PERSPECTIVES

PHOENIX CENTER FOR ADVANCED LEGAL & ECONOMIC PUBLIC POLICY STUDIES

Net Neutrality, Reclassification and Investment:

A Counterfactual Analysis

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Introduction

Perhaps the most frequently cited goal of telecommunications policy is the promotion of infrastructure investment, an outcome of some statutory importance.[1] Investment in telecoms infrastructure, in turn, stimulates jobs, which is another key target of public policy.[2] Naturally, in the heated debate over Net Neutrality, the effects of regulation on investment are a central concern, with special attention given to the presence or absence of investment effects from the FCC's 2010 proposal[3] and subsequent controversial 2015 decision to reclassify broadband Internet access as a common carrier telecommunications service under Title II of the Communications Act of 1934.[4]

From the economic perspective, Net Neutrality and reclassification are expected to attenuate investment incentives, especially under the "virtuous circle" theory offered by the Federal Communications Commission ("FCC"), but how much so is an empirical question.[5] In 2010, respected industry analysts Craig Moffett said that Title II regulation would have "a profoundly negative impact on capital investment" and the introduction of reclassification to the debate was "an unequivocal negative development."[6] Similarly, Frank Louthan of Raymond James Financial not long ago observed, ''Title II is restricting overall investment and returns, … we do not believe it will make the industry as attractive to capital as it had been in the past."[7] Even the former Chairman of the Federal Communications Commission, Tom Wheeler, recognized the tradeoff between Title II and investment, observing the need "to balance the goals of openness with the needs of network operators to receive a return on their investment.''[8]

Whether capital expenditures rise or fall says nothing about the investment effect of a regulatory intervention. Capital expenditures are determined by many factors, of which regulation is only one. To determine the investment effect of a specific regulation, a counterfactual is required and, to date, no counterfactual analysis of the effect of reclassification has been conducted.

Quantifying the investment effects of net neutrality regulation on the dynamic telecommunications industry is a daunting task. For the most part, the heated argument over investment effects thus far has been little more than a tit-for-tat accounting of quarterly or annual changes in capital expenditures of broadband providers over some arbitrarily

chosen time-frames, a largely uninformative effort.[9] A detailed description of the problems with this sort of rudimentary analysis—and the inappropriate use of investment as a policy objective—is detailed in Ford (2015), so I will not repeat the laundry list of concerns here.[10]

Whether capital expenditures rise or fall says nothing about the investment effect of a regulatory intervention. Capital expenditures are determined by many factors, of which regulation is only one. To determine the investment effect of a specific regulation, a counterfactual is required and, to date, no counterfactual analysis of the effect of reclassification has been conducted.

Between 2011 and 2015 (the last year data are available), the threat of reclassification reduced telecommunications investment by about 20% to 30%, or about $30 to $40 billion annually. *** That is, over the interval 2011 to 2015, another $150-$200 billion in additional investment would have been made "but for" Title II reclassification.

In this PERSPECTIVE, I aim to fill this gap in the debate by conducting a counterfactual empirical analysis of the effects of reclassification on investment in telecommunications. To do so, I propose and test the hypothesis that the reclassification "treatment" appropriately starts not with the promulgation of the FCC's *2015 Open Internet Rules*, but with the initial shock to the market: that is, the first realistic threat of reclassification by former FCC Chairman Julius Genachowski in 2010.[11] Applying the difference-in-differences method to a broad measure of investment (thus accounting for "virtuous circle" effects), I estimate the investment effects in telecommunications caused by the overhang of reclassification.

Using standard econometric methods, I find sizable investment effects. Between 2011 and 2015 (the last year data are available), the threat of reclassification reduced telecommunications investment by about 20% to 30%, or about $30 to $40 billion annually. Actual investment averaged $126 billion annually, a sizable expenditure, but the counterfactual analysis indicates the average investment over the five-year window would have been about $160 billion (or more) annually. That is, over the interval 2011 to 2015, another $150-$200 billion in additional investment would have been made "but for" Title II reclassification. Notably, I find no decline in investment following the release of the FCC's "Four Principles" to promote an Open Internet in 2005, suggesting it is reclassification—and not neutrality principles—that is reducing investment.

Investment and the Counterfactual

Broadband Service Providers are among the nation's largest spenders on capital equipment, and many factors influence their capital outlays including the demand for services, capacity needs and enhancements, and regulatory considerations. It is the mix of these varied factors that determines the final outcome, and these inputs may exert conflicting forces on investment incentives. For instance, an increase in demand for services (increasing incentives) may occur during a period of rising interest rates (decreasing incentives). Whether total capital expenditures rise or fall depends on the net effect of many opposing factors influencing investment decisions.

In such a complex setting, determining the effects of any single factor is very difficult and requires what the scientific community calls a "counterfactual." That is, we need to know what would happen in the absence of (or but for) the regulation.

