The Impact of Title II Regulation of Internet Providers On Their Capital Investments

Kevin A. Hassett and Robert J. Shapiro

November 2014

EXECUTIVE SUMMARY

Broadband Internet service providers (ISPs), market analysts and other experts have long predicted that the threat of public utility regulation of broadband Internet services would depress industry investment by billions of dollars. Until now, it has been difficult to quantify the damage to investment. This study presents a new approach for estimating how regulation of ISPs under Title II of the Communications Act of 1934 could affect their future capital investment plans.

The results are not surprising. The study finds that under Title II regulation, ISPs are likely to invest significantly less than they would absent Title II regulation, putting at risk much of the very large capital investments that will be needed to meet the expected increases in demand for data services.

The study employs a novel approach to project a baseline of capital investment growth assuming that the FCC maintains the current "light touch" regulation of data services. In particular, it utilizes a quantitative model to estimate the portion of capital investment from 2009 to 2014 subject to Title II regulation and the portion unencumbered by Title II. The study is based on data from a subset of companies with Title II regulated wireline networks as well as lightly regulated wireline and wireless data networks. From these recent historical trends, we develop a baseline of expected investment growth from 2015 to 2019 and compare it to the alternative case in which wireline data services are reclassified under Title II.

If the status quo continues, with data services unencumbered by Title II regulation, the several ISPs in our sample are expected to spend approximately $218.8 billion in new capital investments over the next five years in their wireline and wireless networks. In contrast, under Title II regulation of all wireline data services, these ISPs' wireline and wireless capital investments over the next five years would drop to an estimated range of $173.4 billion to $190.7 billion. Title II regulation of ISPs thus reduces these companies' total investments by $28.1 billion to $45.4 billion (between 12.8 percent and 20.8 percent) over the next five years. Wireline investments by these firms would be 17.8 percent to 31.7 percent lower than expected.

These estimates are based on a specification of the econometric model which weights ISPs by the number and implicit growth rate of their subscriptions, which helps them plan their capital expenditures based on projected demand. We investigated other specifications, including one unweighted for subscriptions and others which take account of different scale responses to spikes in wireless investments. In every case, a projected expansion of Title II regulation led to large reductions in investments.

These estimates are based on a scenario in which only wireline data is reclassified under Title II. The impact would be even greater if wireless data were reclassified as a Title II service. Moreover, these estimates reflect only the subset of companies in our sample. If applied to the broader industry, including cable companies and wireless-only companies, the absolute impact would be substantially larger. In addition, Title II regulation of ISPs may have even greater adverse effects after taking account of effects on innovation. Innovation usually thrives best in unregulated spaces. In industries characterized by rapid rates of innovation, economic regulation can have large and far-reaching effects by changing market conditions in ways which affect decisions over whether to bear the costs and assume the risks, for example, of developing

new technologies. This suggests that Title II regulation of ISPs could have very deleterious effects on the wireless Internet, which currently exhibits extensive and rapid innovation.

Some proponents of Title II regulation of ISPs have tried to minimize these potential effects on investment and innovation by promising FCC forbearance from the most burdensome aspects of traditional public-utility regulation, such as tariffing, interconnection, unbundling and pricing-related regulation. Yet, many legal experts believe that FCC forbearance would entail a protracted process with significant chances for judicial reversals. Moreover, given the FCC's record of having once rejected Title II regulation of ISPs and now considering a reversal of that position, the prospect of Title II will continue to introduce uncertainties which in themselves will have significant effects on investment. The study reviews the impact of such uncertainties on investment and concludes that the effects are potentially large and negative.

The Impact of Title II Regulation of Internet Providers on Their Capital Investments

Kevin A. Hassett and Robert J. Shapiro[1]

I. Introduction

The Federal Communications Commission (FCC) has reprised the 2010 debate over how to regulate Internet service providers (ISPs) and perhaps other Internet companies as well. The debate involves important issues of economic and social policy, because access to the Internet and its diverse applications is increasingly vital to almost all Americans, their businesses, schools and government agencies, and social and civic organizations. One of the most critical issues raised by the FCC is whether the regulation now applied to telecommunications companies under Title II of the Communications Act of 1934 (Title II Regulation) should be extended to Internet companies. This study analyzes and estimates the impact of extending Title II regulations on future capital investments by broadband Internet service providers.

Strong capital investment by ISPs is an essential factor for the Internet's increasing utility and continuing expansion. According to recent data from Cisco, U.S. IP traffic quintupled over the past five years and should continue to grow at high rates over the next five years. This rapid growth in IP traffic has been encouraged and supported by very high levels of capital investment by ISPs, totaling more than $1 trillion over the past 15 years.[2] The economic literature and extensive evidence across industries have found that strong and sustained investment occurs in response to fast-rising demand and the prospect of earnings from meeting that demand, as well as fears of business setbacks if firms are unable to meet customer demands. To date, demand and investment have kept pace with each other. However, we do not know if such would be the case under a different regulatory climate. As we discuss below, the economic literature suggests that Title II regulation of broadband providers, including the rate regulation provisions of Title II, could substantially slow those investments. Our analysis of the data provides empirical corroboration of that theory as it applies to the current question.

While it is well known and broadly accepted that strict regulation generates many types of costs, a reasonable way of estimating the investment effects of such regulation for Internet providers has not been available. This study will present a set of assumptions under which we can construct an econometric model to estimate how Title II regulation could affect the investment plans of Internet service providers. We also examine the theoretical literature that provides some evidence of the likely scale of effects on investment, based on studies of the irreversibility of investments in telecommunications networks and the impact of regulatory uncertainty on the cost of capital. To construct and operate this new model, we draw on data regarding actual wireless and wireline investments, which allow us to estimate under our specified assumptions the impact on wireline and total wireless and wireline investment of subjecting specified firms to expanded Title II regulation. We found that the results of our empirical model are generally consistent with the predictions of the theory.

---

[1] The authors gratefully acknowledge support provided by AT&T, Inc., for the research for this study. The views and analysis are solely those of the authors.

[2] U.S. Telecom, October 22, 2014, and U.S. Telecom Broadband Industry Statistics.

Our approach carries several important caveats. For example, large spikes in the data for the key variables of an econometric model can drive its results, and those results may contain nonlinear effects. Therefore, we present alternative specifications that take account of these dynamics. In addition, the investments made by Internet service providers vary considerably, based on their subscriptions and other factors. As a consequence, we present a series of estimates based on whether the analysis is weighted by subscriptions, or not weighted at all. In all cases, we found that Title II regulation of Internet service providers would have significant negative effects on their future investments.

Our preferred estimates account for the large differences in scale or size across the ISPs by weighting each ISP based on its number of subscriptions. These estimates suggest that Title II regulation of Internet service providers would reduce their future wireline investments by between 17.8 percent and 31.7 percent per-year, assuming that the effects estimated based on our sample can be applied going forward. This implies that Title II regulation of wireline would reduce future total wireline and wireless investments by between 12.8 percent and 20.8 percent per-year. Direct Title II regulation of wireless would produce much larger reductions. Under current regulation, we estimate that the Internet providers that form the basis of our analysis will undertake $218.8 billion in total wireline and wireless investments over the next five years (2015-2019). Further, we estimate that by placing all wireline under Title II regulation, the implied reduction in their wireless and wireline investments over those five years totals at least $28.1 billion and as much as $45.4 billion. (Table 3, below, subscriber-weighted specifications) As this suggests, our estimates of the likely impact of expanded Title II regulation are sharply negative for all specifications we explore. We conclude that ISPs are unlikely to undertake the large-scale capital investments needed to meet demand rising at the rates expected over the next five years, should our estimates of the impact of Title II regulation prove to be a sound guide to the future.

