy*. It is simply not possible to apply regression analysis to test the outcome of Policy A ("facilities-based" competition) vs. Policy B ("service-based" competition) *when all of the observations upon which the regression model is based are from countries that have uniformly adopted the same Policy B*. Prof. Yoo might, perhaps, argue that inclusion of the US in the regression dataset would not have made much difference, in that it would be just one of 28 countries the remainder of which have adopted a service-based competition regulatory model. But that would miss the point: One cannot reasonably apply regression analysis to test the effect of two alternate policies if all, or virtually all, of the observations adhere to only one of them.

The two policy variables that Prof. Yoo has defined do not provide a valid indicia or representation of the regulatory distinction whose results he seeks to examine.

24. In any event, while Prof. Yoo is seeking to attribute the purportedly greater level of NGA coverage that he claims to exist in the US to the adoption, in the US, of a regulatory regime in which all competition must be facilities-based, the dataset upon which his regression analysis is based is confined entirely to European countries all of which have adopted, in some form, a regulatory regime in which service-based broadband competition is supported and facilitated, and which *does not include the US at all*. Had he included a mix of countries some of which had adopted facilities-based competition while others were pursuing service-based competition, the "policy variable" could be defined as equal to "1" where the former approach was being used, or "0" where the latter approach was in place. But this is not what Prof. Yoo has done. Instead, he defined two policy variables, as follows:

- "The primary measure for service-based competition is the new entrants' market share of DSL lines, which are presumably served by sharing the incumbent's network.

- The primary measure of facilities-based competition is broadband coverage by standard cable."[27]

New entrants market share – Service Based competition. It is not at all apparent as to why "the new entrants' market share of DSL lines" in particular is or should be a valid indicator of the

27. *Id.*, citations omitted.

extent of service-based competition, and Prof. Yoo offers no empirical or other support for this proposition or for his "presumption" that these DSL lines are being "served by sharing the incumbent's network." And even if that "presumption" were valid, the new entrants' market share of DSL lines will be driven by any number of other factors including, but not limited to:

- the length of time that such "service-based" competitors have been in operation;
- the relationships between the wholesale prices being charged to "service-based" competitors and the retail prices being charged by the incumbent provider to its own retail customers;
- the nature of the operations support systems in place to facilitate wholesale purchases; and
- Contractual and then legal disputes.

In the years following the *1996 Act* when local loop unbundling was the official US policy, entrants were forced to engage in protracted litigation with uncooperative incumbent carriers in order to obtain access to unbundled wholesale services.[28]

Facilities Based Competition – Broadband Coverage by Standard Cable. As for Prof. Yoo's "facilities-based" policy variable, in the very same paragraph he concedes that the extent of

28. Indeed, when Prof. Yoo suggests that the US had "soured" on the idea of "permitting competitors to share incumbent providers' networks through local loop unbundling and wholesale access," he obscures the fact that this change in US policy was driven almost entirely by federal court rulings resulting from the persistent litigation initiated and pursued by the incumbent local exchange carriers themselves.

broadband coverage by standard cable is probably not material, in that "94% of all standard cable broadband in Europe and 92% of all standard cable broadband in the U.S. had already been upgraded to DOCSIS 3 by the end of 2012."[29] Put differently, while the extent of broadband coverage by standard cable may, in and of itself, have some predictive property as to the overall extent of NGA development, as used in Prof. Yoo's regression model it teaches nothing with respect to the impact of one regulatory regime vs. the other because the result was virtually the same under both.

25. Prof. Yoo examined four alternative regression model specifications:

- Specification (1) regresses the percentage of DSL provided by new entrants against NGA coverage;
- Specification (2) regresses the degree of standard cable coverage against NGA coverage;
- Specification (3) regresses both variables against NGA coverage to identify the factor(s) that most directly affect the availability of "Next Generation Access" ("NGA") broadband;[30]
- Specification (4) isolates the competitive impact of cable broadband on incumbent telephone companies by eliminating Total NGA coverage as the dependent variable and replacing it with the sum of VDSL and FTTP. This new dependent variable does not include DOCSIS 3 coverage as one of its components and reflects only those aspects of NGA coverage that are spurred on by competition from cable.[31]

29. *Id.*

30. *Id.*, at 11.

31. *Id.*

Yet none of these specifications contain a valid policy variable, and none include any instances of US-style regulation based upon facilities-based competition. Indeed, the stated objective of Specification (4) – to "reflect[] only those aspects of NGA coverage that are spurred on by competition from cable" – seems particularly distant from the effects of the specific regulatory policy differences that are purportedly being studied. That is, the extent of VDSL and HTTP deployment by incumbent local telephone companies may well be driven primarily by competition from cable – a result that would seem to be supported by the results of model (4) – , but nothing in Prof. Yoo's analysis actually establishes that the extent of competition from cable bears any relationship to the choice of one or the other regulatory paradigm under examination. In short, the Yoo regression models are simply incapable of providing any assessment of the effect of US vs. European regulatory policies upon NGA investment, deployment, and coverage.

Prof. Yoo's analysis inappropriately and incorrectly conflates fixed-line and mobile broadband both with respect to the data upon which he relies and as to the applicable regulatory treatment relevant to mobile services.

26. As I have previously noted,[32] Prof. Yoo has included both US fixed-line and mobile NGA broadband in his comparison of US vs. European NGA coverage. Although the US data is excluded from the regression dataset, it is not clear whether or not the NGA coverage data for Europe, which is the dependent variable in the regression models, also includes both fixed-line and mobile, or fixed-line only. That notwithstanding, Prof. Yoo's characterization of US broadband policy as suporting only "facilities-based" competitive entry is specific to fixed-line broadband. The situation applicable to mobile wireless broadband is far more complex.

32. Para, 15, *supra.*

27. In the US, there are currently four nationwide mobile facilities-based carriers (AT&T, Verizon, Sprint and T-Mobile) and several other facilities-based mobile carriers with more limited regional footprints. The FCC, in rejecting the AT&T/T-Mobile merger and, more recently, in less formally discouraging the Sprint/T-Mobile proposed merger that was recently withdrawn as a result, has made it clear that it would not allow less than four nationwide providers in the wireless market.[33] Whether or not FCC rules *require* that facilities-based mobile carriers provide non-facilities-based entrants with access to their networks, they all do so on a voluntary basis. This is because, with four nationwide carriers and the several smaller ones licking at their heels, the larger carriers – particularly nos. 3 and 4 (Sprint & T-Mobile) – are incented to expand their own distribution channels by entering into "Mobile Virtual Network Operator " ("MVNO") and similar resale and private branding deals with non-facilities-based providers (e.g., Wal-Mart's Straight Talk Wireless, TracPhone). The one area where the FCC has gotten involved is in the case of roaming, where facilities-based carriers are generally required to enter into commercially reasonable roaming agreements with smaller carriers – and even with their nationwide rivals – to fill in gaps in their respective coverage. It is thus a gross oversimplification to view the US policy with respect to wireless as equivalent to that for fixed broadband. And although the competitive landscape and resale/roaming policies applicable to mobile broadband are still evolving relative to the conditions applicable to mobile voice, the trajectory is in the same general direction.