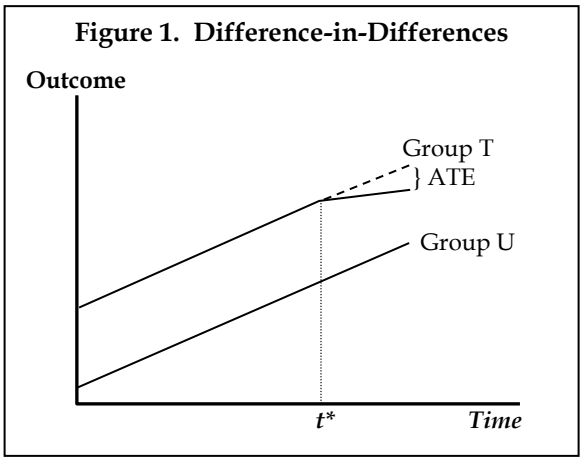
A simple example illustrates the need for a counterfactual. Say, for instance, a drug has been developed as a treatment for warts. To test its efficacy, the drug is given to a sample of persons with warts and the size of the warts is measured daily. After thirty days, it is determined that the 90% of the warts have vanished. It is tempting to say that the drug has cured the warts, but it is not possible to do so since some warts may vanish on their own. To determine the efficacy of the drug, a counterfactual is needed.

A proper experiment of the drug's efficacy includes a control group of persons with warts, but this group receives a placebo instead of the actual drug. As with the treated group, the size of the warts is monitored. For the control group, it is determined that only 20% of the warts were gone in thirty days (the counterfactual), providing strong evidence that the drug effectively eliminates warts. Relative to no treatment at all, the new drug improves the elimination of warts by 4.5 times [= 0.9/0.2].

Analyzing the effects of regulation on investment also requires a counterfactual. To see this, say capital expenditures last year were $10. A regulation is imposed this year and capital expenditures rise to $12. Is it possible to say regulation increased investment by $2? No. Many things may have changed in the year. For example, say that the demand for the firm's service rose sufficiently to induce an increase in capital expenditures, absent the regulation, to $15. This expenditure of $15 is the counterfactual. Assuming nothing else changed, the regulation is found to reduce investment by $3 (= $15 - $12).

Figure 1 illustrates the nature of the counterfactual analysis I employ here. In the figure, the outcome of interest is measured on the vertical axis and time on the horizontal axis. The treatment group is labeled T and the control group U, and the treatment is given at time period t^*. The treatment reduces the outcome of Group T, shows a negative departure from the trend. Under certain assumptions this change can be accurately estimated and, if so, it measures the effect of the treatment, or more formally the Average Treatment Effect ("ATE").

Figure 1. Difference-in-Differences



A key assumption to quantifying the ATE in this manner is that the pattern of outcomes for Group U after the treatment is an unbiased estimate of what would have happened to Group T had Group T not received the treatment.[12] That is, Group U serves as a valid *counterfactual*. In Figure 1, Groups U and T follow an identical pattern before the treatment and U's trend continues on afterwards pretty much as before t^*. Assuming that Group T's trend would have continued on its same trend absent the treatment, which is the same as U's trend, then the observed outcomes can be used to measure the ATE.

Quantifying the ATE in this way often employs a procedure called a difference-in-differences ("DiD") estimator.[13] The treatment effect is computed using

$$\delta = (Y_1^T - Y_0^T) - (Y_1^U - Y_0^U), \qquad (1)$$

where δ is the difference-in-differences estimator, the Y^T are the outcomes of the treated group and the Y^U the control group. The subscripts 0 and 1 indicate, respectively, the outcomes before and after the treatment. Equation (1) shows clearly why the method is referred to as a difference-in-difference estimator; it is literally the difference

between two differences. Equation (1) can be estimated using regression methods, which is the estimation approach I employ here.

Statistical Analysis

Following standard econometric methods, I test for investment effects of Title II reclassification (and Net Neutrality more broadly) using the DiD method. The statistical model used to measure the effect of reclassification on investments in telecommunications infrastructure is:

$$y_{it} = \delta D_{it} + \lambda_t + \mu_i + \varepsilon_{it} \ , \qquad (2)$$

where y_{it} is the (natural log of the) investment for economic sector i at time t, D_{it} is a dummy variable that equals 1 for the period for which the broadband providers faced the possibility of reclassification (0 otherwise), μ_i is fixed effect for each economic sector in the sample i, λ_t is a time effect common to all observations in time t, and ε_{it} is the econometric disturbance term that is assumed to be distributed independently of all μ and λ. This model is a two-way fixed effects model.

The coefficient of interest is the difference-in-differences estimator δ, which measures the change in y resulting from the treatment. The standard t-test on this coefficient indicates whether the "treatment," in this case reclassification, has a statistically-significant effect on investment.[14]

Treatment Date

In this framework, it is essential to determine the date for which the market recognized the threat of Title II reclassification. As it turns out, empirical evidence provides a clear indicator as to when reclassification became embedded in the financial decisions of the industry and investors: On May 6, 2010, Chairman Julius Genachowski and his General Counsel Austin Schlick released statements outlining a path to reclassifying broadband as a Title II telecommunications service.[15] As shown in Ford, Spiwak and Stern (2010), the announcement caught investors by surprise; the stock prices of broadband providers fell by about 10% in the immediate days following the announcement.[16]

Between the time Chairman Genachowski first broached the subject of reclassification until the time Chairman Wheeler formally made that change 2015, the industry was on constant alert that reclassification was on the table. In fact, the Title II proceeding opened by Chairman Genachowski was never closed,[17] leading then-Commissioner Ajit Pai to observe in 2014 (before the reclassification decision the next year), "the specter of Title II reclassification hovers ominously in the background."[18] Accordingly, as analyst Anna Marie Kovacs presciently observed in 2010, "we would expect the industry—telco, wireless, and cable—to assess capital investments from this point in light of the potential for new and more extensive regulations."[19]

... I propose and test the hypothesis that the reclassification "treatment" appropriately starts not with the promulgation of the FCC's 2015 Open Internet Rules, but with the initial shock to the market: that is, the first realistic threat of reclassification by former FCC Chairman Julius Genachowski in 2010.