II. The Impact of Regulation on the Capital Investments of Internet Service Providers: Review of the Theory and Empirics

Economic theory and evidence from a range of industries[3] suggests to us that Title II regulation of Internet service providers would depress investment by those companies, and here we develop and specify a model that enables us to estimate the dimensions of that impact. We begin by explicating the theoretical argument in order to assess the potential scale of the negative effects of such regulation, and then we create a filtering model that can separate existing wireline investment into its Title II and non-Title II components.

The impact of regulation on investment is a long-standing issue for economists. In an important early work that influenced many researchers and regulators, Averch and Johnson demonstrated that when regulators guarantee specific rates of return on capital investment, it can induce an equilibrium in which firms invest in too much capital because the guaranteed rate of return is greater than the firm's cost of capital.[4] In fact, such regulation can raise rates of investment to inefficient levels; and this result has led regulators and economists to consider

[3] For example, Grabowski et al. (1978), Borreau and Dogan (2001), Schmalensee and Rohlfs (1992), Tardiff and Taylor (1993), and Prieger (2002).
[4] Averch and Johnson (1962).

alternative forms of incentive regulation (such as price caps) designed to promote more efficient decision making.[5]

The area of economic research that bears most directly on the empirical work proposed here was established in 2004, when Robert Pindyck argued that the presence of significant sunk costs in investments can lead to a situation in which those investments are "irreversible," and that this condition can significantly affect the impact of regulatory policy on investment.[6] In traditional economic models, a firm invests in a piece of capital in order to serve a market; and if the business is unprofitable, the firm can sell the capital at no loss except its depreciation. Pindyck argued that based on the impact of both economic uncertainty and the irreversibility of certain investments, uncertainty about policy and regulation can have very large negative effects on such investments.

Subsequently, other researchers developed theoretical models to specifically analyze the impact on investment of such conditions or, in technical terms, the impact of an "obligation to serve" constraint that requires "capital to be on hand in order to stand ready to serve customers of basic landline telephone service."[7] Their analyses demonstrate that the interaction between this "obligation to serve" and uncertainty about the rate of return on investments in network infrastructure can result in sharp increases in the cost of capital for such investments. According to this model, these dynamics raise the cost of capital by 70 percent; and a review of the literature on this issue suggests that all else being equal, an increase of that magnitude will reduce investment by 35 percent to 70 percent.[8] More recently, Grajek and Roller found significant evidence that regulation can have large negative effects on investment, writing that, "regulators respond to higher infrastructure investment by incumbents by providing easier access [by competitors to the incumbent's infrastructure], thereby undermining incumbents' incentives to invest in infrastructure in the first place."[9]

Other scholars also have found that telecommunications regulation can have unusually large economic effects, especially because telecommunications is currently characterized by unusually high rates and speed of innovation.[10] The earliest studies found that deregulation was associated with increases in the industry's total factor productivity, often seen as a proxy for innovation.[11] Later studies examined particular forms of innovation and found, for example, that as the FCC phased out some of its regulation of telephony carriers, new service offerings increased by 60 percent to 99 percent.[12] The same researcher also found that if the regulation being repealed had not been introduced in the first instance, consumers would have had the choice of 62 percent more services. A subsequent study found that innovation increased when regulatory delays were reduced (for example, the time required to get approval for a new

[5] Brauetigam *et al.* document and discuss the theoretical support for the transition away from rate of return regulation that occurred in the United States in recent decades.
[6] Pindyck (1991) provides a useful review of these issues.
[7] Bernstein and Manuneas (2007).
[8] Hassett and Hubbard (2002).
[9] Grajek and Roller (2012)
[10] For example, Borreau and Dogan (2001).
[11] Schmalensee and Rohlfs (1992); and Tardiff. and Taylor (1993).
[12] Prieger (2002). The regulation had required carriers controlling local networks to submit "comparably sufficient interconnection (CEI) plans" to the FCC whenever they offer a new service.

service).[13] Similarly, yet another study reported that innovation increased when telecom regulators shifted to more flexible, incentive-based approaches – for example, shifting from rate-of-return regulation to earning-sharing approaches.[14]

The empirical evidence on these issues, however, remains mixed. One study argued that incentive-based regulation slowed innovation,[15] and a review of four studies of the effect on the quality of telecom services of shifting to more flexible regulation reported ambiguous results.[16] Similarly, an analysis of the impact of more flexible, incentive-based regulation of local exchange carriers found no subsequent increase in efficiency.[17] Yet, even the Organization for Economic Cooperation and Development (OECD), which has written that "economic regulation is intended to improve the efficiency of markets in delivering goods and services,"[18] found that telecom deregulation in the United States (and Japan) in the late-1980s and early 1990s was followed by faster growth in new telecom patents, compared to Germany, France and the United Kingdom, which had not deregulated.[19] Because of this mixed evidence, it is important to examine more directly the particular policy choices currently facing the FCC: Will imposition of Title II regulation on broadband access and other Internet services enhance or discourage investment and innovation in these vital services? The balance of this paper develops and applies empirical tests to help answer this question.

III. Modeling the Impact of Title II Regulation on Internet Investment

Before turning to our data analysis, it is important to note the implications of Title II regulation of Internet service providers. Such regulation could subject capital commitments to rate-of-return regulation and a variety of other pricing-related restrictions, including a possible prohibition on offering priority delivery options. At the same time, a decision to apply such regulation to Internet providers would also introduce new uncertainties about what entities would be subject to the Title II regulation and how the new regulations would be applied and enforced. In combination, these conditions could have very large effects on investment.

President Obama and other advocates of Title II regulation claim that the FCC should and would forbear from regulating rates of return and applying other pricing-related restrictions. The President, in fact, has acknowledged that such regulation could drive down investment. Yet, many legal experts believe that the FCC cannot lawfully apply forbearance in this way. Moreover, given the FCC's record of having previously rejected Title II regulation of ISPs and, since reversing that position, its failure to declare that it would not engage in rate and pricing regulation of ISPs, it is safe to conclude that the uncertainty effects on investment of such an approach could be quite large.

The key insight here is that regulatory uncertainty can make it optimal to delay investment until the uncertainty is resolved. Consider the following example.[20] A firm can invest

[13] Prieger (2007).
[14] Ai and Sappington (2002).
[15] Kahn *et al. (1999).*
[16] Sappington (2003).
[17] Ai and Sappington (2002).
[18] OECD (2010).
[19] OECD (1995).
[20] This is a modified version of an example provided in Auerbach and Hassett (2002).

$100 today in network infrastructure, which would be irreversible; and while its returns are uncertain, the firm could earn $400 tomorrow if it could can price its service at market prices tomorrow. However, if a regulator directs the firm to offer that service tomorrow at no cost (an extreme example that makes the mathematics easier to follow), the firm will earn nothing tomorrow. In a traditional Averch and Johnson model, the regulator would assume that the firm will invest today, as its expected rate of return even with regulatory uncertainty is still positive. But if the firm waits until tomorrow to invest $100, it earns $300 ($400-$100) in the good state with a probability of 0.5, and can choose not to invest in the bad state which would generate zero return. The expected return from waiting is $150 ($300 x 0.5), which is higher than the expected return from investing today. So irreversibility and uncertainty associated with regulation have a dramatic negative effect on investment today, reducing it from $100 to $0.

