AN ECONOMIC ANALYSIS OF THE FCC'S MODIFICATIONS TO THE HIGH-COST LOOP SUPPORT MECHANISM

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I. INTRODUCTION

1. The High Cost Loop Support ("HCLS") mechanism gives support to telephone companies to provide service to high-cost areas where revenues from the firm's customer base alone would not be sufficient to cover the costs of deploying telephony services. The HCLS mechanism plays an essential role in America's commitment to implementing the goals the Universal Service for telephony; that is, that the telephone network should be both ubiquitous and affordable throughout America, including rural areas. Recently the Federal Communications Commission ("Commission") has introduced a policy of extending the concept of Universal Service to Broadband access as well as basic telephony. The Commission has imposed modifications to the existing HCLS mechanism. This white paper reviews the methodology proposed by the Commission to place limits or benchmarks on the level of HCLS and redirect some of the funds to support new broadband investment. Section II reviews and comments on the methodology for establishing cost benchmarks for HCLS as adopted by the Wireline Competition Bureau ("Bureau"). Section III presents my econometric analysis of the cost benchmark methodology, and Section IV contains my conclusions and some suggestions for policy modifications.

II. EVALUATING THE COMMISSION'S COST BENCHMARK METHODOLOGY FOR HCLS

2. In its April 25, 2012 Order, the Bureau states that its cost benchmark methodology is "intended to moderate the expenses of those rate-of-return carriers with very high costs compared to their similarly situated peers, while further encouraging other rate-of-

return carriers to advance broadband deployment."[1] The Bureau's adopted benchmark methodology is currently used to impose caps on individual company receipts of HCLS, and it, or a comparable version, might eventually be applied to similarly cap a company's receipt of ICLS.[2] For the reasons discussed below, the benchmarking methodology likely will fail to meet these two goals. Instead, the methodology likely will dampen the incentives of rate of return local exchange carriers ("LECs") generally to upgrade their networks by creating a degree of regulatory uncertainty. In addition, even for those LECs that can overcome such uncertainty in the near-term, the methodology likely will have only modest effects on their incentives to advance broadband deployment because the dollar size of the redistributed funds is relatively small compared to the level of capital investments required for broadband deployment. Companies have difficulty justifying long-term investments when it is unclear, for a material number of them, whether there will be any support at all beyond the current year or a few more. Or even more importantly, whether ongoing support, regardless of the amount of short-term redistribution, will be available to sustain those investments over time in high-cost areas. Finally, the proposed benchmark methodology creates a potential stranded-cost problem for legacy network capital investments.

3. The underlying supposition in the Bureau's approach appears to be that rate-of-return carriers serving high-cost, rural areas are subject to the Averch-Johnson effect,[3] causing costs to be inefficiently large. The Bureau has implicitly extended this framework to the HCLS mechanism and supposes that some relatively high-cost firms exhibit this inefficiency. The

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[1] FCC, In the Matter of Connect America Fund, High-Cost Universal Service Support, WC Docket No. 10-90 and 05-337 (April 25, 2012), ¶ 1.

[2] *Id* at 225.

[3] Averch, H. and Johnson, L. (1962), "Behavior of the Firm Under Regulatory Constraint," *American Economic Review*, vol. 52, pp. 1052–1069.

Bureau's apparent intention is to encourage such firms to be more efficient by capping their HCLS funds. In addition, the Commission intends to divert the saved funds to allegedly more efficient firms, with the goal that that these firms will spend the additional revenues on new broadband deployment. Thus, the implicit assumption within the FCC's economic model is that it can reallocate resources and obtain a near Pareto improvement: by capping allegedly inefficient firms, the Commission assumes it will lose no connectivity and so universal service is not compromised, and by diverting funds it can increase network investment that facilitates broadband deployment.

4. The reforms are based on a model of moral hazard. As stated by the Bureau: "Under the prior rules, some carriers with high costs may have had up to 100 percent of their expenditures on loop costs reimbursed from the federal universal service fund. Because, prior to the USF/ICC Transformation Order, these carriers generally faced no overall limits on their expenditures, our rules gave carriers incentives to increase loop costs with little regard to efficiency or the burden on the Fund, and without regard to whether a lesser amount would be sufficient to provide supported services to their customers."[4] In particular, the Bureau's benchmark cost methodology implicitly posits that firms with costs per loop in the 90th percentile exhibit such moral hazard, while firms below that threshold do not.

5. The Bureau claims that the model is intended to track "similarly situated" companies, but the model appears to establish no such comparator groups in developing the "benchmarks." Instead, within the Bureau's regression methodology, *every* firm's costs are used to estimate the hypothetical 90% cost levels for a constructed firm with the same characteristics. Thus, for example, the costs of a firm in Wyoming are used to determine the estimated costs of a

[4] FCC, In the Matter of Connect America Fund, High-Cost Universal Service Support, WC Docket No. 10-90 and 05-337 (April 25, 2012), ¶ 2.

putative efficient firm in Tennessee. In essence, the costs of all firms are drawn from the same distribution conditioned on a set of observable characteristics for all companies included in the regression model. If this assumption fails to appropriately compare similarly situated entities, then the methodology is unsound.