Media coverage of the industry focused regularly on the reclassification of broadband as a Title II common carrier service, so the investment community and the industry was fully aware of the threat.[20] In Table 1, I provide a count of articles from the communications trade press discussing Title II reclassification for broadband between 2010 and 2015.[21] As the table shows, across the entire period between 2010 until the

FCC's *2015 Open Internet Order* the debate over reclassification was active.

Table 1. "Title II" Trade News Coverage

Year	Articles
2010	595
2011	110
2012	27
2013	65
2014	1,625
2015	2,079

Thus, since May of 2010, the industry has been on constant notice that Title II was in play. As my data is annual, I use the year 2010 as the treatment date indicating a heightened risk for reclassification. To support the treatment date, a statistical test is conducted to determine whether 2010 represented a shift in investment behavior.

Data

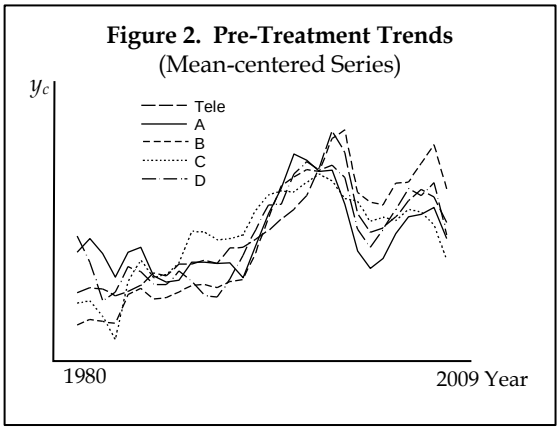
Investment data is supplied by the U.S. Bureau of Economic Analysis' Fixed Assets tables.[22] Telecommunications investment falls under the broad class of "Information" services in the subcategory "Broadcasting and Telecommunications." My data span 1980 through 2015, the last year for which data are available. The pre-treatment period is years 1980-2009, and the post treatment period is years 2011-2015. As is standard, I exclude data in 2010, the treatment year recognizing that investment decisions occur with a delay of a two-or-so years.[23] As alternatives, I limit the pre-treatment period to 1990-2009 and 2000-2009, so three samples are used.

Control Group

To produce quality causal effects, the DiD methodology requires a suitable control group of economic sectors. This control group establishes the counterfactual, which is the expected level of telecommunications investment absent the threat of Title II reclassification. The goal is to find a control or group of controls where the economic outcomes are expected to be similar to those of the treated group through time (the parallel paths assumption). With time-series data, researchers typically evaluate whether or not the trends in economic activity in the control group are equal to those of treated group before the treatment, often using visual inspection or other measures of similarity.

In the BEA's data, there are over 70 different economic sectors, narrowly and broadly defined, from which to choose controls. My approach to selecting a control group is based solely on pre-treatment investment trends and involves the following methods. First, I narrow the possibilities by computing a simple correlation coefficient (r) between broadcasting and telecommunications investment and the other sectors in the pre-treatment period, looking for relatively high correlation coefficients. Second, also for the pre-treatment period, I compute the mean absolute percent error ("MAPE") using mean-centered data, looking for relatively small values of this statistic. Third, I evaluate the candidates using visual inspection. Using these three tools, a control group is selected that best matches the pre-treatment trend in broadcasting and telecommunications investment.

Figure 2. Pre-Treatment Trends
(Mean-centered Series)



Four sectors are chosen for the control group: (A) machinery manufacturing; (B) computer and electronic products manufacturing; (C) plastic and rubber products manufacturing; and (D) transportation and warehousing. Figure 2 illustrates the pre-treatment trends, which are

very similar. The choice of control group appears reasonable.

Results

With the control group selected, I now turn to the estimation of Equation (2). For the full sample (1980-2015, excluding 2010), there are five industry sectors (four controls and telecommunications) and 35 years of data each, so there are 175 total observations. Limiting the analysis to 1990-2015, there are 130 total observations. Finally, considering only data from 2000-2015, there are 75 observations.

For the three samples, Table 2 presents the estimated DiD estimators. The regressions are both statistically significant at better than the 1% level for all three samples and the DiD estimators are all statistically different from zero at the 1% level or better.

Table 2. Summary of Estimates

Sample	Coef. (t-stat)	Marginal Effect	Obs.	Yearly Inv. Effect
1980-2015	-0.226 (-3.09)***	-20.3%	175	-32.0 bil.
1990-2015	-0.227 (-3.28)***	-20.3%	130	-32.2 bil.
2000-2015	-0.267 (-4.83)***	-23.4%	75	-38.5 bil.