33. In a statement issued August 6, 2014, FCC Chairman Tom Wheeler said "Four national wireless providers are good for American consumers. Sprint now has an opportunity to focus their efforts on robust competition." FCC News Release, August 6, 2014, Chairman Wheeler Statement on Competition in the Mobile Marketplace, http://www.fcc.gov/document/chairman-wheeler-statement-competition-mobile-marketplace

28. It is of course, unclear as to whether and, if so, to what extent, mobile broadband availability has been included in any of the regression data. What is clear, however, is that the policy distinction being tested by Prof. Yoo does not accurately reflect the wireless situation in the US, and that in any event no US data has been included in the regression itself.

Prof. Yoo's regression model fails to consider many relevant explanatory variables.

29. As I noted earlier, regression analysis provides an understanding as to how the value of the dependent variable changes when any one of the independent or explanatory variables changes *while the other independent variables are held constant*. Thus, many factors may influence the extent of NGA coverage, but if the objective is to identify specifically how NGA coverage is affected by the choice of regulatory regime, those other factors will need to be identified and controlled for.

30. Yet all four of Prof. Yoo's regression model specifications only control for three country-specific attributes – GDP per capita, percentage of rural households, and total population. There are, however, many other potentially important country-specific attributes that would undoubtedly affect nationwide NGA and/or VDSL and FTTP coverage (Prof. Yoo's proxies for nationwide broadband coverage) none of which were addressed in his models. Macroeconomic literature identifies a variety of country-specific factors that are crucial to explaining cross-country income differences.[34] For example:

34. *See*, e.g., Romer, D., "Cross-Country Income Differences," In *Advanced Macroeconomics* (4th ed.) (pp. 150-188). New York: McGraw-Hill, 2012.

- Social Infrastructure
- Security of property rights
- Human capital
- Physical capital
- Political system (capitalism vs. communism)
- Political stability
- Lack of corruption
- Norms of civic responsibility
- Ethnic diversity
- Geography

Some of these may be similar across all of the EU countries (for example, all are parliamentary democracies notwithstanding the fact that some are also constitutional monarchies). However, others are subject to wide variation across Europe. Prof. Yoo fails to control for any of these in his regression:

- **The geographic size of the country.** For example, one would expect that construction of a broadband network is a far simpler and far less costly undertaking in a small country such as Cyprus than in a large country such as France or Germany. The European NGA (Next Generation Access) mapping studies from which Prof. Yoo compiled his data indicates that Cyprus had no NGA coverage whatsoever in 2011 (0.0% coverage) yet just one year later,

in 2012, Cyprus was reported to have achieved NGA coverage of 73.1%.[35] A jump of this magnitude would be unthinkable in geographically larger countries. No geographic area variable was included in Prof. Yoo's data set.

- **Terrain.** Construction costs are obviously impacted by the physical properties of a country's land area – mountains, rivers, climate, etc. The regulatory regime notwithstanding, the cost and time required to construct a broadband network will be significantly affected by these geographic properties. Prof. Yoo does not account for terrain is his analysis.

- **The availability and extent of government subsidies.** Prof. Yoo presents "case studies" of eight European countries' broadband policies and deployment experience. With the exception of Denmark, he observes that all of the others in this group have provided subsidies, at the national or in some cases at the municipal level, to support broadband infrastructure development.[36] Government subsidies of this type are expressly intended to facilitate broadband infrastructure development by reducing the extent of required private sector investment and risk, and in so doing accelerating the pace of construction relative to

35. European Commission (EC) (2012), *Broadband Coverage in Europe in 2011: Mapping Progress Towards the Coverage Objectives of the Digital Agenda*, available at http://ec.europa.eu/information_society/newsroom/cf/document.cfm?doc_id=1102 (visited 9/10/2014); European Commission (EC) (2013), *Broadband Coverage in Europe in 2012: Mapping Progress Towards the Coverage Objectives of the Digital Agenda*, available at http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=3647 (visited 9/10/2014). It is also possible that these data are simply erroneous, which would potentially impact the overall reliability of Prof. Yoo's analysis.

36. Yoo, at 35.

where it might have been absent the subsidy. Clearly, the presence and value of any government subsidies will have a material and direct impact upon NGA coverage yet, despite being aware of their widespread use throughout the EU, Prof. Yoo failed to include or control for the availability and amount of broadband subsidies in any of his model specifications.

- **Other regulatory differences.** As previously noted, all of the countries in Prof. Yoo's data set have adopted the European style "service-based competition" regulatory model. However, the manner in which each country has implemented and enforced that regime – and the length of time it has been in effect – likely varies widely across the continent. Since adoption of a "service-based competition" regulatory model is mandatory for all EU countries, the date at which each country was admitted to the EU would represent at least one source of country-specific regulatory variation. Apparently, Prof. Yoo recognizes the possibility of such variation in regulatory policy in that he has specified regulatory policy variables that could, arguably, capture the effects of such differences. However, the "percent of DSL provided by new entrants" and the "percent of standard cable availability" are themselves influenced by factors other than each country's regulatory practices (such as the extent of incumbent DSL deployment, the availability of other broadband infrastructure alternatives, pricing, etc.) and their use necessitates a far more detailed understanding of those relationships than is present in the Yoo analysis or regression models.

- **Economic climate.** Although the GNP variable that Prof. Yoo includes in his models may account for static differences in income levels from country to country, it does not account

for the overall economic climate extant in each. In 2011 and 2012, Europe was still in the midst of its great recession, while the US was beginning to emerge from the downturn that had begun in 2008.[37] A number of European countries were faced with onerous sovereign debt and potential default, and had in a number of cases adopted various austerity measures that may have affected both public and private sector infrastructure investments. During the 2000's decade Spain, for example, was experiencing considerable prosperity and was, among other things, engaged in the construction of a high-speed rail network. But when faced with the prospect of default on its debt, much of that infrastructure development effort came to an abrupt halt.[38] Nowhere in Prof. Yoo's model specifications does he include any economic climate variable or control for these types of national economic conditions.

- **Spectrum Policy.** One particularly important example of variation in regulatory policy from one European country to the next involves spectrum. Countries vary as to their policies regarding allocation of electromagnetic spectrum among competing demands – e.g., broadcast television, mobile wireless services, public safety, national defense, among others. The availability of spectrum for wireless data services, specifically NGA data services such as LTE, will be a limiting (or enabling) factor in the buildout of NGA wireless services.