6. An alternative means of reviewing firms' costs would suppose that each firm has idiosyncratic cost effects given the unique features of its specific service area and the density of its customer base. Under this alternative hypothesis, firms would have economies of scale that a linear quantile regression would not pick up. Thus, under the hypothesis that rate-of-return firms are increasing their capital costs inefficiently, I would expect to see no relation between high capital cost firms and high operating cost firms. That is, there would be a zero correlation between their capital and operating costs. Conversely, if firms all faced the same technology and regional effects, but optimally substituted between capital and operational expense based on size, then I would expect to see a negative correlation between their capital and operating costs. Indeed the Averch-Johnson model would also predict a negative correlation. In fact, I find a strongly positive correlation between firms' capital costs and operating expenses. This is consistent with the hypothesis that there are simply higher and lower cost service areas. Moreover, this positive correlation between firms' capital and operating expenses are explained by the number of loops, which is consistent with the hypothesis that there are (non-linear in scale) fixed costs not accounted for in the linear regression model.

7. An alternative explanation for this correlation is "gold-plating," i.e., management derives utility from incurring both inefficient capital and operating expenses ("Capex" and "Opex"). However, if the allowed rate of return exceeds the cost of capital of, for example, a Private Equity fund, then returns to excess Capex would exceed returns to excess Opex.

Therefore, we would expect that a profit-maximizing entity would not engage in such purely wasteful Opex. If a firm's management were to do so, then we would expect that firm would be bought out by a profit-maximizing entity such as a Private Equity fund.

8. If variation in firms' capital costs and operating expenses is largely explained by the particular cost characteristics of the areas they serve, then the moral hazard assumption on which the Bureau based its proposed cost benchmark is incorrect. A reduction in HCLS to firms above the 90th percentile will directly reduce investment in infrastructure by those firms, since there is no inefficient capital spending. In this case, the Bureau's proposed cost benchmark methodology likely will reduce the rate of broadband deployment, since some firms will now have an incentive to wait and allow depreciation schedules to lower their costs until they are below the cap. Because the average life of loop plant and backbone investments is very long and the associated depreciation rates slow—for example, the life of a fiber-optic transport loop may be 30 years—companies have an inherent inability to quickly reduce the current book level of Capex in response to actually being capped or expecting to be capped. Thus, this incentive to cut off new investment until a firm gets "under the cap" may have a substantial long-term impact on investments

9. Moreover, and perhaps more disconcerting due to its adverse impacts upon incentives for efficient broadband deployment over time by multiple firms, my econometric analysis shows that the identities of capped firms vary substantially year by year. Under the Bureau's mechanism,[5] approximately 13% of firms over the past seven years would have been

[5] FCC, In the Matter of Connect America Fund, High-Cost Universal Service Support, WC Docket No. 10-90 and 05-337 (April 25, 2012).

capped in at least one year.[6] This is a substantial risk by any standard. The problem is that firms cannot predict with a reasonable degree of certainty whether or not they will be among those whose HCLS funds are capped, especially as the caps affect all firms' behavior going forward. In particular, because the regression coefficient depends on the actions taken by all 700+ study areas, an individual firm has little control over the determination of what is the level of a "similarly situated firm." Thus, the movement of firms into and out of the 90th percentile is beyond the control of any individual firm and would create substantial regulatory and financial uncertainty in its decision making regarding long-term capital investments. Such uncertainty would raise the threshold rate of return that an investment would have to earn in order to be financed. Therefore, firms at risk of moving into the 90th percentile will reduce their long-term capital investments, resulting in lower broadband deployment.

10. I also analyze the economic incentives provided by the cost benchmark methodology on firms that, *ex post*, were not in the 90th percentile. I find that such firms did not, *ex ante*, have an increased incentive to deploy broadband. The increase in funding provided by diverted HCLS funds from capped firms depends on whether, *ex post*, a firm is in the 90th percentile. From an *ex ante* perspective, a firm is more likely to pick up greater percentage support payments by reducing its capital expenditures if it anticipates that, without such reductions, it would have been capped.

[6] See Table 5. Of the 726 study areas, 656 are such that annual data on Capex, Opex, Loops, and PUP are not missing for each year in the time period 2006-2012. The percentage of firms that would have been capped in at least one year over the past seven years is calculated using the balanced panel of 656 firms.

III. ECONOMIC ANALYSIS OF THE HCLS PROGRAM

A. *Data*

11. I obtained annual National Exchange Carrier Association ("NECA") data on 726 unique study areas for the time period 2006-2012. Of the 16 explanatory variables used in the capital cost ("Capex") and operating expense ("Opex") regressions in the April 25 Bureau Order, annual NECA data for the time period 2006-2012 were available for two variables—number of loops ("Loops") and percentage of undepreciated plant ("PUP"). Table 1 shows summary statistics of Capex, Opex, Loops, PUP, and the time-invariant explanatory variables in the FCC regression.