Sig. Levels: * 10%, ** 5% *** 1%

The estimated coefficient for the full sample is -0.226, indicating that the threat of Title II reclassification has reduced overall investment in the broadcasting and telecommunications sector by about 20% relative to the counterfactual. Limiting the data to 1990-2015, the results are almost identical. However, for the 2000-2015 sample, the coefficient (-0.267) and the marginal effect (-23.4%) are somewhat larger.

For the final five years of the data, the average investment level for telecommunications and broadcasting was $126 billion (in 2015 dollars). This level of investment is 20% below the counterfactual, implying a reduction in investment of approximately $32 billion annually. For the third sample, the reduction is even larger at $39 billion.

These estimated reductions in investment are sizeable, no doubt. Over the five-year, post-treatment window (2011-2015), the overhang of reclassification is estimated to have reduced telecommunications investment by about $160 to $200 billion. In effect, over the five-year window, reclassification has cost the U.S. more than an entire year's worth of investment.

Table 3. Average Investment Levels

Sector	1980-2009	2011-2015	Ratio
Telecom	116.4	126.4	1.09
Control A	22.2	26.7	1.20
Control B	69.4	103.6	1.49
Control C	10.8	13.0	1.20
Control D	67.6	107.2	1.59
Controls	147.8	223.8	1.51

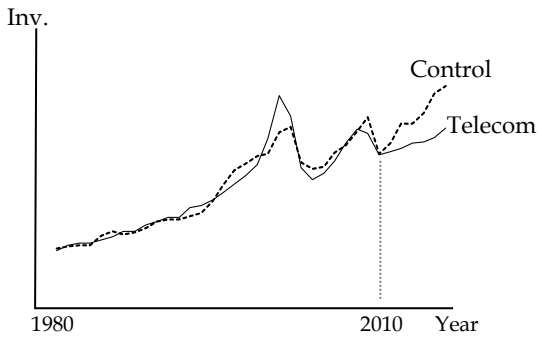
Measured in 2015 dollars (billions).

The econometric results are consistent with a simple analysis of average investment levels across the pre- and post-treatment periods. Table 3 summarizes the mean investment levels across the two periods (in 2015 dollars). Telecommunications investment rose by 9% across the two periods, but the investment levels of the members of the control group rose significantly more. For the control group (in total), the ratio of post- to pre-investment levels is 1.51, which is about 38% larger than that for the broadcasting and telecommunications sector. Thus, the econometric estimates are very much in line with—though smaller than—the changes in the average investment levels.

Using a synthetic control group offers a less formal but perhaps clearer picture of the estimated investment effects, linking the estimates to Figure 1. To produce the synthetic control, I regress telecommunications investment on the investment levels of the four control sectors using data from 1980-2009.[24] A linear

prediction of telecommunications investment through 2015 is calculated using the estimated coefficients. Figure 3 illustrates the investment data for the telecommunications sector and the synthetic control.

Figure 3. Synthetic Control Group



The synthetic control provides a close match for telecommunications investment prior to 2010, following investment closely even through two cycles of rapid growth. After 2010, the expectation is for another period of significant growth in telecommunications investment, yet investment remained somewhat flat for the telecommunications sector. The spread between the two lines—the ATE from Figure 1 above—is an investment gap of about $130 million (through 2015).

Reclassification or Net Neutrality?

In choosing 2010 as the treatment date, my intent is to quantify the investment effects of reclassification, not Net Neutrality more broadly. Chairman Genachowski's unexpected introduction of reclassification to the political calculus in May of 2010 dramatically altered the debate and had a significant effect on broadband providers' stock prices. The investment community, and in turn the providers themselves, apparently began to "bake in" reclassification into their investment decisions at that point.

Still, a legitimate question is whether this analysis captures the effects on investment of reclassification or, more generally, Net Neutrality without reclassification. An additional empirical test provides an answer. The FCC's initial foray into Net Neutrality occurred on August 5, 2005, with the release of Chairman Michael Powell's "Four Principles" to promote an Open Internet.[25] Commissioner Michael Copps observed the Four Principles "will protect network neutrality," so the release of the Four Principles is a reasonable initial date for Net Neutrality more generally.[26]

Four years (2006-2009) passed between the release of the principles and the beginning of the reclassification window, so I define these years as the treatment window for Net Neutrality under Title I of the Communications Act. Again using Equation (2), I can estimate the effects on investment of the Net Neutrality principles. The results are summarized in Table 4, and all three regressions are statistically significant.

Table 4. Effect of Internet Principles (2005)

Sample	Coef. (t-stat)	Marginal Effect	Obs.
1980-2009	-0.010 (-0.12)	-1%	145
1990-2009	-0.009 (-0.11)	-0.9%	100
2000-2009	-0.070 (-1.11)	-6.8%	45

Sig. Levels: * 10%, ** 5% *** 1%

From Table 4, we see the estimated DiD estimators are much smaller than those in Table 2. None of the DiD estimators is statistically different from zero. Thus, unlike reclassification, the principles appear to have had no meaningful effect on telecommunications investment.