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37. Krugman, Paul, "The Austerity Debate," *The New York Times*, Januray, 2010, http://www.nytimes.com/2012/01/30/opinion/krugman-the-austerity-debacle.html?_r=0&pagewanted=print (visited September 12, 2014); Krugman, Paul, "U.S. Chose Better Path to Recovery," *The New York Times*, May, 2012, http://www.nytimes.com/2012/05/04/business/us-chose-better-path-to-economic-recovery.html=0&pagewanted=print (visited September 12, 2014).

38. Taylor, Julien, "Spain's obsession with high-speed trains runs into budget reality," *Reuters*, June, 2013, http://www.reuters.com/assets/print?aid=USL5N0EQ1KI20130617 (visited September 12, 2014); Govan, Fiona, "Spain cuts high speed 'ghost train,'" *The Telegraph*, June, 2011, http://www.telegraph.co.uk/news/worldnews/europe/spain/8603392/Spain-cuts-high-speed-ghost-train.html (visited September 12, 2014).

While Prof. Yoo includes LTE coverage in his analysis, he fails to control for this major factor in LTE deployment. Using Prof. Yoo's case studies as a guide, if we compare the deployment of LTE in Sweden to the deployment of LTE in France, we confirm that there still remains wide variation in the deployment of LTE across the EU. Prof. Yoo characterizes Sweden as a "global leader in LTE" and suggests the reason for Sweden's success in deploying near country-wide LTE coverage by 2011 is a direct result of Sweden's quick adoption of spectrum auctions.[39] Sweden was the second country in Europe to hold auctions for 2.6 GHz (May 2008) and for 800 MHz (March 2011).[40] On the other hand, Prof. Yoo characterizes France as "lagg[ing] well behind the rest of Europe," citing the fact that LTE coverage was 0% in 2011 and 6% in 2012.[41] Prof. Yoo again links the deployment of LTE directly to the timing of spectrum auctions, suggesting that, among other reasons, the fact that France did not allocate its 2.6 GHz spectrum until September 2011 hurt the extent of its of LTE coverage relative to other European countries.[42] He also suggests another reason why France is struggling relative to other countries – that third-generation HSPA+ networks used by French wireless providers have limited coverage, which has also contributed to lower levels of overall broadband coverage in France.[43] Prof. Yoo concedes that the timing of spectrum auctions and the extent of development of wireless networks

39. Yoo, at 26.

40. *Id.*

41. *Id.*, at 29

42. *Id.*

43. *Id.*, at 29-30

within a given country can have significant effects upon overall LTE deployment; however, he fails to control for either of these effects in his models.

- **Government initiatives to further develop broadband infrastructure**. A major difference between the US and Europe and even among European countries is the extent of government initiatives and subsidies to advance construction of broadband infrastructure. In addition to differences in subsidy levels, as Prof. Yoo has discussed at length in his eight "case study" discussions, there is substantial variation across European governments regarding both the extent of broadband development and the specific technology to be adopted. For example, Ireland's "National Broadband Scheme" is funded by the government, while Spain has developed a public/private partnership to expand broadband coverage.[44] Some countries, such as Austria, France, Iceland, and the Netherlands, have chosen to pursue FTTP architecture, while others have instead adopted VDSL over existing copper infrastructure, or expansion of DOCSIS 3.0 in their cable infrastructures.[45] These are major policy differences that directly affect the cost, pace and extent of broadband deployment, and may well have a far greater impact than any differences in the alternative regulatory paradigms that Prof. Yoo has undertaken to analyze.

- **Preexisting telecommunications competitive landscape.** For most European countries, the traditional approach to telecom had been through government-owned monopolies, often

44. OCED Directorate for Science, Technology and Industry Committee for Information, Computer and Communications Policy (2008), *Broadband Growth and Policies in OCED. Countries*, OCED Ministerial Meeting on the Future of the Internet Economy, Seoul, Korea, June 2008.

45. *Id.*, at 35 and 50.

affiliated with the national postal service. Over the past several decades, most of these state-owned enterprises have been privatized, but at different times and with widely varying capitalizations.[46] Some of these now-private enterprises have aggressively pursued foreign investments and acquisitions, while others have remained close to their traditional national service areas. For example, Germany's deregulation, following the 1996 German Telecom Act, began with the privatization of former monopolies like Deutsche Telekom AG, a company that developed into a major multinational enterprise. In contrast, Belgium's largest wireless provider, Belgacom, is still a partially state-owned company and provides coverage mainly in western Europe. The timing and nature of the evolution of competition within each country has a material impact upon each country's level and rate of investment in new infrastructure, yet none of these factors were addressed or controlled for in the Yoo models.

I have not attempted to suggest an exhaustive list of potential explanatory variables, and there may well be others. Moreover, not all of those I have listed above may prove to be statistically significant. However, these, and potentially others, should have been examined and evaluated, but were not.

31. One of the reasons why Prof. Yoo had included only a handful of explanatory variables in each of his model specifications was due to the relatively small number of observations that were available in his data set. Regression analysis produces unreliable results when the number

46. Bain & Company, *Next Generation Competition: Driving Innovation in Telecommunications*, Bain digital broadband infrastructure study, October 2009, at 23.

of independent variables approaches the number of individual observations in the data sample. Prof. Yoo had devised a so-called "cross-sectional" model construct, in which he used data from each of the 27 EU countries plus a few non-EU European states – Norway, Iceland, and Switzerland – excluding certain observations for which data was missing.[47] That would have provided only 27 or 28 observations. One way to overcome this small sample size problem is to utilize a technique known as a "panel model," in which data for the same set of entities (countries, in this case) over several years are utilized. In this instance, Prof. Yoo did use a panel model, but employed a flawed design whose results are dubious at best. Prof. Yoo's model utilized data for two years – 2011 and 2012. He had 27 observations for 2011 and 28 for 2012, for a total of 55 observations. Such a "panel model" is a combination of a cross-sectional and a time-series model, and requires that both the "time" and the individual data entities (countries, in this instance) be controlled for. Thus, the panel model should have included a time variable (which it did) and one "dummy variable"[48] for each of the individual countries in the sample (which it did not). Notably, even in the absence of a panel model approach, the significant variation across the various EU countries with respect to the many attributes I have identified above (but which were not addressed in Prof. Yoo's study) required that some country-specific or perhaps attribute-specific variables be included in the specification *even under a straight cross-sectional approach*. However, where a panel model is used, entity-specific

47. See Exhibit 1. It should be noted that Prof. Yoo's description of the countries/states to be included in his analysis is inconsistent and erroneous. For example, Prof. Yoo attempted to include Croatia as an EU member country in 2012, even though Croatia was admitted to the EU on July 1, 2013. Similarly, Norway was to be omitted from the analysis as a non-EU member state, but appears to have been inadvertently included for one, but not both, years.