Table 1
Summary Statistics (726 Study Areas)

Variable	Number of Non-Missing Observations[/1]	Mean	Median	Std. Dev.	Min	Max
Time-Varying						
Capex (000s)[/2]	4,907	1,852.42	990.69	2,576.07	6.93	22,566.87
Opex (000s)	4,908	2,197.72	1,402.99	2,657.52	21.72	29,138.25
Loops	4,908	5,427.39	2,901.00	8,503.72	16.00	126,285.00
PUP[/3]	4,902	35.38	34.16	14.00	0.14	99.96
Time-Invariant						
Road Miles	5,082	1,810.00	635.14	3,537.62	6.52	37,425.68
Road Crossings	5,082	6,531.51	2,810.50	10,802.70	104.00	95,202.00
State SACs	5,082	1.94	1.00	2.57	1.00	21.00
Density	5,082	22.36	9.31	62.95	0.01	1,124.31
Exchanges	5,013	5.41	3.00	6.80	1.00	76.00
Pct. Bedrock 36	5,082	0.06	0.00	0.14	0.00	0.89
Diff	5,082	1.06	1.00	0.19	1.00	2.81
Climate	5,082	6.20	6.00	1.59	1.67	12.65
Pct. Tribal Land	5,082	9.03	0.00	24.80	0.00	100.00
Pct. Park Land	5,082	0.64	0.00	3.85	0.00	47.81
Pct. Urban	5,082	9.17	0.00	19.45	0.00	95.38
Alaska	5,082	0.02	0.00	0.15	0.00	1.00
Midwest	5,082	0.41	0.00	0.49	0.00	1.00
Northeast	5,082	0.08	0.00	0.27	0.00	1.00

Notes
[/1] The maximum possible number of non-missing observations for any variable is 5,082, i.e., 726 study areas × 7 years = 5,082 observations. Variables with less than 5,082 observations have missing values for at least one year.
[/2] Of 4,908 non-missing observations for Capex, 4,907 are non-negative. Summary statistics are shown for these 4,907 observations.
[/3] Of 4,908 non-missing observations for PUP, 4,902 are non-negative. Summary statistics are shown for these 4,902 observations.

B. *Robustness of the Bureau's Quantile Regression Approach*

12. To check the robustness of the Bureau's quantile regression approach, I first perform quantile regressions as specified in the April 25 Bureau Order using annual data for the 2006-2012 time period. Of the 16 explanatory variables used in each regression, only two variables, Loops and PUP, vary across time for each study area. The estimated coefficients from the Capex, Opex, and Total Cost regressions are shown in Tables 2, 3, and 4. The pseudo R-squared values of the three sets of regressions range from 0.62 to 0.69.[7] When the Capex, Opex, and Total Cost regressions are performed without the 14 time-invariant variables, i.e., using only Loops and PUP as independent variables, the pseudo R-squared values range from 0.50 to 0.56. This suggests there is relatively poor explanatory power of the model given that the extra 14 variables do so little to improve the pseudo R-squared, and significant explanatory variables are omitted. However, what appears to be little variation in the coefficients from year to year implies much more substantial variation in terms of support. This is due to the fact that the variables in the equation are in logarithmic forms. After transforming the estimated numbers back to dollar terms via exponential transformation, the financial impact of the instability in the coefficients becomes much larger.

[7] Pseudo R-squared is a goodness-of-fit measure for quantile regression. See Koenker, R. and Machado, J. (1999), "Goodness of Fit and Related Inference Processes for Quantile Regression," *Journal of the American Statistical Association*, vol. 94, pp. 1296-1310.

TABLE 2
QUANTILE REGRESSION ANALYSIS
DEPENDENT VARIABLE: LN(CAPEX)

Variable	2006	2007	2008	2009	2010	2011	2012
Constant	5.516***	5.645***	5.677***	5.881***	6.261***	6.039***	5.987***
	(0.346)	(0.371)	(0.387)	(0.332)	(0.346)	(0.416)	(0.377)
Ln(Loops)	0.726***	0.649***	0.651***	0.671***	0.751***	0.788***	0.783***
	(0.046)	(0.060)	(0.052)	(0.049)	(0.052)	(0.071)	(0.044)
PUP	0.026***	0.027***	0.028***	0.032***	0.029***	0.031***	0.029***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Ln(Road Miles)	-0.135	-0.006	-0.002	0.020	-0.156	-0.208	-0.147
	(0.111)	(0.128)	(0.116)	(0.103)	(0.115)	(0.136)	(0.112)
Ln(Road Crossings))	0.283***	0.202**	0.184**	0.122	0.204**	0.240***	0.229**
	(0.078)	(0.088)	(0.089)	(0.079)	(0.090)	(0.091)	(0.097)
Ln(State Sacs)	-0.019	-0.041	-0.049	-0.024	-0.052	-0.070*	-0.095**
	(0.033)	(0.034)	(0.035)	(0.031)	(0.034)	(0.043)	(0.040)
Ln(Density)	-0.140***	-0.073	-0.076	-0.088*	-0.150***	-0.158**	-0.129***
	(0.050)	(0.061)	(0.056)	(0.051)	(0.056)	(0.072)	(0.045)
Ln(Exchanges)	0.090*	0.125**	0.138**	0.123**	0.131**	0.118*	0.086
	(0.054)	(0.058)	(0.060)	(0.052)	(0.055)	(0.061)	(0.054)
Pct. Bedrock 36	0.116	0.008	-0.026	-0.194	-0.163	-0.072	0.077
	(0.147)	(0.159)	(0.147)	(0.133)	(0.146)	(0.156)	(0.152)
Diff	-0.028	0.092	0.118	0.144	0.083	0.118	0.120
	(0.095)	(0.099)	(0.102)	(0.093)	(0.077)	(0.087)	(0.144)
Climate	0.093***	0.099***	0.111***	0.108***	0.090***	0.089***	0.067**
	(0.025)	(0.026)	(0.027)	(0.026)	(0.027)	(0.030)	(0.029)
Pct. Tribal Land	0.003***	0.002**	0.002*	0.002**	0.001	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Pct. Park Land	0.017***	0.016***	0.017***	0.015***	0.019***	0.018***	0.011***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.003)
Pct. Urban	0.000	0.002	0.002	0.002	0.000	0.001	-0.000
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)
Alaska	-0.550**	-0.273	-0.237	-0.361	-0.669**	-0.622*	-0.309
	(0.254)	(0.289)	(0.285)	(0.256)	(0.274)	(0.337)	(0.195)
Midwest	0.102	0.078	0.120	0.084	0.067	0.092	0.096
	(0.071)	(0.078)	(0.084)	(0.076)	(0.084)	(0.091)	(0.086)
Northeast	-0.067	-0.022	-0.018	-0.120	-0.281**	-0.309**	-0.228*
	(0.098)	(0.106)	(0.118)	(0.109)	(0.120)	(0.124)	(0.124)
Number of Observations	659	678	692	707	721	726	724
Pseudo R^2	0.67	0.66	0.67	0.67	0.66	0.67	0.67