Testing the Treatment Date

In estimating the investment effects of reclassification, I assumed a treatment date of 2010. If, however, investment began to turn

down before the surprise announcement in May of 2010, then the results presented above may be spurious. My analysis showing no effect in the 2005-2009 window offers some evidence that the downturn in investment did not occur prior to the reclassification treatment window.

Another test may be used to assess whether 2010 is the proper treatment date.[27] To do so, I alter the treatment window and re-estimate the model. The estimated model with the largest R^2 best fits the data. This statistical analysis confirms that of four alternative treatment dates (2007, 2008, 2009, and 2010), the model fits the data best with my chosen reclassification treatment date of 2010.[28]

Robustness to Controls

For the analysis above, four economic sectors are chosen for the control group. To evaluate whether any particular control has an undue influence on the estimates, I exclude one sector from the control group and re-estimate the model. The sample 2000-2015 is used for all the estimates. Results are summarized in Table 5.

Table 5. Analysis of Controls

Controls	Coef. (t-stat)	Marginal Effect	Obs.
ABC	-0.218 (-4.26)***	-19.6%	60
ABD	-0.292 (-5.88)***	-25.3%	60
ACD	-0.289 (-4.79)***	-25.1%	60
BCD	-0.268 (-4.33)***	-23.5%	60

Sig. Levels: * 10%, ** 5% *** 1%

Table 5 shows very little variation in the estimates across control groups; the investment effects are consistently negative, large, and statistically significant.[29] The largest difference is observed when Control D (transportation and warehousing) is excluded, reducing the marginal effect from about 23.4% to 19.6%. The marginal effects are equal to or exceed that with the full control group. Overall, the results do not suggest any outsized influence of any the individual controls.

Robustness to Alternate Specifications

For established businesses, a great portion of capital expenditures aim to replace depreciated plant. Thus, investment levels are related to net capital stock. There are two ways to incorporate net capital stock into the analysis. The first is to include the net capital stock (at the beginning of the year) as a regressor. To do so, Equation (2) may be written as,

$$y_{it} = \delta D_{it} + \beta X_{it} + \lambda t + \mu_i + \varepsilon_{it} \quad , \qquad (3)$$

where the X_{it} are additional regressors. In some investment studies, sales is also used as a regressor. BEA offers measures of Gross Output by industry (years 1997-2015), so it is possible to include output as a regressor for at least a sub-sample of the data.

Table 6. Summary of Estimates, Eq. (3)

Sample	Coef. (t-stat)	Marginal Effect	Obs.	Yearly Inv. Effect
1980-2015[a]	-0.264 (-4.50)***	-23.2%	175	-38.1 bil.
1990-2015[a]	-0.254 (-4.60)***	-22.4%	130	-36.3 bil.
2000-2015[a]	-0.284 (-5.57)***	-24.7%	75	-41.4 bil.
1997-2015[b]	-0.277 (-5.16)***	-24.2%	90	-40.2 bil.

Sig. Levels: * 10%, ** 5% *** 1%
[a] Includes (nat. log of) net capital stock as regressor.
[b] Includes (nat. log of) net capital stock and gross output as regressors.

Table 6 summarizes the results from these alternate specifications. The first three sets of results include net capital stock as a regressor; the fourth result includes both net capital stock and gross output as regressors. Across all alternatives, the DiD estimator is large and statistically significant. These changes in model specification do not materially affect the results,

though the effects are slightly larger than those reported in Table 2.

Table 7. Summary of Estimates

(Dep. Var. = Investment/Net Capital Stock)

Sample	Coef. (t-stat)	Marginal Effect	Obs.	Yearly Inv. Effect
1980-2015	-0.034 (-2.87)***	-20.6%	175	-32.7 bil.
1990-2015	-0.032 (-2.95)***	-20.5%	130	-32.3 bil.
2000-2015	-0.042 (-4.34)***	-28.1%	75	-49.3 bil.

Sig. Levels: * 10%, ** 5% *** 1%

Another option to specify y_{it} as investment divided by net capital stock and estimate Equation (2).[30] Table 7 summarizes the results. The dependent variable is a ratio and is no longer in natural log form so the coefficients are much smaller. The marginal effects, however, are consistent with the other specifications—reclassification has significantly reduced investment (20% to 30%) in the telecommunications industry.

Spurious Treatment Effect

The statistical analysis above reveals a large and negative departure of telecommunications investment from the counterfactual for the five-years following the threat of applying Title II to broadband services in 2010. Such evidence would be less compelling if large, statistically-significant investment effects for five-year windows were somewhat common over the entire sample, suggesting the control group was not very good.