48. The term "dummy variable" is not prejorative. It is simply an indicator variable for the presence or absence of a particular trait. For example, when data comes from France, the French "dummy variable" would be set equal to 1. When the data came from another country, the French variable would be set equal to 0.

dummy variables would be considered a requirement when entity-specific effects are correlated with explanatory variables.[49] Thus, Prof. Yoo should have defined and included country-specific dummy variables so as to control for country specific effects, the absence of which is likely to have generated misleading results.

32. The panel data that Prof. Yoo had compiled spans only two years – and two *consecutive years* at that – which provides little evidence as to how either new entrants' share of market DSL or standard cable coverage may have affected NGA and VDSL and FTTP coverage over time. In order to properly estimate these effects, a more appropriate data set would either include more panels spanning a longer period of time, or two panels that are separated by a few years (rather than two consecutive panels).[50] Two reasons why two consecutive panels are inappropriate for measuring regulatory effects relate to controlling for the longevity of a country's broadband policies (regulation, subsidies, other factors) and the lagged effect that the implementation of such policies would have upon broadband coverage. The use of such a limited panel fails to adequately control for policies that have been in place for twenty years vs. those that have only been in place for one year. Moreover, the effects that new policies may have on market behavior may require an extended period of time to be observed, which is why regression models often seek to account for lagged effects.[51] In the case of NGA coverage, there is likely to be a

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49. Cameron, A. C., & P. K. Pravin, "Linear Panel Models: Basics," *In Microeconometrics: Methods and Applications* (1st ed.) (pp. 697-740). New York: Cambridge University Press, 2005 ("Cameron & Pravin"), at 702-703.

50. Stock, J. H. & W. W. Watson, *Introduction to Econometrics* (3rd ed.). Boston: Addison-Wesley, 2011 ("Stock & Watson"), at 353-369.

51. *Id.*, at 520-582.

significant lag from the introduction of a policy to the time when that policy begins to affect broadband coverage. Prof. Yoo did not include any such lagged effects in his study.

33. One method econometricians use to control for entity- (or country-) specific effects is a fixed effects regression.[52] Essentially, fixed effects regressions control for any characteristics of an identified entity that do not typically change over time. For example, the geographic size of most European countries has been relatively stable since the end of World War II (notwithstanding the current situation in Ukraine and Russia); similarly, cultural norms are expected to remain relatively consistent over time. The fixed effects model is generally accepted as the baseline method to control for any unobservable entity-specific factors that may have an effect on the dependent variable (in this case NGA coverage) of a regression model. Failing to control for entity-specific effects can bias regression estimates if entity-specific effects are correlated with the independent variable(s) of a specified regression model.[53]

34. Prof. Yoo does not explain how the sample of countries used to estimate the final regression results was selected. The data provided to me by Prof. Yoo (reproduced in Exhibit 1) includes three non-EU countries – Norway, Iceland, and Switzerland – as well as some data for Croatia, which Prof. Yoo apparently, but incorrectly, believed had become a member of the EU

52. *Id.*, at 354-358; see also, Glick, R. & R. Kenneth. "Global Versus Country-specific Productivity Shocks and the Current Account," *Journal of Monetary Economics* 35(*1)*, February, 1995, 159-192; Louzis, D. P., T. A. Vouldis & V. L. Metaxas, "Macroeconomic and Bank-specific Determinants of Non-performing Loans in Greece: a Comparative Study of Mortgage Business and Consumer Loan Portfolios," No 118, Working Papers, Bank of Greece, 2010.

53. Cameron & Pravin, at 702-703.

in 2012. In fact, Croatia had not been admitted to the EU until July 1, 2013.[54] Data was thus collected for 31 countries over two years for a total of 62 observations, but the final regression data only included a total of 55 observations. In his paper, Prof. Yoo does not disclose which countries were included or excluded from his analysis, nor why.

35. Table 3 in the Yoo paper summarizes the results for the four model specifications that were evaluated by Prof. Yoo. In Specification (1), he includes only one of the two "policy" variables, in this case, the "Percentage DSL by New Entrants." In that model, two of the four explanatory variables – Percentage Rural Households and GDP Per Capita – are not statistically significant at the 95% confidence level, the confidence level most commonly accepted by econometricians.[55] The time variable, Year, is significant at the 95% level, which is not particularly surprising inasmuch as the extent of NGA coverage in any given country will either be increasing or remain unchanged from one year to the next. The policy variable, Percentage DSL by New Entrants," is significant at the 99% level. However, the overall model has an r^2 of only 0.38, which is interpreted as indicating that the model "explains" only 38% of the variation in the dependent variable, NGA Coverage in this instance. In the second model, Prof. Yoo substitutes the alternate policy variable, Standard Cable Coverage, for Percent DSL. With that change, only the GDP Per Capita variable is found not to be statistically significant at the 95% level (again, Prof. Yoo notes that it is significant at the 90% level, below the generally accepted threshold). The r^2 jumps to 0.89, making this model a far better fit to the data. However, as I

54. http://europa.eu/about-eu/countries/member-countries/croatia/index_en.htm (visited September 10, 2014).

55. Stock & Watson, at 77-78.

discussed above, the "Standard Cable Coverage" variable, which seems to account for the vast improvement in specification (2) vs. (1), teaches nothing about the effect of "facilities-based" vs. "service-based" competition policy since, as Prof. Yoo has himself observed, the Standard Cable Coverage is virtually identical in both the US and in Europe and, in any event, has essentially nothing at all to do with the effects of facilities-based vs. service-based broadband competition.

36. Prof. Yoo's specification (3) includes both of his policy variables. The r^2 drops slightly to 0.88, but in this model the Percentage DSL by New Entrants variable is no longer statistically significant (Prof. Yoo notes that it is significant at the 80% level, even further below the generally accepted minimum 95% threshold). Specification (3) thus corroborates the finding, in specification (2), that the principal driver of NGA coverage is Standard Cable Coverage, which of course has nothing whatsoever to do with the regulatory policy distinction that the Yoo model is intended to examine.

The exclusion of relevant explanatory variables causes the Yoo regression models to suffer from omitted variable bias.

37. Prof. Yoo's regression models appear to suffer from omitted variable bias. Omitted variable bias causes a violation of the class linear regression model assumptions, leading to unreliable results. The effect of omitted variable bias is often the inflation of the coefficients for the included variables (and thus the measure of statistical significance). In other words, the results reported by Prof. Yoo are likely not the true value of the coefficients, and to the extent they were not already below standard levels, overstate the level of statistical significance that can be ascribed to each coefficient.

38. As I have discussed in detail above, there are numerous variables that have a basis in economic theory for inclusion in this study that were not included by Prof. Yoo. Even if Prof. Yoo had made an attempt to include such additional data, the small number of observations in the dataset (a frailty that Prof. Yoo acknowledges[56]) limits the number of explanatory variables that can be included before the statistical properties of the model cease to be meaningful.