Note: Standard errors are enclosed in parentheses. Symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels respectively.

TABLE 3
QUANTILE REGRESSION ANALYSIS
DEPENDENT VARIABLE: LN(OPEX)

Variable	2006	2007	2008	2009	2010	2011	2012
Constant	7.358***	7.512***	7.613***	7.741***	8.007***	8.198***	8.211***
	(0.348)	(0.359)	(0.343)	(0.382)	(0.269)	(0.255)	(0.375)
Ln(Loops)	0.726***	0.707***	0.701***	0.704***	0.697***	0.596***	0.644***
	(0.053)	(0.063)	(0.052)	(0.056)	(0.041)	(0.037)	(0.049)
PUP	0.008***	0.010***	0.010***	0.008***	0.006***	0.008***	0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)
Ln(Road Miles)	-0.328***	-0.266**	-0.297**	-0.337**	-0.333***	-0.247***	-0.235*
	(0.125)	(0.128)	(0.118)	(0.133)	(0.098)	(0.086)	(0.123)
Ln(Road Crossings)	0.276***	0.215**	0.245***	0.310***	0.291***	0.272***	0.246**
	(0.091)	(0.096)	(0.090)	(0.100)	(0.084)	(0.081)	(0.119)
Ln(State Sacs)	-0.057	-0.076	-0.071	-0.070	-0.068*	-0.078**	-0.102**
	(0.047)	(0.050)	(0.047)	(0.053)	(0.037)	(0.035)	(0.047)
Ln(Density)	-0.170***	-0.138**	-0.145***	-0.161***	-0.190***	-0.128***	-0.147***
	(0.057)	(0.058)	(0.051)	(0.056)	(0.042)	(0.034)	(0.049)
Ln(Exchanges)	0.093	0.113*	0.140**	0.094	0.124***	0.125***	0.104**
	(0.061)	(0.061)	(0.057)	(0.062)	(0.036)	(0.032)	(0.044)
Pct. Bedrock 36	0.174	0.235*	0.270*	0.398**	0.196	0.279***	0.091
	(0.160)	(0.138)	(0.149)	(0.171)	(0.123)	(0.098)	(0.143)
Diff	0.213***	0.248***	0.169*	0.074	0.091*	0.114**	0.112
	(0.069)	(0.094)	(0.087)	(0.098)	(0.053)	(0.057)	(0.086)
Climate	0.140***	0.138***	0.138***	0.123***	0.131***	0.135***	0.121***
	(0.027)	(0.028)	(0.027)	(0.030)	(0.021)	(0.020)	(0.030)
Pct. Tribal Land	0.003***	0.003***	0.002**	0.003***	0.002**	0.002***	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Pct. Park Land	0.004	0.000	0.002	0.007*	0.004**	0.006	0.007
	(0.002)	(0.003)	(0.002)	(0.004)	(0.002)	(0.004)	(0.005)
Pct. Urban	0.001	-0.000	0.001	-0.001	0.003***	0.002**	0.003**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Alaska	0.278	0.362	0.495**	0.076	0.230	0.299*	0.258
	(0.222)	(0.232)	(0.217)	(0.262)	(0.154)	(0.155)	(0.222)
Midwest	0.150*	0.163*	0.191**	0.141	0.140**	0.134**	0.130
	(0.079)	(0.087)	(0.081)	(0.092)	(0.067)	(0.063)	(0.096)
Northeast	0.083	0.035	0.033	0.017	0.007	0.015	0.008
	(0.106)	(0.115)	(0.109)	(0.125)	(0.096)	(0.085)	(0.131)
Number of Observations	659	678	692	707	722	726	724
Pseudo R^2	0.63	0.62	0.64	0.63	0.63	0.62	0.62

Note: Standard errors are enclosed in parentheses. Symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels respectively.