Figure 4. Rolling Treatment Window

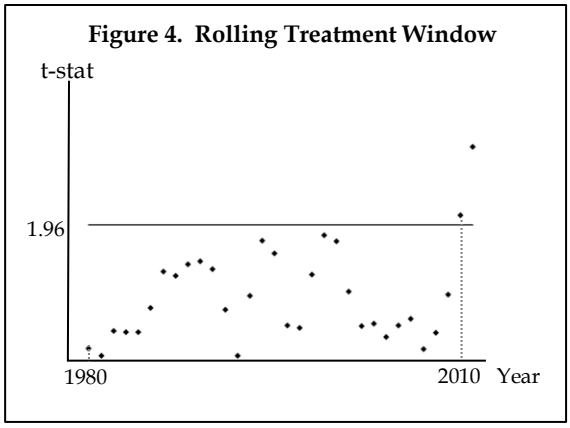


Figure 4 illustrates the t-statistics for the DiD estimator based on a five-year rolling treatment window starting in 1980 (1980-1984), sliding up one year for the next DiD estimate, and finally ending in 2011 (2011-2015). In all, 32 tests are conducted producing the same number of t-statistics on the DiD estimator, all of which are illustrated in Figure 4 (in absolute value). The solid line measures the critical t-statistic at the 5% alpha level (±1.96). As shown in Figure 4, statistically-significant investment effects are limited to the final two windows beginning in either 2010 or 2011. This finding provides good support for the control group and the negative investment consequences of reclassification.

Conclusion

Ever since the initiation of the FCC's controversial reclassification proposal in 2010, there has been much debate over the effect of these rules on network investment. Both sides of the debate, desperate to demonstrate the validity of their positions, have focused on short-term capital expenditures as a bellwether of their arguments, but such evidence cannot provide meaningful evidence of investment effects. The economically valid measurement of the effect of regulation requires a counterfactual—that is, how much firms would have invested "but for" the regulatory intervention.

[N]o negative investment consequences are found for the period where Net Neutrality was enforced via the FCC's "Four Principles" to promote an Open Internet, suggesting it is reclassification—and not the principles of Net Neutrality—that is reducing investment.

In this PERSPECTIVE, I make an attempt to do exactly that, measuring investment not from the date of the *2015 Open Internet Rules*, but from 2010 when reclassification was introduced by Chairman Genachowski and investors fled broadband stocks. Using government-supplied investment data and econometric methods, I find sizable negative investment effects beginning in 2010. Between 2011 and 2015, the threat of reclassification reduced telecommunications investment by 20% (or more), or about $32 to $40 billion annually; that's about $160-$200 billion in total over the five-year period. In effect, reclassification has cost the U.S. an entire year's worth of telecommunications investment (averaging $126 billion annually since 2011).

Alternatively, no negative investment consequences are found for the period where Net Neutrality was enforced via the FCC's "Four Principles" to promote an Open Internet, suggesting it is reclassification—and not the principles of Net Neutrality—that is reducing investment.

It appears that Chairman Ajit Pai intends to reformulate Net Neutrality policy, reversing the reclassification of broadband services as a Title II service and returning to a principles-based approach.[31] These econometric results indicate that the policy choice is a prudent one, especially if the encouragement of investment is an important policy goal.

NOTES:

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1 *See, e.g.*, Section 706 of the Telecommunication Act of 1996, 47 U.S.C. § 1302

2 *See, e.g.*, T.R. Beard, G.S. Ford, H. Kim, *Capital Investment and Employment in the Information Sector,* 38 TELECOMMUNICATIONS POLICY 371-382 (2014) (available at: http://www.sciencedirect.com/science/article/pii/S0308596113002000).

3 *See In re Preserving The Open Internet,* FCC 10-201, 25 FCC Rcd 17905, REPORT AND ORDER (rel. December 23, 2010), *rev'd and remanded*, *Verizon v. FCC,* 740 F.3d 623 (D.C. Cir. 2014).

4 *Protecting and Promoting the Open Internet*, REPORT AND ORDER ON REMAND, DECLARATORY RULING AND ORDER, GN Docket No. 14-28, FCC 15-24, 80 Fed. Reg. 19738 (rel. Mar. 12, 2015) (hereinafter "*2015 Open Internet Order*"), *aff'd, United States Telecom Association v. FCC*, 825 F.3d 674 (D.C. Cir. 2016).

5 G.S. Ford, *Bait-and-Switch – Or Why the FCC's "Virtuous Circle" Theory is Nonsense,* BLOOMBERG BNA (May 18, 2015) (available at: http://www.phoenix-center.org/oped/BloombergBNAVirtuousCircle18May2015.pdf).

6 C. Moffett, *Quick Take-U.S. Telecommunications, U.S. Cable & Satellite Broadcasting: The FCC Goes Nuclear*, Bernstein Research (May 5, 2010); E. Savitz, *Will FCC Choose "The Nuclear Option" in Net Neutrality Fight*, Tech Trader Daily (April 6, 2010) (available at: http://blogs.barrons.com/techtraderdaily/2010/04/06/will-fcc-choose-the-nuclear-option-in-net-neutrality-fight/).

7 Testimony of Frank Louthan, Managing Director of Equity Research at Raymond James Financial, before the House Committee on Energy and Commerce, Subcommittee on Communications and Technology (October 27, 2015) (available at: http://docs.house.gov/meetings/IF/IF16/20151027/104110/HHRG-114-IF16-Wstate-LouthanF-20151027-U1.pdf); see also Testimony of Craig Moffett, Partner and Senior Analyst, Moffett Nathanson before the House Committee on Energy and Commerce (July 22, 2015) (''The counter argument, that Title II regulation will only stifle investment even among incumbents, and will thereby make the problem worse, and will in the process generate unwelcome unintended consequences, is equally well- intentioned, and, unfortunately, is equally well supported by the historical evidence.'') (available at: http://docs.house.gov/meetings/IF/IF16/20150722/103745/HHRG-114-IF16-Wstate-MoffettC-20150722.pdf).