In theory, the negative impact of irreversibility could be lessened if a provider can lock a customer into a long-term contract with a given fee schedule. Such contracts could ensure that the provider has future sales at a set price and thereby reduce its hurdle to investing in a long-term capital project. The possibility that the customer will go bankrupt might constrain the value of the contract; otherwise, pre-commitment and irreversibility constraints appear to be significant factors in telecommunications investments.

This example highlights that the uncertainty associated with regulation could, in theory, reduce investment in telecommunications capital subject to strict Title II regulation by 35 percent to 70 percent, compared to investing a comparable amount in areas unconstrained by regulation. To evaluate whether current data suggest a negative effect of that scale, we turn to a more detailed empirical analysis.

The transition from a highly-stylized model to real-world data relies on two features of the case under consideration here. First, some wireline investments by ISPs support both some activities that would currently be affected by Title II regulation and other activities that would not be so affected. However, the econometrician can only observe the sum of both types of wireline investments -- wireline investments not subject to Title II regulations and therefore "unconstrained," and wireline investments that would be so regulated and would therefore be "constrained." It would be easier to assess the impact of Title II if we could observe both types of capital readily; as a practical matter, we can observe only the mixture of the two types of capital. The challenge is to filter out an estimate of the constrained investment. The second observation is that while wireless voice is subject to Title II, the recent upswing in investments in wireless telecommunications in the U.S. has been widely viewed as a result of light-handed regulation in this space relating to the FCC's decision in 2007 that mobile broadband is an information service. Thus, the large increases since then of wireless investments can be viewed as driven by factors other than Title II regulation. If we constrain our analysis to the most recent period, wireless investment, which has skyrocketed along with the demand for data services, should be highly correlated with unobserved unconstrained wireline investment.

These two features suggest a strategy to help identify, or at least bound, the possible historical effects of Title II regulation on Internet investment by wireline providers, where the legacy Title II effects are likely to be significant. To begin, demand for data services using "unconstrained" or less constrained forms of capital depends on factors outside of or exogenous to the traditional voice infrastructure, such as demand for data services. Since there are significant variations in the forces driving demand for both types of services, over time and

across regions, an estimate of the part of wireline investment "unconstrained" by Title II regulation should be simply the portion of each firm's investments that is predictable, given the same firm's new investments in wireless capital, which are observable and correlated with the factors driving data demand for wireline services.

To illustrate this approach, suppose that technology-savvy consumers demand more digital products in a given region, and a firm serves that region with wireless technologies, wireline technologies that are unconstrained by Title II regulation, and wireline technologies that are constrained by Title II. Part of that firm's wireline investments would be correlated with the observed movements of its wireless investments, and that would be the portion that responds to the exogenous demand-driving forces without Title II constraints.[21] By observing the co-movements of wireless and wireline investments for multiple firms over time, we can estimate a model that can predict the wireline capital investments that should follow or accompany a given surge in wireless capital spending. Given that, we can estimate both the share of wireline investment with significant co-movements with relatively unconstrained wireless investment, and the share of wireline that does not. The latter is an estimate of the "constrained" Title II wireline investment. An analysis of the trends of this "filtered" estimate of Title II investment could then allow one to infer the relative impacts of the different forms of regulation.

This strategy rests on a number of important assumptions. If the underlying exogenous demand which drives the increase in wireless subscriptions is related to the convenience of wireless telephony, a regression relating wireless investments to wireline will find little correlation, and therefore the share of capital spending attributed to traditional Title II covered services will be too large. In addition, since Title II-covered services can be avoided by switching to either unconstrained wireline service or wireless service, this estimate can provide little guidance if the FCC applied Title II regulation to all forms of telecommunication. In the end, our approach can identify the portion of wireline investment that is not correlated with the recent factors driving both wireless and wireline investments. The most likely factor driving both is the demand for data services and the increasing popularity of the Internet and Internet applications, and the most likely residual factor is the demand for traditional voice connections. Moreover, to the extent that wireless demand is driven by factors that do not affect the demand for wireline services which are not constrained by Title II, this approach will attribute too large a share to Title II investment; and therefore, our estimates of the impact of Title II regulation on investment are likely to be conservative.

Next, we discuss the data set we use to construct these estimates, and then we will present the evidence that suggests that a significant portion of wireline investment appears to be driven by the same forces driving unconstrained wireless investment, and a significant portion does not. Following that presentation, we will assess other evidence which supports our estimates.

The Data for the Empirical Analysis

Our empirical model uses the Infonetics Research database, which provides company-level data on capital expenditures (capex) on an annual basis covering the period from 2009 to

[21] This condition should generally hold even if the demand drivers for wireless and wireline access are different.

2014.[22] These data include all public and semi-private/government-owned service providers with more than $100 million in annual revenues. In addition, company-level subscription data are available on a quarterly basis from the first quarter of 2011 through the first quarter of 2014. The database groups the service providers into five company types: incumbent, competitive, independent wireless, cable operator, and satellite. Incumbent companies are historical and national operators that previously were monopolies, including incumbent local exchange carriers (ILECs), regional bell operating companies (RBOCs), and independent operating companies. Competitive providers are non-incumbent telecommunication companies, including competitive local exchange carriers (CLECs), Internet service providers (ISPs), and interexchange carriers (IXCs). Independent wireless providers are cellular carriers and include companies that began as wireless providers and have since started a wireline business. Cable operators are multiple system operators, and satellite companies are Direct Broadcast Satellite (DBS) providers.

When possible, the database disaggregates total capex into wireline capex, wireless capex, and other capex. Wireline capex covers purchases of property, plant and equipment that sustain wireline operations, including maintenance costs, upgrades, and the construction costs for wireline network facilities. Wireless capex encompass the same purchases for wireless operations and wireless network facilities. The subscription data that we use in our analysis are reported at the aggregate level. Finally, for our analysis we only consider US-headquartered companies and subscribers in the US.[23]

The Infonetics Research data are reported at the company level. In order to assess how these data relate to industry aggregates, and highlight the difference between industry aggregates and the subsample we use for our estimation, we compare total capital expenditures across companies in the dataset to the USTELECOM database, which reports annual, industry-level US broadband provider capital expenditures. [24] The USTELECOM data cover wireline telecommunications providers, wireless telecommunications providers, and cable broadband providers, and they estimate capex for relevant non-reporting companies. Satellite providers, telecommunications resellers, and electric utilities are excluded from their sample. Their measure of capex "may include investment in property, plant, and equipment, capitalized software, capitalized interest during construction, corporate, directory, and other capital expenditures, and intra-company eliminations." Figure 1, below, presents the USTELECOM data and our aggregated total capex data over the period from 2009 through 2013. Aggregating total capex across companies in the Infonetics Research database allows us to closely match USTELECOM's industry-level capex numbers.[25]