39. Prof. Yoo's own results indicate that important variables have been omitted. Tables 3 & 4 in the Yoo report, which display the author's regression results, show significant increases in r^2 from model specification (1) to model specification (3) after the addition of a single explanatory variable.[57] Such a substantial increase is often characteristic of omitted variable bias, and should have been a red flag to Prof. Yoo that the results from the first specified regression are questionable at best.[58]

Several variables that have been defined in percentage terms have been inappropriately weighted by the total population of each country.

40. Statistical weighting, the practice of changing the effect of an observation to reflect its importance or "weight," is appropriate in certain circumstances – but not here. Since both of Prof. Yoo's dependent variables are *percentages*, i.e. both represent the percentage of the

56. Yoo, at page 9: "Although the number of observations is quite limited, the dataset reflects sufficient heterogeneity to support regression analysis of the impact of service-based and facilities-based competition on NGA coverage." Not really. The "number of observations" is actually so small as to preclude the inclusion of many highly relevant explanatory variables, thus creating omitted variable bias.

57. Yoo, at 11.

58. Stock & Watson, at 234-235

country's population with coverage, it is simply methodologically incorrect to then also weight the regression by total population. Indeed, it is hard to imagine, and there is no theoretical basis to believe, that the success or failure of a regulatory policy should be more important in countries with larger populations. If the dependent variable used in the regression was instead specified as the total number of people (or households) with coverage, then weighting the regression by total population might be appropriate. Thus, had Prof. Yoo used quantities of lines instead of percentages, a weighted model would normalize for different populations – e.g., Malta vs. the UK. However, the use of percentages accomplishes this same normalization. Thus, the correct approach when using percentage data is to not use country population weights.

41. I have undertaken to reproduce the Yoo model in two ways: as he had presented it, i.e., with country population weights, and without such weights.[59] Prof. Yoo's incorrect use of weighted data produces a higher correlation and seemingly better statistical properties – higher r^2's and larger coefficients on the Standard Cable Coverage policy variable – than when the correct unweighted methodology is used, thus making the results appear better than they really are.

59. These results are presented in Exhibit 3 hereto. As I had noted above, I was able to precisely reproduce Prof. Yoo's specifications (1), (3) and (4), but in the case of specification (2) the results I obtained were slightly different. For this comparison, I am using the results that I have been able to obtain for specification (2) for both the weighted and unweighted versions.

Conclusion

42. Prof. Yoo's regression analyses and and the data upon which it relies are simply not capable of supporting the core conclusion that his paper advances – i.e., that US-style broadband regulation and its reliance upon facilities-based competitive entry, outperforms the European-style, common carrier approach under which incumbent providers are required to make components of their infrastructures available to entrants on a nondiscriminatory unbundled basis so that "service-based" competition can arise. The Yoo model is simply incapable of comparing US-style "facilities-based entry" regulation to European-style "service-based entry" regulation using the type of statistical analysis that his regression approach contemplates *because he has failed to include any instances of US-style regulation in the dataset underlying his regression model*. Beyond that fundamental – and fatal – flaw, the Yoo models also suffer from a range of other shortcomings, including misspecification of the principal "policy" variables that are being tested, omission of highly relevant and important explanatory variables, misapplication of the "panel model" methodology by failing to include entity-specific "dummy" variables, failing to control for other country-specific attributes including public subsidies and overall macroeconomic conditions, among other things. For almost any one of these individual reasons, and certainly for all of them when viewed together, Prof. Yoo's regression analyses and comparative data do not support any of the conclusions that he claims to have reached, and should be afforded no weight by the Commission in addressing and resolving the important legal and policy matters at issue in this proceeding.

1 VERIFICATION

2

3 The foregoing statements are true and correct to the best of my knowledge, information and

4 belief, and if called to testify thereon I am prepared to do so.

LEE L. SELWYN

Executed at Boston, Massachusetts
this 17th day of September, 2014.

Exhibit 1

Regression Data
Used in the Yoo Models

Source: Provided by Prof. Yoo 8/20/14

Yoo DATA - Total Coverage

Country	Year	Rural	TotNGA	VDSL	FTTP	VDSL+FTTP	StdCable	DSLShareNewEnt	RurPct	GDPPCPPS	PopTot
Austria	2012	0	0.695	0.505	0.063	0.568	0.356	0.127	0.143	130	8,451,860
Austria	2011	0	0.644	0.465	0.053	0.518	0.348	0.128	0.143	129	8,408,121
Belgium	2012	0	0.971	0.850	0.003	0.853	0.959	0.128	0.046	120	11,161,642
Belgium	2011	0	0.968	0.810	0.002	0.812	0.959	0.147	0.046	120	11,094,850
Bulgaria	2012	0	0.607	0.000	0.073	0.073	0.571	0.000	0.196	47	7,284,552
Bulgaria	2011	0	0.593	0.000	0.056	0.056	0.562	0.000	0.196	47	7,327,224
Croatia	2012	0	0.191	0.159	0.062	0.221	0.196		0.224	62	4,262,140
Croatia	2011	0							0.224	61	4,275,984
Cyprus	2012	0	0.731	0.520	0.000	0.520	0.474	0.197	0.125	92	865,878
Cyprus	2011	0	0.000	0.000	0.000	0.000	0.459	0.195	0.125	94	862,011
Czech Republic	2012	0	0.493	0.250	0.122	0.372	0.331	0.153	0.142	81	10,516,125
Czech Republic	2011	0	0.403	0.096	0.113	0.209	0.328	0.148	0.142	81	10,505,445
Denmark	2012	0	0.729	0.207	0.430	0.637	0.631	0.247	0.166	126	5,602,628
Denmark	2011	0	0.619	0.199	0.372	0.571	0.626	0.275	0.166	126	5,580,516
Estonia	2012	0	0.610	0.006	0.362	0.368	0.716	0.006	0.225	71	1,324,814
Estonia	2011	0	0.521	0.024	0.307	0.331	0.715	0.003	0.225	69	1,333,788
Finland	2012	0	0.655	0.450	0.333	0.783	0.420	0.000	0.181	115	5,426,674
Finland	2011	0	0.639	0.460	0.310	0.770	0.416	0.000	0.181	116	5,401,267
France	2012	0	0.242	0.000	0.065	0.065	0.255	0.561	0.175	109	65,633,194
France	2011	0	0.232	0.000	0.038	0.038	0.237	0.548	0.175	109	65,327,724
Germany	2012	0	0.662	0.463	0.026	0.489	0.591	0.467	0.105	123	80,523,746
Germany	2011	0	0.638	0.406	0.024	0.430	0.551	0.477	0.105	123	80,327,900
Greece	2012	0	0.219	0.217	0.004	0.221	0.000	0.565	0.199	75	11,062,508
Greece	2011	0	0.042	0.042	0.000	0.042	0.000	0.557	0.199	80	11,123,034
Hungary	2012	0	0.597	0.028	0.216	0.244	0.629	0.140	0.321	67	9,908,798
Hungary	2011	0	0.528	0.028	0.171	0.199	0.620	0.156	0.321	67	9,931,925
Iceland	2012	0	0.541	0.447	0.451	0.898	0.000		0.363	115	321,857
Iceland	2011	0	0.446	0.224	0.383	0.607	0.000		0.363	115	319,575
Ireland	2012	0	0.421	0.005	0.017	0.022	0.424	0.366	0.387	129	4,591,087
Ireland	2011	0	0.312	0.005	0.017	0.022	0.384	0.346	0.387	129	4,582,707
Italy	2012	0	0.140	0.045	0.118	0.163	0.000	0.467	0.127	101	59,685,227
Italy	2011	0	0.107	0.000	0.107	0.107	0.000	0.458	0.127	102	59,394,207