8 Remarks of FCC Chairman Tom Wheeler, Silicon Flatirons Center, Boulder Colorado (February 9, 2015) (available at: https://apps.fcc.gov/edocs_public/attachmatch/DOC-331943A1.pdf).

9 *C.f.*, H. Singer, *Does The Tumble In Broadband Investment Spell Doom For The FCC's Open Internet Order?* FORBES (August 25, 2015) (available at: https://www.forbes.com/sites/halsinger/2015/08/25/does-the-tumble-in-broadband-investment-spell-doom-for-the-fccs-open-internet-order/#48c4b03e1ef5); Free Press Fact Sheet, *The Truth About ISP Industry Investment After the FCC Net Neutrality Vote* (September 10, 2015) (available at: https://www.freepress.net/resource/107129/truth-about-isp-industry-investment-after-fcc-net-neutrality-vote); *see also* Prepared Remarks of FCC Chairman Tom Wheeler, *A Time to Look Forward: Protecting What Americans Now Enjoy,* The Aspen Institute (January 13, 2017) ("In the year after the Open Internet rules were adopted, venture investment in Internet-specific businesses was up 35 percent.") (available at: https://apps.fcc.gov/edocs_public/attachmatch/DOC-332260A2.pdf).

10 G.S. Ford, *Is the FCC's Regulatory Revival Deterring Infrastructure Investment?* BLOOMBERG BNA (November 13, 2015) (available at: http://www.phoenix-center.org/BloombergBNAInvestmentCounterfactual13Nov2015.pdf); *see also,* G.S. Ford, *Finding the Bottom: A Review of Free Press's Analysis of Network Neutrality and Investment,* PHOENIX CENTER PERSPECTIVE NO. 09-04 (October 29, 2009) (available at: http://www.phoenix-center.org/perspectives/Perspective09-04Final.pdf).

11 Press Release, Federal Communications Commission, *The Third Way: A Narrowly Tailored Broadband Framework,* Statement of Chairman Julius Genachowski 4-5 (May 6, 2010) (available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-297944A1.pdf) (hereinafter "*Genachowski Statement*"); Press Release, Federal Communications Commission, *A Third-Way Legal Framework for Addressing the Comcast Dilemma,* Statement of General Counsel Austin Schlick (May 6, 2010) available at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-297945A1.pdf) (hereinafter "*Schlick Statement*").

12 It is worth noting that theoretically the comparison here is not simply between Group T and U. Rather, U is being used as a proxy for Group T in the case where Group T does not receive the treatment. This proxy (or counterfactual) is necessary because we only observe Group T when it is treated. Obviously, the selection of the control group—Group U—is important.

13 *See, e.g.*, B.D. Meyer, *Natural and Quasi-Experiments in Economics*, 13 JOURNAL OF BUSINESS & ECONOMIC STATISTICS 151-161 (1995); J.D. Angrist and J.S. Pischke, MOSTLY HARMLESS ECONOMETRICS: AN EMPIRICIST'S COMPANION (2008); J.D. Angrist and A.B.

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[14] The literature recommends clustered standard errors for DiD analysis, but number of counties evaluated here is too small for the technique. M. Bertrand, E. Duflo and S. Mullainathan, *How Much Should We Trust Differences-In-Differences Estimates?* 119 QUARTERLY JOURNAL OF ECONOMICS 249-275 (2004).

[15] *Supra* n. 11.

[16] G.S. Ford, L.J. Spiwak and M. Stern, *The Broadband Credibility Gap*, 19 COMMLAW CONSPECTUS 75 (2010)

[17] J. Eggerton, *Pai: FCC Should Close Title II Docket ASAP*, BROADCASTING & CABLE (October 16, 2012) (available at: http://www.broadcastingcable.com/news/washington/pai-fcc-should-close-title-ii-docket-asap/60724).

[18] K. Tummarello, *FCC Revives Net Neutrality*, THE HILL (February 19, 2014) (available at: http://thehill.com/policy/technology/198704-fcc-revives-net-neutrality).

[19] Anna-Maria Kovacs, *Telecom Regulatory Note: D.C. Circuit Vacates FCC's Comcast Network-Management Order*, Regulatory Source Associates LLC, (April 7, 2010) at p. 2.