TABLE 4
QUANTILE REGRESSION ANALYSIS
DEPENDENT VARIABLE: LN(TOTAL COST)

Variable	2006	2007	2008	2009	2010	2011	2012
Constant	7.168***	7.267***	7.304***	7.254***	7.512***	7.929***	7.770***
	(0.308)	(0.316)	(0.223)	(0.295)	(0.304)	(0.371)	(0.310)
Ln(Loops)	0.760***	0.710***	0.740***	0.805***	0.741***	0.676***	0.664***
	(0.043)	(0.055)	(0.034)	(0.045)	(0.048)	(0.060)	(0.037)
PUP	0.014***	0.016***	0.015***	0.016***	0.017***	0.018***	0.017***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)
Ln(Road Miles)	-0.303***	-0.305***	-0.318***	-0.350***	-0.350***	-0.217*	-0.059
	(0.096)	(0.108)	(0.073)	(0.101)	(0.111)	(0.124)	(0.099)
Ln(Road Crossings)	0.295***	0.327***	0.315***	0.312***	0.366***	0.242**	0.155*
	(0.079)	(0.080)	(0.057)	(0.082)	(0.088)	(0.103)	(0.092)
Ln(State Sacs)	-0.041	-0.037	-0.066**	-0.051	-0.077**	-0.076*	-0.101***
	(0.032)	(0.039)	(0.029)	(0.036)	(0.034)	(0.044)	(0.038)
Ln(Density)	-0.191***	-0.170***	-0.197***	-0.246***	-0.211***	-0.140**	-0.092**
	(0.042)	(0.053)	(0.034)	(0.047)	(0.052)	(0.058)	(0.037)
Ln(Exchanges)	0.092*	0.109**	0.106***	0.077	0.101**	0.136**	0.079*
	(0.049)	(0.052)	(0.036)	(0.049)	(0.049)	(0.056)	(0.045)
Pct. Bedrock 36	0.083	-0.052	0.169*	0.034	-0.012	0.185	0.049
	(0.135)	(0.157)	(0.102)	(0.147)	(0.142)	(0.147)	(0.130)
Diff	0.173	0.262***	0.201***	0.183**	0.122*	0.136*	0.128**
	(0.115)	(0.064)	(0.056)	(0.089)	(0.064)	(0.074)	(0.063)
Climate	0.135***	0.125***	0.141***	0.136***	0.113***	0.112***	0.108***
	(0.023)	(0.024)	(0.017)	(0.024)	(0.024)	(0.029)	(0.024)
Pct. Tribal Land	0.002***	0.002**	0.002***	0.001*	0.001	0.002*	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Pct. Park Land	0.007***	0.007***	0.009***	0.010***	0.010***	0.011*	0.009**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.006)	(0.004)
Pct. Urban	-0.001	-0.000	0.001	0.000	0.002	0.002	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Alaska	-0.031	0.095	0.091	-0.219	-0.114	-0.033	0.186
	(0.166)	(0.198)	(0.139)	(0.183)	(0.196)	(0.242)	(0.183)
Midwest	0.170**	0.142**	0.146***	0.134*	0.121	0.115	0.157**
	(0.068)	(0.071)	(0.053)	(0.075)	(0.075)	(0.089)	(0.079)
Northeast	0.062	0.042	0.053	-0.020	-0.049	-0.117	-0.070
	(0.087)	(0.096)	(0.069)	(0.100)	(0.102)	(0.122)	(0.109)
Number of Observations	659	678	692	707	722	726	724
Pseudo R^2	0.68	0.68	0.69	0.68	0.68	0.68	0.68

Note: Standard errors are enclosed in parentheses. Symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels respectively.

13. However, the more important check of the stability of the Bureau's approach lies in variation in the identities of the capped firms over time. To determine whether a firm is capped, the Bureau uses an "aggregation rule" that combines quantile regression results from the separate Capex and Opex regressions. Suppose that firm i's actual Capex per loop and Opex per loop are c_i and o_i. Let c_i^{90} and o_i^{90} denote the per-loop values of firm i's predicted Capex and Opex 90th percentiles. I also perform a "Total Cost" quantile regression where the dependent variable is the natural logarithm of total cost (the sum of Capex and Opex). In this case, let t_i and t_i^{90} determine firm i's actual total cost per loop and the per-loop value of the predicted 90th percentile of total cost.

14. Of the 726 study areas, 656 are such that annual data on Capex, Opex, Loops, and PUP are not missing for each year in the time period 2006-2012. For the "balanced panel" of 656 study areas, Table 5 shows for each of the three aggregation rules, (1) the number of firms capped in every year, (2) the number of firms capped in at least 1 year, and (3) the number of firms capped in at least 1 year and not capped in at least 1 year. I observe that a relatively large number of firms (27%, 13%, and 18% under rules 1, 2, and 3 respectively) are capped in at least 1 year. Further, a significant number of firms (22%, 11%, and 15% under rules 1, 2, and 3 respectively) are capped in at least 1 year and not capped in at least 1 year.