Latvia	2012	0	0.785	0.071	0.785	0.856	0.414	0.002	0.285	64	2,023,825
Latvia	2011	0	0.660	0.016	0.608	0.624	0.331	0.002	0.285	60	2,044,813
Lithuania	2012	0	0.800	0.000	0.800	0.800	0.530	0.007	0.346	72	2,971,905
Lithuania	2011	0	0.622	0.000	0.594	0.594	0.528	0.007	0.346	68	3,003,641
Luxembourg	2012	0	0.938	0.877	0.318	1.195	0.696	0.222	0.131	263	537,039
Luxembourg	2011	0	0.852	0.800	0.231	1.031	0.635	0.202	0.131	266	524,853
Malta	2012	0	0.999	0.750	0.009	0.759	0.999	0.005	0.009	86	421,364
Malta	2011	0	0.988	0.750	0.000	0.750	0.985	0.005	0.009	86	417,546
Netherlands	2012	0	0.984	0.599	0.177	0.776	0.988	0.266	0.082	128	16,779,575
Netherlands	2011	0	0.971	0.473	0.128	0.601	0.985	0.276	0.082	129	16,730,348
Norway	2012	0	0.757	0.327	0.296	0.623	0.461		0.218	195	5,051,275
Norway	2011	0	0.694	0.268	0.249	0.517	0.459	0.371	0.218	186	4,985,870
Poland	2012	0	0.445	0.257	0.029	0.286	0.324	0.360	0.207	67	38,533,299
Poland	2011	0	0.368	0.117	0.022	0.139	0.302	0.371	0.207	65	38,538,447
Portugal	2012	0	0.778	0.000	0.461	0.461	0.774	0.150	0.177	76	10,487,289
Portugal	2011	0	0.745	0.000	0.412	0.412	0.759	0.189	0.177	77	10,542,398
Romania	2012	0	0.637	0.174	0.547	0.721	0.264	0.000	0.209	50	20,020,074
Romania	2011	0	0.574	0.174	0.475	0.649	0.238	0.000	0.209	48	20,095,996
Slovakia	2012	0	0.511	0.003	0.394	0.397	0.283	0.146	0.148	76	5,410,836
Slovakia	2011	0	0.472	0.000	0.389	0.389	0.215	0.094	0.148	75	5,404,322
Slovenia	2012	0	0.651	0.429	0.427	0.856	0.362	0.370	0.256	84	2,058,821
Slovenia	2011	0	0.627	0.415	0.386	0.801	0.360	0.361	0.256	84	2,055,496
Spain	2012	0	0.639	0.109	0.179	0.288	0.513	0.409	0.177	96	46,704,308
Spain	2011	0	0.560	0.109	0.097	0.206	0.469	0.408	0.177	96	65,327,724
Sweden	2012	0	0.566	0.166	0.462	0.628	0.406	0.370	0.170	126	9,555,893
Sweden	2011	0	0.534	0.167	0.462	0.629	0.368	0.389	0.170	125	9,482,855
Switzerland	2012	0	0.942	0.534	0.167	0.701	0.950		0.146	158	8,039,060
Switzerland	2011	0	0.927	0.436	0.122	0.558	0.917		0.146	155	7,954,662
UK	2012	0	0.703	0.469	0.007	0.476	0.480	0.611	0.088	106	63,896,071
UK	2011	0	0.583	0.261	0.002	0.263	0.465	0.608	0.088	105	63,495,303

Yoo DATA - Rural Coverage

Country	Year	Rural	TotNGA	VDSL	FTTP	VDSL+FTTP	StdCable	DSLShareNewEnt	RurPct	GDPPCPPS	PopTot
Austria	2012	1	0.144	0.000	0.012	0.012	0.159	0.127	0.143	130	8,451,860
Austria	2011	1	0.087	0.000	0.000	0.000	0.111	0.128	0.143	129	8,408,121
Belgium	2012	1	0.654	0.586	0.000	0.586	0.591	0.128	0.046	120	11,161,642
Belgium	2011	1	0.654	0.559	0.000	0.559	0.589	0.147	0.046	120	11,094,850
Bulgaria	2012	1	0.000	0.000	0.000	0.000	0.000	0.000	0.196	47	7,284,552
Bulgaria	2011	1	0.001	0.000	0.001	0.001	0.000	0.000	0.196	47	7,327,224
Croatia	2012	1	0.000	0.000	0.000	0.000	0.000		0.224	62	4,262,140
Croatia	2011	1							0.224	61	4,275,984
Cyprus	2012	1	0.450	0.450	0.000	0.450	0.000	0.197	0.125	92	865,878
Cyprus	2011	1	0.000	0.000	0.000	0.000	0.000	0.195	0.125	94	862,011
Czech Republic	2012	1	0.015	0.000	0.013	0.013	0.011	0.153	0.142	81	10,516,125
Czech Republic	2011	1	0.000	0.000	0.000	0.000	0.000	0.148	0.142	81	10,505,445
Denmark	2012	1	0.030	0.000	0.030	0.030	0.000	0.247	0.166	126	5,602,628
Denmark	2011	1	0.000	0.000	0.000	0.000	0.000	0.275	0.166	126	5,580,516
Estonia	2012	1	0.000	0.000	0.000	0.000	0.251	0.006	0.225	71	1,324,814
Estonia	2011	1	0.014	0.014	0.000	0.014	0.137	0.003	0.225	69	1,333,788
Finland	2012	1	0.066	0.000	0.066	0.066	0.000	0.000	0.181	115	5,426,674
Finland	2011	1	0.042	0.000	0.000	0.000	0.000	0.000	0.181	116	5,401,267
France	2012	1	0.006	0.000	0.006	0.006	0.007	0.561	0.175	109	65,633,194
France	2011	1	0.000	0.000	0.000	0.000	0.000	0.548	0.175	109	65,327,724
Germany	2012	1	0.264	0.218	0.007	0.225	0.093	0.467	0.105	123	80,523,746
Germany	2011	1	0.215	0.131	0.004	0.135	0.072	0.477	0.105	123	80,327,900
Greece	2012	1	0.000	0.000	0.000	0.000	0.000	0.565	0.199	75	11,062,508
Greece	2011	1	0.000	0.000	0.000	0.000	0.000	0.557	0.199	80	11,123,034
Hungary	2012	1	0.101	0.000	0.035	0.035	0.161	0.140	0.321	67	9,908,798
Hungary	2011	1	0.039	0.000	0.034	0.034	0.144	0.156	0.321	67	9,931,925
Iceland	2012	1	0.000	0.000	0.000	0.000	0.000		0.363	115	321,857
Iceland	2011	1	0.000	0.000	0.000	0.000	0.000		0.363	115	319,575
Ireland	2012	1	0.014	0.000	0.000	0.000	0.014	0.366	0.387	129	4,591,087
Ireland	2011	1	0.000	0.000	0.000	0.000	0.014	0.346	0.387	129	4,582,707
Italy	2012	1	0.000	0.000	0.000	0.000	0.000	0.467	0.127	101	59,685,227
Italy	2011	1	0.000	0.000	0.000	0.000	0.000	0.458	0.127	102	59,394,207