---

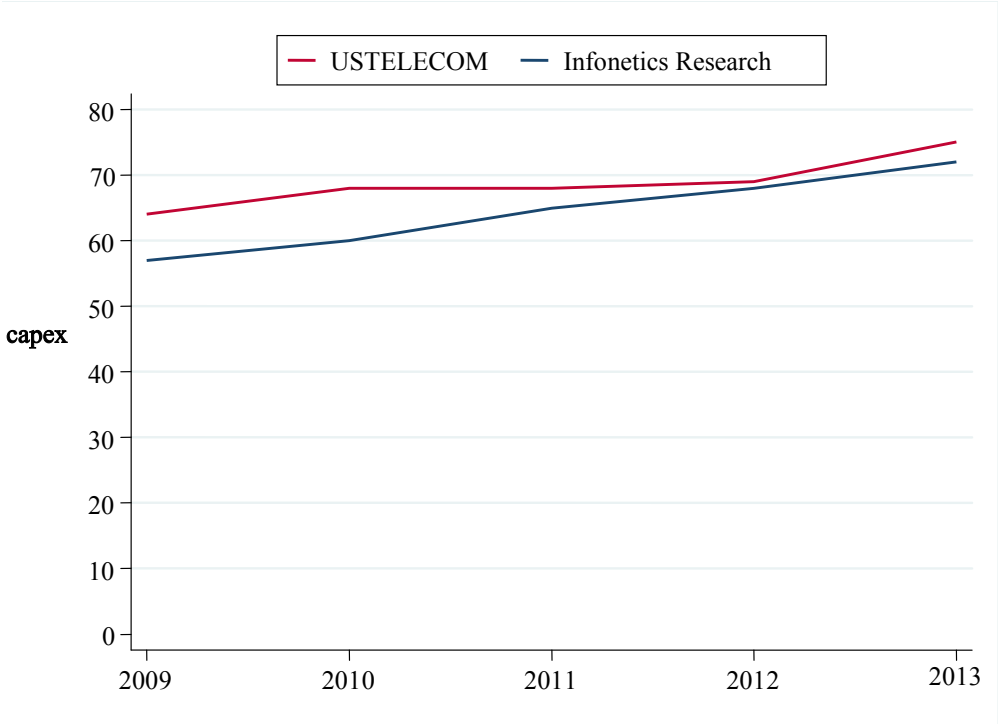
[22] The full name of the database is "Service provider capex, opex, revenue, and subscribers; Quarterly worldwide and regional database: 2nd Edition, full set." The data were purchased from Infonetics Research on Sept. 30, 2014.

[23] To match the quarterly subscriptions data with the annual capex data, we keep the last quarter of data available in each year.

[24] For the USTELECOM data and methodology, see http://www.ustelecom.org/broadband-industry-stats/investment/historical-broadband-provider-capex.

[25] There are several explanations for the small discrepancies in the datasets. We note that our values, which are consistently smaller than those reported by USTELECOM, lack estimations for non-reporting companies, whereas USTELECOM includes these estimations.

Figure 1: Total Capital Expenditures in the USTELECOM data and Infonetics Research Database, 2009-2013 ($ billions)[26]



For the purposes of our regression analysis, we focus on companies in the incumbent category with non-missing wireline and wireless investment data.[27] The sample includes five incumbent service providers headquartered in the United States (Alaska Communications, AT&T, Cincinnati Bell, TDS, and Verizon) with six observations per-variable and company, one for each year of data. We also focus only on wireline and wireless capital expenditures. In the Infonetics Research data, these categories exclude other forms of capex including capitalized software, product distribution, product marketing, and capex used to support non-telecom operations. In our restricted sample, aggregate wireline and wireless capex is $38 billion in 2013.

Companies in the incumbent category face the strictest wired communication service regulation. ILECs, local exchange carriers (LECs) that provided telephone exchange services when the 1996 Telecommunications Act was enacted must comply with all LEC regulations as well as additional obligations outlined in Part II of Title II.[28] These ILEC regulations include sections 251(c)(3) and 251(d)(2), which require those companies, when necessary, to provide unbundled access to parts of their telecommunications service to "any requesting telecommunication carrier," and in ways "that allow requesting carriers to combine such

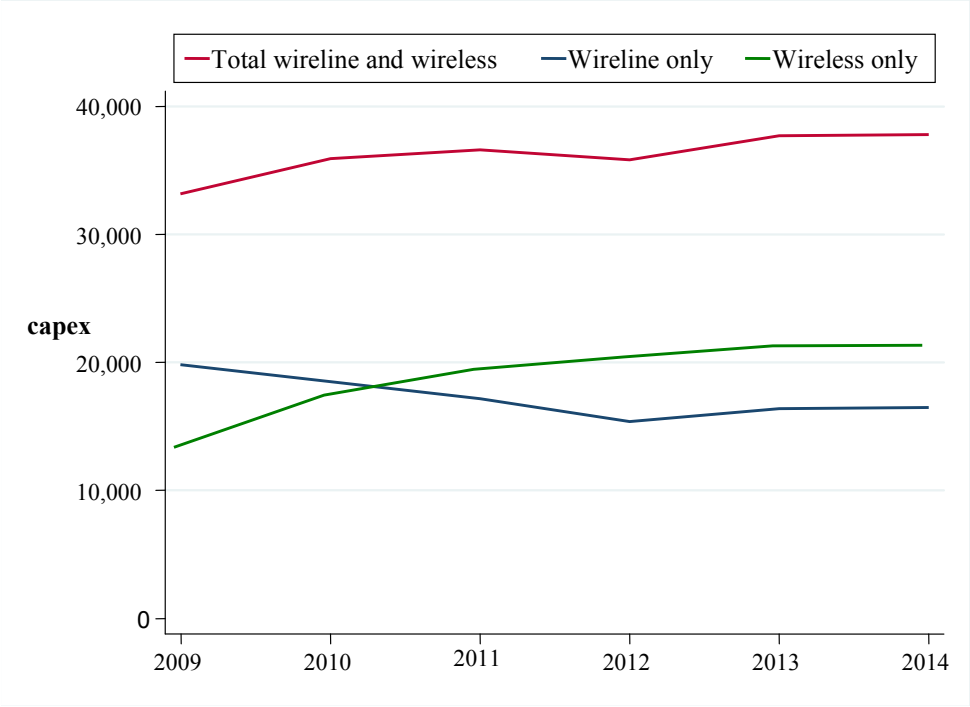
[26] We aggregate capex for incumbent companies, competitive companies, cable operators, and independent wireless companies that are headquartered in the US in the Infonetics Research database. We exclude companies in the satellite category as USTELECOM also excludes these providers in their calculations.

[27] We exclude cable operators from our sample as our analyses require non-missing wireline and wireless investment data. Companies in the incumbent category have the most complete wireline and wireless capex data in the Infonetics Research database.

[28] See Telecommunications Act of 1996, 47 U.S.C. § 251(c).

elements in order to provide such telecommunications service."[29] RBOCs, the firms that emerged after AT&T's breakup in the early 1980s, are also subject to additional regulation under Title II. Part III of the 1996 Act, entitled "Special provisions concerning Bell Operating Companies," is dedicated to regulating RBOCs. With other requirements, these companies must receive the FCC's permission to offer interLATA (inter-Local Access Transport Area) services.[30] Figure 2, below, presents total wireline and wireless investments across the five incumbent companies in our sample, from 2009 through 2014. Wireless capex increased steadily from $13,355 million in 2009 to $21,344 million in 2014, while total wireline investment declined beginning in 2009 to $15,402 million in 2012, and then rose from 2012 to 2014.