15. The variation in the identities of the capped firms introduces a substantial amount of regulatory and financial uncertainty into firms' long-term investment decisions. Consider a firm undertaking a cost-benefit analysis of investing in a network upgrade that could enhance its provision of broadband. To assess the prudence of the investment, the firm would compare the cost with the expected discounted sum of future revenues, including any HCLS. Now it faces an additional revenue uncertainty as it does not know if it will have its HCLS revenues capped and

cut in the future by the regression benchmarks. At a minimum, the firm should use a higher cost of capital to discount its future revenues due to the increase in risk., However, it should also attach probability and potential cost to being capped during various portions of the lifetime of the investment. This may tip the cost-benefit ratio against the new investment. Thus, at the margin, any profit-maximizing firm would invest *less* in broadband deployment.

TABLE 5
NUMBER OF CAPPED STUDY AREAS UNDER AGGREGATION RULES 1, 2, AND 3
BALANCED PANEL OF 656 STUDY AREAS

Number of Study Areas	Sum of the Minimums	Minimum of the Sums	Total Cost Regression
Capped in every year	34	18	20
Capped in at least 1 year	179	88	118
Capped in at least 1 year and not capped in at least 1 year	145	70	98

16. Another measure of the regulatory uncertainty implied by the quantile regression methodology is the number of firms that avoid being capped by a negligible amount. These are firms that are "at risk" of being capped in the near future. The aggregation rules used to establish the cost per loop that determines HCLS support all take the form $c_i > \overline{c_i}$, where c_i is firm i's actual cost per loop and $\bar{c}_i$ is firm i's threshold cost per loop. Let firm i be an "at-risk firm" if it is not capped (i.e., $c_i \leq \bar{c}_i$) but has an actual cost per loop greater than or equal to 90% of the threshold, i.e., firm i is an "at-risk firm" if $\bar{c}_i \geq c_i \geq 0.9\bar{c}_i$. In plain English, a firm is considered to be "at-risk" if its costs are within 10% below its benchmark.

17. The number of "at-risk" firms is a salient factor. If a firm is close to the cap, it may have an incentive to cut investments because of a concern that, without these cuts, it will be capped in the next period. Indeed, the results above show that this is a real concern. Table 6

shows the number of "at-risk" firms under each of the aggregation rules. The percentage of additional "at-risk" firms varies from 7% to 22% across the three aggregation rules. The Bureau's proposed cost benchmark methodology likely will reduce the incentives of these firms to make network investments. As we explain below, this "at risk" number is significant because the proposed HCLS revision introduces strategic issues regarding how one firm's actions affect other firms' payoffs. Thus, we need to use game theory to analyze the equilibrium outcome.

18. Consider the following hypothetical case. Suppose that a firm is currently at the level of 75% HCLS support for incremental costs, and that as is currently the rule, the redistributed broadband funds are distributed only to uncapped firms. Consider a firm that faces the decision to invest an extra $10K (annualized) in its network. Absent this extra investment, suppose that incremental costs above the national average are $80K, so the HCLS will pay $60K leaving $20K to be recovered from its rate base. Suppose that the 90th quantile cost estimate from the prior year's regression model sets the cost cap at $90K. Now the firm is considering increasing network investment, thus facilitating broadband deployment, but that will raise its costs to $90K. Assuming the cap remains the same, the firm would recover $67.5K from the HCLS fund and need to recover $22.5K from it end users. Suppose that the firm can recover up to an incremental $25.0K from end users. In this case, the firm would undertake the incremental investment.

19. Now, however, suppose that the firm faces a 50% chance that, due to cost reductions by other firms, the estimated 90th quantile cost estimate will fall to $80K. In this case, the firm's HCLS support will be limited to $60K. The firm's costs are $90K and it can only recover an extra $25K from end users, hence the firm faces a 50% chance of losing $5K on the incremental $10K investment. Thus, the firm will not undertake the incremental investment.

Hence, *because the benchmark against which providers are measuring their costs is a moving target beyond the control of any one firm*, the threat of being capped in the future can reduce incentives to invest even for firms not currently capped in this period.

TABLE 6
NUMBER OF AT-RISK FIRMS

Year	Total Number of Firms	Sum of the Minimums	Minimum of the Sums	Total Cost Regression
2006	659	90	120	144
2007	678	88	104	123
2008	692	89	89	112
2009	707	94	68	91
2010	721	98	56	72
2011	726	105	58	77
2012	724	101	52	87

20. The above analysis suggests that the investment decisions of many more firms than the 50 firms suggested by the FCC. In addition, historical data show that the monetary size of the impact to the affected firms is significantly higher than stated by the FCC. The amounts for the various cap methodologies are presented below in Table 7.

TABLE 7
FUNDS (US DOLLARS) REALLOCATED FROM CAPPED FIRMS

Year	Total Number of Firms	Sum of the Minimums	Minimum of the Sums	Total Cost Regression
2007	659	44,807,947	31,491,362	46,346,935
2008	678	52,275,790	37,007,300	51,482,233
2009	692	52,077,664	36,210,966	40,005,754
2010	707	61,870,219	46,168,501	47,751,756
2011	721	60,236,159	40,431,506	45,794,072
2012	726	61,781,745	42,881,267	53,063,792
2013	724	58,854,021	43,903,880	56,586,014

21. The FCC has specified an approach for redistributing to rate-of-return carriers sums realized from application of the new HCLS caps. Unfortunately, with the induced uncertainty, any redistributed sums—no matter how large or small—may still make it difficult to justify additional new investment in the absence of knowing whether doing so might result in exceeding the cap and suffering a subsequent loss of USF support in later years.