Latvia	2012	1	0.244	0.000	0.244	0.244	0.000	0.002	0.285	64	2,023,825
Latvia	2011	1	0.074	0.000	0.074	0.074	0.000	0.002	0.285	60	2,044,813
Lithuania	2012	1	0.422	0.000	0.422	0.422	0.003	0.007	0.346	72	2,971,905
Lithuania	2011	1	0.221	0.000	0.221	0.221	0.003	0.007	0.346	68	3,003,641
Luxembourg	2012	1	0.913	0.825	0.242	1.067	0.000	0.222	0.131	263	537,039
Luxembourg	2011	1	0.841	0.753	0.176	0.929	0.000	0.202	0.131	266	524,853
Malta	2012	1	0.895	0.000	0.000	0.000	0.895	0.005	0.009	86	421,364
Malta	2011	1	0.029	0.000	0.000	0.000	0.029	0.005	0.009	86	417,546
Netherlands	2012	1	0.845	0.284	0.085	0.369	0.860	0.266	0.082	128	16,779,575
Netherlands	2011	1	0.729	0.278	0.085	0.363	0.829	0.276	0.082	129	16,730,348
Norway	2012	1	0.190	0.055	0.093	0.148	0.094		0.218	195	5,051,275
Norway	2011	1	0.205	0.022	0.050	0.072	0.082	0.371	0.218	186	4,985,870
Poland	2012	1	0.007	0.000	0.000	0.000	0.007	0.360	0.207	67	38,533,299
Poland	2011	1	0.006	0.000	0.000	0.000	0.006	0.371	0.207	65	38,538,447
Portugal	2012	1	0.318	0.000	0.060	0.060	0.308	0.150	0.177	76	10,487,289
Portugal	2011	1	0.307	0.000	0.051	0.051	0.301	0.189	0.177	77	10,542,398
Romania	2012	1	0.250	0.013	0.232	0.245	0.042	0.000	0.209	50	20,020,074
Romania	2011	1	0.216	0.013	0.200	0.213	0.040	0.000	0.209	48	20,095,996
Slovakia	2012	1	0.000	0.000	0.000	0.000	0.000	0.146	0.148	76	5,410,836
Slovakia	2011	1	0.000	0.000	0.000	0.000	0.000	0.094	0.148	75	5,404,322
Slovenia	2012	1	0.000	0.000	0.000	0.000	0.000	0.370	0.256	84	2,058,821
Slovenia	2011	1	0.000	0.000	0.000	0.000	0.000	0.361	0.256	84	2,055,496
Spain	2012	1	0.130	0.000	0.000	0.000	0.140	0.409	0.177	96	46,704,308
Spain	2011	1	0.066	0.000	0.000	0.000	0.075	0.408	0.177	96	65,327,724
Sweden	2012	1	0.063	0.002	0.062	0.064	0.001	0.370	0.170	126	9,555,893
Sweden	2011	1	0.049	0.002	0.047	0.049	0.001	0.389	0.170	125	9,482,855
Switzerland	2012	1	0.648	0.127	0.029	0.156	0.657		0.146	158	8,039,060
Switzerland	2011	1	0.412	0.069	0.000	0.069	0.644		0.146	155	7,954,662
UK	2012	1	0.182	0.143	0.001	0.144	0.050	0.611	0.088	106	63,896,071
UK	2011	1	0.038	0.038	0.000	0.038	0.000	0.608	0.088	105	63,495,303

Exhibit 2

Yoo Model Specifications

Source: Provided by Prof. Yoo 8/23/14

```
reg TotNGA DSLShareNewEnt RurPct GDPPCPPS Year [aweight = PopTot]
if Rural == 0, cluster(Country)

reg TotNGA StdCable RurPct GDPPCPPS Year [aweight = PopTot] if
Rural == 0, cluster(Country)

reg TotNGA DSLShareNewEnt StdCable RurPct GDPPCPPS Year [aweight
= PopTot] if Rural == 0, cluster(Country)

reg VDSLFTTP DSLShareNewEnt StdCable RurPct GDPPCPPS Year
[aweight = PopTot] if Rural == 0, cluster(Country)
```

Exhibit 3

Replication of the Yoo models with and without country population weightings

Table 1. Regression Results for Yoo Model (Weighted per Yoo Results)

Specification	(1)	(2)	(3)	(4)
Dependent Variable	TotNGA	TotNGA	TotNGA	VDSL+FTTP
Percent DSL by New Entrants	-0.809***		-0.244	-0.770***
	(0.247)		(0.167)	(0.219)
Standard Cable Coverage		0.893***	0.818***	0.288**
		(0.0667)	(0.0931)	(0.115)
Percentage rural households	-1.477*	-0.333	-0.655*	-1.283**
	(0.792)	(0.319)	(0.367)	(0.473)
GDP per capita	0.00271*	-0.000749	-0.000435	0.00189
	(0.00147)	(0.00112)	(0.000977)	(0.00137)
Year	0.0496***	0.0354**	0.0355**	0.0842***
	(0.0131)	(0.0145)	(0.0146)	(0.0211)
Constant	0.757***	0.254*	0.398**	0.482*
	(0.237)	(0.134)	(0.147)	(0.248)
Observations	55	61	55	55
Adjusted R-squared	0.334	0.843	0.864	0.620
F-Statistic	30.76	72.28	42.82	82.95
RMSE	0.192	0.0948	0.0866	0.137

Note 1: Clustered standard errors are displayed in parenthesis.
Note 2: I was unable to exactly re-produce Yoo's 2nd Specification, however, the results are relatively similar.
Significance levels: * p<0.10; ** p<0.05; *** p<0.01
Source: Yoo Data.