[20] *See, e.g.,* J. Eggerton, *House Republican Moves to Block Broadband Reclassification*, BROADCASTING & CABLE (June 9, 2010) (available at: http://www.broadcastingcable.com/news/technology/house-republican-moves-block-broadband-reclassification/47527); J. Eggerton, *Cantwell Introduces Bill Applying New Net Neutrality Rules to Wireless*, BROADCASTING & CABLE (January 26, 2011) (available at: http://www.broadcastingcable.com/news/washington/cantwell-introduces-bill-applying-new-net-neutrality-rules-wireless/58439); J. Eggerton, *Net Neutrality Debate Gets Prime Floor Time*, BROADCASTING & CABLE (April 8, 2011) (available at: http://www.broadcastingcable.com/news/washington/net-neutrality-debate-gets-prime-floor-time/58770); J. Eggerton, *Wheeler to Congress: News Info Study Not An Attempt To Influence Media*, BROADCASTING & CABLE (December 12, 2013) (available at: http://www.broadcastingcable.com/news/washington/wheeler-congress-news-info-study-not-attempt-influence-media/127931); J. Eggerton, *Walden: FCC Title II Move Would Disrupt Relationship With Congress*, BROADCASTING & CABLE (January 23, 2013) (available at: http://www.broadcastingcable.com/news/washington/walden-fcc-title-ii-move-would-disrupt-relationship-congress/61039); M. Lazarus, *Net Neutrality: Both Sides Are Wrong*, COMMLAW BLOG (January 7, 2011) (available at: http://www.commlawblog.com/2011/01/articles/cellular/net-neutrality-both-sides-are-wrong); T. Romm, *FCC to Make Move on Net Neutrality*, THE HILL (May 5, 2010) (available at: http://thehill.com/policy/technology/96273-fcc-to-make-move-on-net-neutrality-thursday); S. Jerome, *Democrats Push FCC Ahead of Key Vote*, The Hill (June 16, 2010) (available at: http://thehill.com/policy/technology/103665-letter-circ-ing-with-dem-senators-says-fcc-will-not-qregulate-internetq); G. Nagesh, J. Ryan and B. Sasso, *Senate in Party-Line Vote Rejects Measure to Overturn FCC Net-Neutrality Rules*, THE HILL (November 10, 2011) (available at: http://thehill.com/policy/technology/192899-senate-rejects-bid-to-overturn-net-neutrality-rules); B. Sasso, '*Father of the Internet' Says Battle Over UN Regulation Will Determine Future of the Web*, THE HILL (May 31, 2012) (available at: http://thehill.com/policy/technology/230317-father-of-the-internet-warns-battle-over-un-regulation-will-determine-future-of-the-net); C. Ziegler, *The Engadget Interview: Steve Largent, President and CEO, CTIA*, ENDGADGET (December 6, 2010) (available at: https://www.engadget.com/2010/12/06/the-engadget-interview-steve-largent-president-and-ceo-ctia); P. Goldstein, *FCC Approves Mandatory Data Roaming Rules*, FIERCEWIRELESS (April 7, 2011) (available at: http://www.fiercewireless.com/wireless/fcc-approves-mandatory-data-roaming-rules).

[21] These data result from a search of Westlaw's "Communications News" database (subscription required) using the terms "DA(YEAR) & 'Title II' & 'Net Neutrality'" for each year provided in the table.

[22] Table 3.7ESI (http://bea.gov/iTable/iTable.cfm?ReqID=10&step=1#reqid=10&step=3&isuri=1&1003=55); *see also* Beard, Ford, and Kim, *supra* n. 2.

[23] Excluding both 2010 and 2011 is another option, but the data on telecommunications investment is already thin in the treatment period. Excluding 2011 produces larger results than those summarized in this PERSPECTIVE.

[24] The regression has 30 observations and the R^2 is 0.95.

[25] FCC Press Release, *FCC Adopts Policy Statement* (August 5, 2005) (available at: https://apps.fcc.gov/edocs_public/attachmatch/DOC-260435A1.pdf).

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[26] Statement of Commissioner Michael Copps (August 5, 2005) (available at: https://apps.fcc.gov/edocs_public/attachmatch/DOC-260433A4.pdf).

[27] R.S. Pindyck and D.L. Rubinfeld, ECONOMETRIC MODELS & ECONOMIC FORECASTS (1991), at pp. 118-120.

[28] I suspect the fit may improve using treatment dates after 2010 since investment plans often are made years in advance. Given the paucity of post-treatment data, however, I do not report the results of tests on years later than 2010.

[29] The character of these findings are similar across the other two samples.

[30] T. Erickson and T.M. Whited, *Measurement Error and the Relationship Between Investment and "q"*, 108 JOURNAL OF POLITICAL ECONOMY 1027-1057 (2000); R.S. Chirinko, *Business Fixed Investment Spending: Modeling Strategies, Empirical Results, and Policy Implications*, 31 JOURNAL OF ECONOMIC LITERATURE 1875-1911 (1993); S. M. Fazzari, G. Hubbard, B.C. Petersen, A. Blinder, and J.M. Poterba, *Financing Constraints and Corporate Investment*, BROOKINGS PAPERS ON ECONOMIC ACTIVITY, 141-206 (1988). C. Bischoff, *Business Investment in the 1970s: a Comparison of Models*, 2 BROOKINGS PAPERS ON ECONOMIC ACTIVITY 13-58 (1971).

[31] D. Shepardson, U*.S. FCC Chairman Plans Fast-Track Repeal of Net Neutrality: Sources*, REUTERS (April 6, 2017) (available at: http://www.reuters.com/article/us-usa-internet-idUSKBN1790AP); J.D. McKinnon, *FCC Chairman Ajit Pai Faces Balancing Act in Net Neutrality Rollback*, WALL STREET JOURNAL (April 16, 2017) (available at: https://www.wsj.com/articles/fcc-chairman-ajit-pai-faces-balancing-act-in-net-neutrality-rollback-1492340400).