Figure 2: Aggregate Wireline, Wireless, and Total Wireline and Wireless Capex, 2009-2014 ($ millions)[31]



As noted, the Infonetics database also provides quarterly, company-level subscription data covering the period from the first quarter of 2011 through the first quarter of 2014. Subscriptions are grouped by geographical region and type. For the following statistics, we focus only on the five incumbent companies in our sample and on subscriptions in the U.S.

[29] Telecommunications Act of 1996, 47 U.S.C. § 251(c)(3) and Telecommunications Act of 1996, 47 U.S.C. § 251(d)(2). Which "Unbundled Network Elements" ILECs must provide and when such provision is necessary have been the subject of several litigations since the1996 Act. Ultimately, the FCC required ILECs to unbundle loops or transport when competitors have "no other viable way to compete." See Michael K. Powell, *Separate statement of Chairman Michael K. Powell, RE: Unbundled Access to Network Elements (WC Docket No. 04-313); Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers (CC Docket No. 01-338),* 2004: http://apps.fcc.gov/ecfs/document/view;jsessionid=BRsnRypQlTsbYVVQMTFFtmyPwGl15sGBhZxrT6LmN16GmpkTykb1!-1705390101!956499833?id=6517502883.

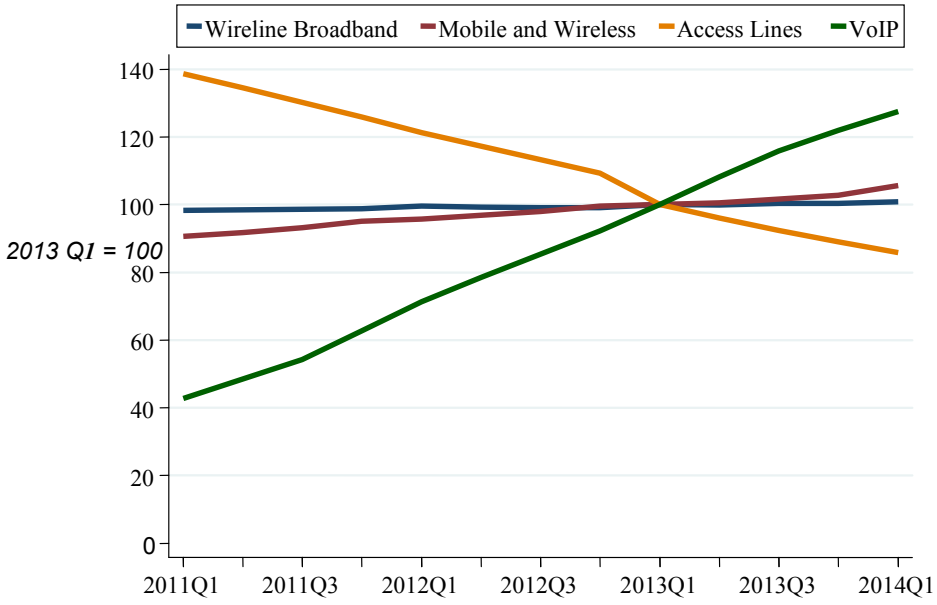
[30] See Telecommunications Act of 1996, 47 U.S.C. § (271).

[31] Figure 2 covers the five incumbent companies in the Infonetics Research database with non-missing wireless and wireline investment data.

The types of subscriptions in the data are wireline broadband, mobile and wireless, access lines, and Voice over Internet Protocol (VoIP). The wireline broadband category includes residential, business, and wholesale subscriptions to all forms of digital subscriber line (DSL) broadband service, and cable broadband subscriptions. The mobile and wireless category includes single users of 2G, 3G, and LTE services. The access lines category includes residential, business, and wholesale public switched telephone network (PSTN) connections subscriptions - or old telephone service (POTS) – and subscriptions to Integrated Services Digital Network (ISDN) connections. POTS and ISDN transmit signals over copper wire; the former transmits voice via analog signals, and the latter transmits voice, data, and video via digital signals. The VoIP category includes residential, small office, or home office subscriptions to hosted VoIP services. The VoIP subscriptions data do not include users of pure peer-to-peer messenger focused services or users of free applications.

Figure 3, below presents indexed subscription levels for each technology from 2011 to 2014. This graph illustrates the large gains in subscriptions to VoIP services, the steady gains in subscriptions to wireline broadband service and mobile and wireless, and the steady decline in subscriptions to access lines. Subscriptions in the mobile and wireless category rose 16.5 percent over the period. Wireline subscriptions increased 2.5 percent and VoIP subscriptions rose 198.5 percent. Subscriptions to access lines declined 38.2 percent from 2011-Q1 to 2014-Q1. Over this period, subscriptions to mobile and wireless services increased at an average quarterly rate of 1.3 percent, compared to 0.2 percent for wireline broadband and 15.3 percent for VoIP, while subscriptions to access lines declined at an average quarterly rate of 2.9 percent.

Figure 3: Growth of Subscriptions, By Technology, Indexed, 2011 Q-1 to 2014 Q-1[32]



[32] Figure 3 reports subscriptions in the US for AT&T Inc., Alaska Communications, Cincinnati Bell, TDS, and Verizon. While we do not use these disaggregated data in our regressions, the trends inform our analysis.

IV. Results of the Analysis

As described earlier, our model allows us to distinguish between a scenario in which wireline investments by ILECs are constrained by expanded Title II regulation and one in which these investments would be unaffected by new regulation. First, we use the Infonetics panel data to estimate regressions of total wireline investment on wireless investments by the same companies. To assess the robustness of this approach, we allow for possible nonlinear effects by including a quadratic term in the wireless investment, and we perform regressions weighted by subscriptions to assess how much variations in investment by small providers affect the results.[33] Table 1, below, reports the regression results from our model for estimating the portion of wireline capital expenditures that would be regulated under Title II. The first column presents the result for the model without weighting to account for the different scale of providers in our sample. Specifications that do weight are preferred when using the results to extrapolate to aggregates given the large diversity in the relative size of firms in the sample, thus, the subscription-weighted results likely to be most reliable. We present all of the results however, for purposes of comparison. The results in column 1 show that wireline investment is highly responsive to wireless investment: Each $1.00 of additional wireless investment is accompanied by a $0.90 increase in wireline investment. Moreover, the coefficient on wireless investment is highly statistically significant. Columns 2 through 4 of the table present the regression results under alternative specifications. The results also show that there is little evidence that the relationship between wireless and wireline capital spending is nonlinear, as the quadratic terms are at best marginally significant.[34]

Table 1: Results -- Dollar Value Regressions of Wireline Investment on Wireless Investment, With and Without Weighting by Subscriptions (Robust standard errors in parentheses)[35]

Variable	Wireline Capex (1)	Wireline Capex (2)	Wireline Capex (3)	Wireline Capex (4)
Wireless Capex	0.897***	1.804***	1.028***	0.0953
	(0.0572)	(0.535)	(0.0855)	(0.402)
Wireless Capex ^2		-9.15e-05*		7.12e-05**
		(5.23e-05)		(3.24e-05)
Constant	69.78	-243.9	-2,107*	4.833
	(150.8)	(154.2)	(1,020)	(338.9)
Weighted by Subscriptions	No	No	Yes	Yes
Observations	30	30	20	20
R-squared	0.871	0.899	0.674	0.729
*** p<0.01, ** p<0.05, * p<0.1				

[33] The model for the first specification is $Y_{(it)} = \beta_0 + \beta_1 X_{(it)} + \varepsilon$ and the model for the second specification, with the quadratic term, is $Y_{(it)} = \beta_0 + \beta_1 X_{(it)} + \beta_2 X_{(it)}^2 + \varepsilon$, where $Y_{(it)}$ is wireline capex for company i at time t and $X_{(it)}$ is wireless capex for company i at time t. We then use the coefficient estimates and data on wireless and wireline investment to decompose investment in each firm into the component that is not driven by Title II and that component that is.