Table 2. Regression Results for Yoo Model (Unweighted)

Specification	(1)	(2)	(3)	(4)
Dependent Variable	TotNGA	TotNGA	TotNGA	VDSL+FTTP
Percent DSL by New Entrants	-0.703***		-0.326**	-0.736***
	(0.185)		(0.132)	(0.236)
Standard Cable Coverage		0.692***	0.599***	0.119
		(0.0919)	(0.0855)	(0.137)
Percentage rural households	-0.773**	0.125	-0.200	-0.453
	(0.352)	(0.369)	(0.296)	(0.672)
GDP per capita	0.00194***	0.000918**	0.00108***	0.00332***
	(0.000487)	(0.000420)	(0.000295)	(0.000667)
Year	0.0850***	0.0651**	0.0727**	0.0987***
	(0.0277)	(0.0258)	(0.0276)	(0.0224)
Constant	0.663***	0.115	0.272**	0.280
	(0.107)	(0.116)	(0.112)	(0.227)
Observations	55	61	55	55
Adjusted R-squared	0.416	0.651	0.697	0.435
F-Statistic	12.02	25.18	41.16	17.79
RMSE	0.182	0.143	0.132	0.220

Note 1: Clustered standard errors are displayed in parenthesis.
Significance levels: * p<0.10; ** p<0.05; *** p<0.01
Source: Yoo Data.

Attachment 1

STATEMENT OF QUALIFICATIONS

LEE L. SELWYN

Statement of Qualifications

LEE L. SELWYN

Dr. Lee L. Selwyn has been actively involved in the telecommunications field for more than forty years, and is an internationally recognized authority on telecommunications regulation, economics and public policy. Dr. Selwyn founded the firm of Economics and Technology, Inc. in 1972, and has served as its President since that date. He received his Ph.D. degree from the Alfred P. Sloan School of Management at the Massachusetts Institute of Technology. He also holds a Master of Science degree in Industrial Management from MIT and a Bachelor of Arts degree with honors in Economics from Queens College of the City University of New York.

Dr. Selwyn has testified as an expert on rate design, service cost analysis, form of regulation, and other telecommunications policy issues in telecommunications regulatory proceedings before some forty state commissions, the Federal Communications Commission and the Canadian Radio-television and Telecommunications Commission, among others. He has appeared as a witness on behalf of commercial organizations, non-profit institutions, as well as local, state and federal government authorities responsible for telecommunications regulation and consumer advocacy.

He has served or is now serving as a consultant to numerous state utilities commissions including those in Arizona, Minnesota, Kansas, Kentucky, the District of Columbia, Connecticut, California, Delaware, Maine, Massachusetts, New Hampshire, Vermont, New Mexico, Wisconsin and Washington State, the Office of Telecommunications Policy (Executive Office of the President), the National Telecommunications and Information Administration, the Federal Communications Commission, the Canadian Radio-television and Telecommunications Commission, the United Kingdom Office of Telecommunications, and the Secretaria de Comunicaciones y Transportes of the Republic of Mexico. He has also served as an advisor on telecommunications regulatory matters to the International Communications Association and the Ad Hoc Telecommunications Users Committee, as well as to a number of major corporate telecommunications users, information services providers, competitive local exchange carriers, interexchange carriers, wireless services providers, and specialized access services carriers.

Dr. Selwyn has presented testimony as an invited witness before the U.S. House of Representatives Subcommittee on Telecommunications, Consumer Protection and Finance and before the U.S. Senate Judiciary Committee, on subjects dealing with restructuring and deregulation of portions of the telecommunications industry.

In 1970, he was awarded a Post-Doctoral Research Grant in Public Utility Economics under a program sponsored by the American Telephone and Telegraph Company, to conduct research on the economic effects of telephone rate structures upon the computer time sharing industry. This work was conducted at Harvard University's Program on Technology and Society, where he was appointed as a Research Associate. Dr. Selwyn was also a member of the faculty at the College of Business Administration at Boston University from 1968 until 1973, where he taught courses in economics, finance and management information systems.

Dr. Selwyn has been an invited speaker at numerous seminars and conferences on telecommunications regulation and policy, including meetings and workshops sponsored by the National Telecommunications and Information Administration, the National Association of Regulatory Utility Commissioners, the U.S. General Services Administration, the Institute of Public Utilities at Michigan State University, the National Regulatory Research Institute, the Harvard University Program on Information Resources Policy, the Columbia University Institute for Tele-Information, the Massachusetts Institute of Technology Alfred P. Sloan School of Management, the National Association of State Utility Consumer Advocates (NASUCA), the National Conference of Regulatory Attorneys, as well as at numerous conferences and workshops sponsored by individual regulatory agencies. Dr. Selwyn is an elected Town Meeting Member for the Town of Brookline, Massachusetts, and serves on the Town's Advisory and Finance Committee and its Subcommittee on Planning and Regulation, on the Town's Audit Committee, and on its Tax Override Study Committee.

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RECORD OF EXPERT TESTIMONY

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1981

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Texas Public Utilities Commission, *Application of Southwestern Bell Telephone Company for a Statewide Rate Increase,* Docket No. 2673, on behalf of Texas Retailers Association, Direct Testimony filed August 27, 1979, cross-examination September 19, 1979.

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Illinois Commerce Commission, *Illinois Bell Telephone Company Proposed general increase in telephone rates applicable in all exchanges of the Company in Illinois*, Docket No. 78-0034, on behalf of Illinois Retail Merchants Association, Direct Testimony filed June 9, 1978, cross-examination July 10, 1978.

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1977

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Illinois Commerce Commission, *Illinois Bell Telephone Company Proposed general increase in telephone rates applicable to all exchanges of the Company in Illinois*, Docket No. 76-0409, on behalf of Illinois Retail Merchants Association, Direct Testimony filed January 1977, cross-examination January 30, 1977.

1976

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Illinois Commerce Commission, *Illinois Bell Telephone Company Proposed rate increase for Private Line and Mileage Services, revisions and increases for Telephone Answering Service Equipment and Services applicable to all exchanges of the company in Illinois*, Docket No. 76-0200, on behalf of Illinois Retail Merchants Association, Direct Testimony filed October 1976, cross-examination November 10, 1976.

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New Mexico State Corporation Commission, *Mountain States Telephone and Telegraph Company,* Docket No. 673, on behalf of New Mexico Retail Association, Direct Testimony filed October 30, 1975, cross-examination November 3-4, 1975.

North Carolina Utilities Commission, *Application of Southern Bell Telephone and Telegraph Company for Authority to Increase its Local Exchange Rates and Charges Throughout its Franchised Areas in North Carolina*, Docket No. P-55 Sub 742, on behalf of North Carolina Retail Merchants Association, Direct Testimony filed September 23, 1975, cross-examination October 16, 1975.

Illinois Commerce Commission, *Illinois Bell Telephone Company proposed general increases in telephone rates applicable to all exchanges of the company in Illinois*, Docket No. 59666, on behalf of Illinois Retail Merchants Association, Direct Testimony filed September 10, 1975, cross-examination September 29-30, 1975.

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