22. Given the uncertainty induced by the mechanism for rate-of-return carriers, there is unlikely to be any significant increase in broadband investments by the group overall. The FCC estimates that its proposed cost benchmark methodology would cause approximately $55 million annually to be redistributed to uncapped carriers.[8] Uncapped carriers currently have approximately 2.7 million loops. Thus, on a per loop basis, the redistributed funds amount to approximately $20.37 annually, an amount too small (and too tenuous over the long-term life of

[8] FCC, In the Matter of Connect America Fund, High-Cost Universal Service Support, WC Docket No. 10-90 and 05-337 (April 25, 2012), ¶ 5.

a network to be built) for any single carrier to increase the quality or reach of broadband services significantly.

23. The FCC has argued that the prior regime was highly uncertain as well, with the national average cost per loop ("NACPL") increasing each year. While there is some uncertainty about the baseline level on which funding was calculated, there are important differences. First, it was not unpredictable—rather, it was a glide-path where firms knew over time their support would go away as the NACPL trended upward and could even predict to some degree the pace of decline over time. Second, and more importantly, this uncertainty did not affect marginal payments, but rather only the infra-marginal level of payments. Thus, as a matter of economics, it did not have the same impact on the incentives to invest as under the new regime which explicitly introduces uncertainty at the margin.

24. These findings are consistent with NTCA survey data, which shows that firms have reduced their planned broadband investment. In January 2013, NCTA surveyed its members to assess the impact of the proposed USF/ICC reforms.[9] The results of the survey are as follows:

> Question 1. "Has your company postponed or cancelled any fixed network upgrades as a result of the uncertainty surrounding the Bureau's ongoing universal service fund (USF)/intercarrier compensation (ICC) reform efforts?"
>
> - Postponed or cancelled projects: 69%
> - Neither postponed nor cancelled projects: 31%
>
> Breaking down the responses of impacted companies further:

[9] A total of 185 NTCA member companies responded to the survey, representing 34% of the 538 unique email addresses in NTCA's membership email database. Based on this sample size, results of this survey can be estimated to be accurate to within +/- 6% at the 95% confidence level.

- Postponed projects: 62%
- Cancelled projects: 18%
- Both postponed and cancelled projects: 11%

25. When asked the approximate total dollar amount of investment that has been subject to postponement or cancellation the responses were:[10]

- Total dollar value of postponed or cancelled projects: $492.7 million
- Average: $4.9 million
- Median: $2.0 million
- High: $145 million
- Low: $80,000

26. The survey data are consistent with the findings in Tables 5 and 6. The HCLS revisions inject such significant revenue risk for small rate-of-return firms that the cost benchmark methodology significantly reduces network investment that may facilitate broadband deployment in the highest high-cost areas, thus working against the putative benefits of reform.

27. The analysis so far considers the impact at the individual firm level. However, the situation becomes more worrisome once we undertake a full Game-Theoretic equilibrium analysis, including the feedback effect of changes in behavior across time. In particular, the reforms to the HCLS mechanism do not reduce the cost of the various funds overall, but they do induce a reallocation between the various rate of return carriers. In this regard, two considerations must be appreciated. First, computation of the study-area specific 90th percentile cap for each firm depends on the costs reported by *all of the 726 study area firms.* Thus, each

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[10] 101 respondents (78% of those who indicated that they had postponed or canceled projects) responded to this question.

individual firm has very little impact on the calculation of its own cap. Second, calculation of the NACPL is done in a tautological fashion to exhaust the target expenditures.

28. The interaction of these two features with the analysis of capped and at-risk firms can be explained as follows. In the first period, at-risk firms reduce their Capex investments at the margin. This lowers the 90th quantile estimate for all firms in the next period. This reduction, in turn, places more firms "at risk" and induces them to cut investment even if they might be an "efficient" firm under the model's ideal construct. This would incent a long-term investment-cutting spiral—a "race to the bottom." However, calculation of the NACPL is performed in such a manner that the funds available to be distributed are always spent, so there is no saving overall to consumers paying into the fund. Thus, in equilibrium, consumers will support the same amount of HCLS funding, but carriers will be encouraged to reduce their investments. Much of the capital investment in the legacy network would facilitate greater deployment of broadband, but the revisions to the HCLS mechanism may undercut the very goals of increasing broadband deployment.

C. *Alternative Means of Reviewing Costs and Low-Density Area Selection Bias*

29. As an alternative economic framework to the hypothesis that the interaction of rate-of-return regulation and the HCLS mechanism causes an Averch-Johnson effect, I consider an alternative perspective for review of the causal factors that explain differences in firms' costs. In particular, I do not assume that each study area represents a draw from the same cost generating statistical model. Instead, I assume that each rural, rate-of-return carrier has idiosyncratic cost characteristics given the geographic features of its specific region.[11] Because I

[11] It is worth mentioning here that this same conclusion was reached in research sponsored by the Federal-State Joint Board on Universal Service in 2001. The Rural Task Force found significant differences in costs not only between