[34] We performed the same regressions weighting for revenue and obtained similarly significant results.

[35] Subscription data are available for the years 2011 through 2014. The regression results in columns 3 and 4 are weighted by subscriptions; their lower observation numbers reflect the availability of those data.

These regressions do not establish a causal link between wireless investments and wireline investments. Rather, the assumption is that both are driven by the demand for data services, and the part of wireline investment that is not correlated with that demand can be a metric for the movement of regulated investment. In Table 2, below, we estimate the annual growth rates for our filtered estimates of both unregulated wireline investments and regulated wireline investments based on our regressions, which enable us to divide or decompose wireline investments into those that increase with wireless investment and those which do not. The two specifications are a standard approach in econometrics, based on whether or not an unusually large change in one variable (wireless investments) has a different scale effect on the other variable (wireline investments).

Table 2: Annual Growth Rate of Wireline Investments, With and Without Weighting by Subscriptions

First Specification		***Second Specification***	
Unconstrained	**Title II**	**Unconstrained**	**Title II**
Not Weighted			
0.097	- 0.224	0.025	- 0.287
Weighted for Number of Subscriptions			
0.429	- 0.317	0.236	- 0.178

The first specification provides the first base case drawn from the regressions, assuming a scaled response to changes in wireless investments: Not weighted by the number of subscriptions, unconstrained investments grew at an annual rate of 9.7 percent, whereas constrained investments – those subject to Title II regulation -- declined at an annual rate of 22.4 percent.[36] Weighted by subscriptions, unconstrained investments grew at an annual rate of 42.9 percent, compared to constrained investments which declined at a 31.7 percent annual rate. The second specification allows for the possibility of a different scale response to spikes in wireless investments: Not weighted for number of subscriptions, investments not subject to Title II grew at an annual rate of 2.5 percent, whereas investments subject to that regulation declined at an annual rate of 28.7 percent.[37] Weighted by subscriptions, investments not subject to Title II grew 23.6 percent per-year, compared to investments subject to Title II which declined at a 17.8 percent annual rate. Under all conditions, investments under Title II declined sharply while investment not subject to Title II rose substantially.

If we assume that the trends we have identified in Title II investments extend to other forms of investment as Title II is expanded, then our estimates allow us to anticipate how expanded regulation might influence future investment. Based on these estimates, we plot the impact on total wireless and wireline investment of Title II regulation of wireline services, compared to projections based on investments in 2009-2014 under the current regulation.[38]

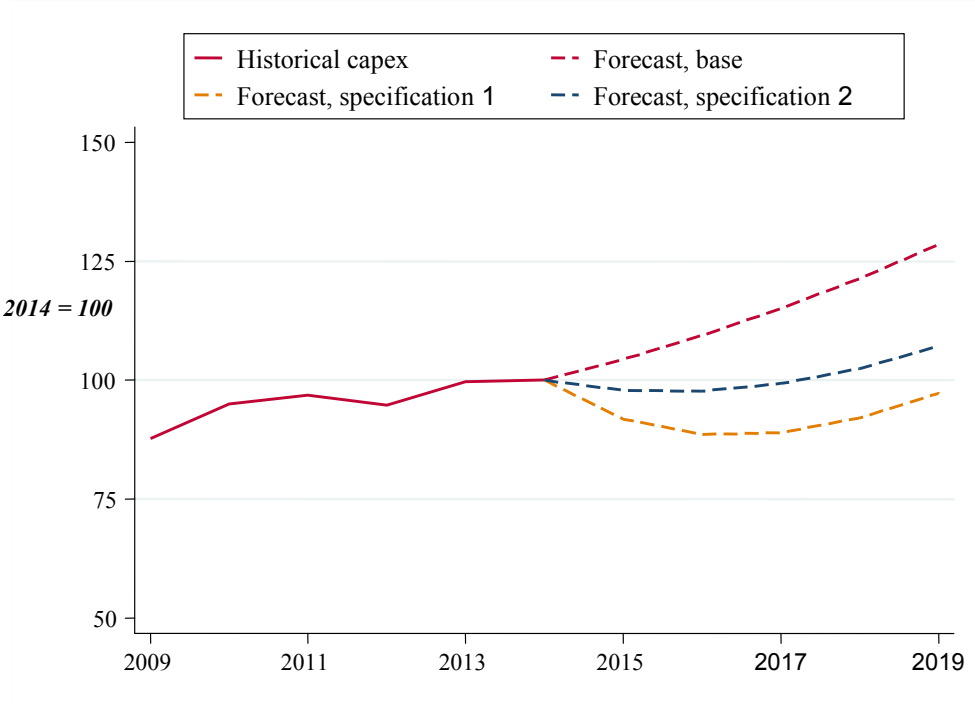
[36] In technical terms, this specification does not include the quadratic term. Also, we note that PSTN voice was declining sharply, with or without Title II regulation.

[37] In technical terms, this specification includes the quadratic term.

[38] These projections assume that the trend in our estimate of Title II investment in our sample period applies to all wireline investments in the projection period. Our future trend estimates are constructed by estimating the trend in Title II wireline investment in the sample period, expressing that trend in annual percentage-changes, and then assuming that those percentage-changes apply to all wireline investment in the projection period.

Figure 4, below, presents the graph of our subscription-weighted models under the first and second specifications. The solid line reports the historical values of aggregated wireless and wireline capex for our sample indexed to set 2014 equal to 100. The dotted lines are forecasts of wireless and wireline investment for the period from 2015 through 2019: The top dotted line shows our base forecast, which relies on wireless and wireline investment growth under current regulation and assumes it continues. The orange and blue dotted lines show what would happen to wireless and wireline investment if all of wireline was placed under Title II regulation. These forecasts are based on the results from our subscription-weighted models under the first and second specifications.

Figure 4: Indexed Total Wireline and Wireless Capital Investment With and Without Title II Regulation of all Wireline, 2009-2014, and Projections for 2014-2019, Using the Subscription-Weighted models



Our analysis indicates that total wireline and wireless investments would be substantially reduced if the FCC imposes Title II regulation on all wireline services. Table 3 reports total wireline and wireless investment levels over the next five years (2015-2019) under current regulation and under Title II regulation of all wireline for our un-weighted and subscription-weighted models. Under current regulatory arrangements, we estimate that wireline and wireless investments would total to $218.8 billion over the next five years. Under our un-weighted and subscription-weighted first specification, this number would fall to $184.2 billion and $173.4 billion if all of wireline were placed under Title II regulation; wireline and wireless investment would incur a penalty of $34.6 billion and $45.4 billion, respectively. Under our second specification, the reductions in investment total to $42.2 billion in the un-weighted model and $28.1 billion in the subscription-weighted model.

Under the first specification, placing all wireline under Title II regulation would reduce wireless and wireline investments by Internet providers by an estimated 20.8 percent per-year, in

our subscription-weighted model; on a non-weighted basis, Title II regulation would reduce wireless and wireline investments by Internet providers by 15.8 percent per-year. Similarly, under the second specification of our model, we estimate that Title II regulation would reduce wireless and wireline investments by Internet providers by an estimated 12.8 percent per-year in our subscription-weighted model; on a non-weighted basis, Title II regulation would reduce wireless and wireline investments by Internet providers by 19.3 percent per-year.

Table 3: Estimated Internet Provider Capital Investments
With and Without Title II Regulation of all Wireline, 2015-2019 (millions)

2015-2019	No Title II	Title II – Not Weighted	Title II – Subscription Weighted
First Specification			
Total	$218,806.80	$184,188.50	$173,404.60
Title II Penalty		$34,618.30	$45,402.20
Second Specification			
Total	$218,806.80	$176,568.40	$190,697.90
Title II Penalty		$42,238.40	$28,108.90

In addition to proposing that Title II regulations be applied to wireline services, many advocates have argued that these regulations should also be applied to wireless services. FCC officials have stated that they are seriously considering this path of action.[39] If this policy is followed, the estimates that our model would suggest for the expected reductions in wireline plus wireless capital investment would be far larger than those predicted if Title II regulations were applied only to wireline services.

V. Other Effects of Title II Regulation of Internet Service Providers

Our econometric analysis has considered only the impact of Title II regulation on investment. Before concluding, it is important to recognize the possible impact of such regulation on innovation, a critical aspect of information and telecommunications services. In classical economic theory, most forms of economic regulation entail costs that result in firms investing less in developing new goods and services. The lesson from the current period of technological and organizational innovation in information technologies and the Internet is that innovation has thrived in unregulated spaces. Innovation entails substantial risk and often involves substantial sunk costs. Therefore, the incentives to assume those risks and bear those costs should be greatest when the additional costs of regulation are absent. If the objective of regulation, as one author put it, is to "ensure a self-sustained pro-competitive market structure … that benefits consumers, in terms of lower prices, better quality and extended variety of product

[39] See Tom Wheeler, "Prepared Remarks of FCC Chairman Tom Wheeler 2014 CTIA Show, Las Vegas, NV," (September 2014): http://www.fcc.gov/document/chairman-wheeler-remarks-2014-ctia-show-super-mobility-week.

choice,"[40] it must be said that deregulation serves that purpose more directly and efficiently, unless an industry is truly dominated by a monopoly power.

Most fundamentally, economic regulation changes market conditions which affect decisions to assume the risks and bear the costs of innovation. For example, Title II regulation could set concessionary prices or rates of return and subsidize inefficient entry. In both cases, businesses will be forced to accommodate the new conditions; and that usually involves diverting resources from other investments. Considered more narrowly, the costs to comply with economic regulations can divert resources from investments, including R&D.[41]

The prospect of the FCC imposing Title II regulation on ISPs also creates uncertainty about its extent and terms. In most cases, such uncertainty about pending regulation leads to delays or suspensions of investments in innovations that could be affected by the new regulation, or diverts resources to compliance efforts before-the-fact. There is no evidence in the literature covering telecommunications and across industries that refutes the conclusion that policy uncertainty associated with Title II regulation will delay investment decisions.

Economists also have examined the impact of regulation on innovation in wireless telecommunications.[42] They have demonstrated, for example, that the U.S. markets for wireless service, devices, handsets and applications all display extensive product choice and competition, with no evidence of non-competitive pricing.[43] Smaller carriers and producers can compete effectively by innovating and offering, for example, a cooler device, faster network, or more extensive coverage. More generally, research has shown that competition among wireless networks has accelerated both innovation and investment in wireless networks, much as the platform competition between fiber and cable did for the wireline industry.[44] Title II regulation could slow the wireless industry's investments in innovation and capacity in other, particular ways. For example, wireless carriers often participate in efforts to develop new handsets and devices such as the iPhone, in exchange for temporary exclusive rights to market them. If Title II regulation barred such arrangements, innovation could suffer as the risk of developing and introducing new products increases.

Similarly, the network management practices which Title II regulation would potentially bar enable wireless investment and innovation, because wireless networks face serious capacity constraints. Thus, regulations that discourage or bar those practices raise the risk of introducing new products and applications: Without those practices, carriers would be less able to manage unpredictable changes in network demand associated with their introduction, and so maintain the quality of network services for all of its users. The wireless industry also exhibits a quality common across the Internet – namely, that innovation in one layer, such as handsets or memory capacity, creates the conditions for innovations in other layers such as the overall network, applications and content. In this regard, investments by Internet providers that improve the Internet's capacity and speed enable innovation by not only a wide range of device, application

[40] Borreau and Dogan (2001).
[41] However, the prospect of compliance burdens can also spur innovations – for example, innovations to sidestep the regulations as when financial firms develop new instruments that fall outside existing regulatory bounds.
[42] Erhlich *et al* (2009).
[43] *Ibid.*
[44] Blind (2011).

and content companies, but also by the countless businesses and households that use the Internet and those devices, applications and content.[45]

VI. Conclusions

This study has explored the impact on investment of extending Title II regulations to all wireline services. We find that this policy shift would be ill-advised. The empirical results of our econometric analysis are highly consistent with the theoretical analysis of the impact of such regulation. We found that the application of Title II regulation of all wireline would, in our preferred model, result in a reduction in future wireline investments of between 17.8 percent and 31.7 percent per-year, which implies a reduction in future wireless and wireline investments of between 12.8 percent and 20.8 percent per-year. These results are statistically significant. We find that future investment, if it follows this path because of expanded Title II regulation, will decline at rapid rates even as the demand for data services is projected to increase at rapid rates. Finally, we believe that these effects would be even larger if one were to account for the impact of Title II regulation on innovation.

[45] See, for example, Van Leeuwen (2008), Polder et al (2009), Spieza (2010), Brynjolfsson and Hitt (2000).

References

Chunrong Ai and David E.M. Sappington, "The Impact of State Incentive Regulation on the U.S. Telecommunications Industry," *Journal of Regulatory Economics* 22 (2002): 133-160.

Harvey Averch and Leland L. Johnson, "Behavior of the Firm under Regulatory Constraint," *American Economic Review* 52 (1962): 1052–1069.

Jeffrey I. Bernstein and Theofanis P. Mamuneas, "Irreversible Investment, Capital Costs and Productivity Growth: Implications for Telecommunications," *Review of Network Economics, Concept Economics* 6 (2007): 299-320.

Knut Blind, "The Internet as Enabler for New Forms of Innovation: New Challenges for Research," HIIG Discussion Paper Series Paper 2012-06 (2011): 1-33.

Marc Bourreau and Pinar Doğan, "Regulation and Innovation in the Telecommunications Industry," *Telecommunications Policy* 25 (2001): 167-184.

Ronald E. Braeutigam and John C. Panzar, "Effects of the Change from Rate-of-Return to Price-Cap Regulation," *American Economic Review* 83 (1993): 191–198.

Erik Brynjolfsson and Lorin M. Hitt, "Beyond Computation: Information technology, Organizational Transformation and Business Performance," *Journal of Economic Perspectives* 14 (2000): 23-48.

Everett Ehrlich, Jeffrey A. Eisenach and Wayne A. Leighton, "The Impact of Regulation on Innovation and Choice in Wireless Communications," *Review of Network Economics* 9 (2010).

Jerry Ellig, "Costs and Consequences of Federal Telecommunications Regulations," *Federal Communications Law Journal* 58 (2006): 38-102.

Federal Communications Commission, *Internet Policy Statement (FCC 05-151),* 2005: https://apps.fcc.gov/edocs_public/attachmatch/FCC-05-151A1.pdf.

Federal Communications Commission, "Open Internet," accessed October 2014, http://www.fcc.gov/openinternet.

Federal Communications Commission, "Sixth Broadband Progress Report," accessed October 2014: http://www.fcc.gov/reports/sixth-broadband-progress-report.

George S. Ford and Lawrence Spiwak, "Justifying the Ends: Section 706 and the Regulation of Broadband," Phoenix Center Policy Perspective 12-04 (2012): 1-11.

Suzanne Fox and Lee Rainie, "The Web at 25 in the U.S.," Pew Research Internet Project (2014): http://www.pewinternet.org/2014/02/27/the-web-at-25-in-the-u-s/.

Christopher Garbacz and Herbert Thompson, "Assessing the Impact of FCC Lifeline and Link-Up Programs on Telephone Penetration," *Journal of Regulatory Economics* 1 (1997): 67-77.

Henry Grabowski, John Vernon and Lacy Gleenn Thomas, "Estimating the Effects of Regulation on Innovation: An International Comparative Analysis of the Pharmaceutical Industry," *Journal of Law and Economics*, 21 (April 1978): 133-163.

Michal Grajek and Lars-Hendrik Röller, "Regulation and Investment in Network Industries: Evidence from European Telecoms," *Journal of Law and Economics* 55 (February 2012): 189-216.

Shane Greenstein and Ryan McDevitt, "Evidence of a Modest Price Decline in U.S. Broadband Service," NBER Working Paper 16166 (2010).

Alfred E. Kahn, Timothy J. Tardiff and Dennis L. Weisman, "The Telecommunications Act at Three Years: An Economic Evaluation of its Implementation by the Federal Communications Commission," *Information Economics and Policy*. 11 (December 1999): 319-365.

George van Leeuwen and Shikeb Farooqui, "ICT, innovation and productivity," in *Information Society: ICT impact assessment* (Eurostat 2008): 163-190.

Luke A. Stewart, "The Impact of Regulation on Innovation in the United States: A Cross-Industry Literature Review," Information Technology & Innovation Foundation (June 2010): 1-29.

Office of Science and Technology Policy and the National Economic Council, "Four Years and Broadband Growth," (June 2013), www.whitehouse.gov/sites/default/files/broadband_report_final.pdf.

Organisation for Economic Co-Operation and Development, "Regulatory Reform and Innovation," (1997): http://www.oecd.org/science/inno/2102514.pdf .

Organisation for Economic Co-Operation and Development, "Communications Outlook," (February1995): http://www.oecdbookshop.org/oecd/display.asp?LANG=EN&SF1=DI&ST1=5LMQCR2K998P.

Robert S. Pindyck, "Irreversibility, Uncertainty, and Investment," *Journal of Economic Literature* 29 (September 1991): 1110-1148.

Robert S. Pindyck, "Mandatory Unbundling and Irreversible Investment in Telecom Networks," MIT Sloan Working Paper 4452-03 (2004).

Michael Polder, George van Leeuwen, Pierre Mohnan and Wladimir Raymond, "Productivity effects of innovation modes," MPRA Paper 18893 (November 2009).

J. E. Prieger, "Regulation, Innovation and the Introduction of New Telecommunications Services," *Review of Economics and Statistics* 84 (2002): 704-715.

J. E. Prieger, "Regulatory Delay and the Timing of Product Innovation," *International Journal of Industrial Organization* 25 (2007): 219-236.

David E. Sappington, "The Effects of Incentive Regulation on Retail Telephone Service Quality in the United States," *Review of Network Economics* 2 (December 2003): 355-375.

Richard Schmalensee and Jeffrey Rohlfs, "Productivity Gains Resulting from Interstate Price Caps for AT&T," National Economic Research Associates, Research Paper (September 1992).

Vincenzo Spiezia, "Are ICT Users More Innovative? An Analysis of ICT-Enabled Innovation in OECD Firms," *OECD Journal: Economic Studies* 2011/1 (2011).

T. Tardiff and W. Taylor, "Telephone Company Performance under Alternative Forms of Regulation in the U.S.," National Economic Research Associates (1993).

Noel D. Uri, "Measuring the impact of incentive regulation on technical efficiency in telecommunication in the United States," *Applied Mathematical Modeling* 28 (March 2004): 255-271.

About the Authors

Kevin A. Hassett is Director of Economic Policy Studies and Resident Scholar at the American Enterprise Institute (AEI). Before joining AEI, Dr. Hassett was a senior economist at the Board of Governors of the Federal Reserve System and an associate professor at the Graduate School of Business of Columbia University. He was the chief economic advisor to John McCain during the 2000 primaries. He also served as a policy consultant to the U.S. Department of the Treasury during both the former Bush and Clinton administrations. He holds a B.A. from Swarthmore College and a Ph.D. from the University of Pennsylvania. Dr. Hassett is a member of the Joint Committee on Taxation's Dynamic Scoring Advisory Panel. He is also the author, coauthor or editor of six books on economics and economic policy. He has published articles in many scholarly professional journals as well as popular media, and his economic commentaries are regularly aired on radio and television.

Robert J. Shapiro is the chairman of Sonecon, LLC, a private firm that advises U.S. and foreign businesses, governments and non-profit organizations on economic and security-related matters. Dr. Shapiro has advised, among others, U.S. President Bill Clinton, British Prime Minister Tony Blair, Treasury Secretaries Timothy Geithner and Robert Rubin, and UK Foreign Minister David Miliband; private firms including Amgen, AT&T, Elliot Management, Exxon-Mobil, Gilead Sciences, Google, Liberty Mutual, Nordstjernan of Sweden, and Fujitsu of Japan; and non-profit organizations including the Center for American Progress, PhRMA, and the U.S. Chamber of Commerce. He is also a Senior Policy Fellow of the Georgetown School of Business, advisor to the IMF, chairman of the Globalization Initiative of NDN, and co-chair of the American Task Force Argentina. From 1997 to 2001, he was Under Secretary of Commerce for Economic Affairs. Prior to that, he was co-founder and Vice President of PPI. Dr. Shapiro also served as Legislative Director for Senator Daniel P. Moynihan, as well as principal economic advisor in Bill Clinton's 1991-1992 presidential campaign and a senior economic advisor to the campaigns of Al Gore, Jr., John Kerry, Hillary Clinton and Barack Obama. He also has been a Fellow of Harvard University, the Brookings Institution, and the National Bureau of Economic Research. Dr. Shapiro holds a Ph.D. and M.A. from Harvard University, a M.Sc. from the London School of Economics, and an A.B. from the University of Chicago.