(and the FCC) have several years of data, these idiosyncratic characteristics can be estimated using a fixed-effects panel regression. I estimate the following econometric models:

$$\mathrm{Ln}(\mathrm{Capex}_{it}) = \alpha_1 \mathrm{Ln}(\mathrm{Loops}_{it}) + \alpha_2 PUP_{it} + \alpha_3 T_t + C_i + \varepsilon_{it}$$

$$\mathrm{Ln}(\mathrm{Opex}_{it}) = \beta_1 \mathrm{Ln}(\mathrm{Loops}_{it}) + \beta_2 PUP_{it} + \beta_3 T_t + O_i + \varepsilon_{it}$$

30. where T_t denotes time fixed effects and C_i and O_i denote firm fixed effects in the Capex and Opex regressions respectively. The interpretation of the firm fixed effects is that they represent time-invariant cost shifters for each study area. By construction, the average Capex fixed effect will be zero, so a positive number means that a given study are has higher than average capital costs. Similarly, a negative fixed effect means that a study area has lower than average capital expenditures across the time period. Thus, we can rank firms based on these fixed effects using seven years of data as an alternative to the FCC's single-year quantile regression approach. The fixed-effects analysis is carried using the balanced panel of 656 study areas. The regression coefficients are shown in Table 8.

31. Using the Capex and Opex fixed-effects models, I find that the correlation between Capex fixed effects and Opex fixed effects equals 0.75. Under the Averch-Johnson hypothesis that some rate-of-return firms increase their capital costs and are inefficient due to excessive capital deployment, the expected correlation between Capex fixed effects and Opex fixed effects would equal zero. In particular because the theoretical excess returns over time to excess capital base compared with just recovering op-ex expenditures, the Averch-Johnson model would suggest that an inefficient firm would rather ineffectively inflate its Capex expenditures than its Opex expenditures. Furthermore, if high-cost firms faced the same technology and regional effects, but optimally substituted between Capex and Opex based on

rural and non-rural companies, but also among rural companies. *See* Rural Task Force, The Rural Difference, White Paper #2.

size, then the expected correlation between the Capex fixed effects and Opex fixed effects would be negative. Thus, a positive correlation of 0.75 indicates that a firm's costs may simply be a consequence of the area in which it operates, i.e., even among the firms in the HCLS there exist "higher high-cost" and "lower high-cost" areas. In other words, companies with higher Capex costs historically tend to also have higher Opex costs.

TABLE 8
ALTERNATIVE ECONOMIC HYPOTHESIS

Variable	Dependent Variable: Ln(Capex)	Dependent Variable: Ln(Opex)
Constant	0.613***	0.565***
	(0.086)	(0.078)
Ln(Loops)	0.029***	0.008***
	(0.001)	(0.001)
PUP	0.085***	0.052***
	(0.006)	(0.005)
Year 2007	0.168***	0.106***
	(0.010)	(0.008)
Year 2008	0.247***	0.154***
	(0.015)	(0.012)
Year 2009	0.327***	0.200***
	(0.020)	(0.015)
Year 2010	0.399***	0.241***
	(0.024)	(0.019)
Year 2011	0.458***	0.273***
	(0.028)	(0.022)
Year 2012	7.633***	9.238***
	(0.696)	(0.623)
Number of Observations	4,592	4,592
R-squared (Within)	0.508	0.215
Number of Study Areas	656	656

Notes:
Robust standard errors are enclosed in parentheses.
Symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels respectively.
Both Capex and Opex regressions include firm and year fixed effects.

32. Under this alternative hypothesis, firms' "fixed effects" are cost shifters determined by intrinsic market characteristics. In this case, if randomly drawn, the fixed effects should exhibit a symmetric, normal or "bell curve" shape. Under the hypothesis that there is a group of firms allegedly manipulating costs to game the HCLS mechanism, then the distribution

of fixed effects should be asymmetric and fat-tailed with an extra mass of highest cost firms. That is, the Capex fixed effects distribution should have a "fat right tail."

33. Figures 1 and 2 show histograms and fitted normal empirical distribution functions ("EDF") of the Capex and Opex fixed effects. The parameters of the EDFs are estimated using maximum likelihood.[12] Using the Kolmogorov-Smirnov test, the null hypothesis for normality is not rejected for both Capex and Opex fixed effects. For both Capex and Opex EDFs, the maximum likelihood estimates of the mean are zero. The maximum likelihood estimates of standard deviation is approximately 0.6 for Capex fixed effects and approximately 0.5 for Opex fixed effects. Capex fixed effects are symmetric and, therefore, highly consistent with the argument that firms are allocating fixed capital costs across the normally distributed number of loops. In other words, Capex fixed effects are inconsistent with the Averch-Johnson effect. Opex fixed effects are also symmetrically distributed and, thus, consistent with market fixed effects rather than cost padding. Indeed the skewness of both distributions is negative, -0.4, contradicting the hypothesis of an extra mass of firms in the high cost tail.

[12] See Delignette-Muller, M., Pouillot, R., Denis, J.-B., and Dutang, C. (2013), "Fitdistrplus: Help to Fit of a Parametric Distribution to Non-censored or Censored data," available at http://cran.r-project.org/web/packages/fitdistrplus/index.html.

FIGURE 1
HISTOGRAM AND EMPIRICAL DISTRIBUTION FUNCTION OF CAPEX FIXED EFFECTS

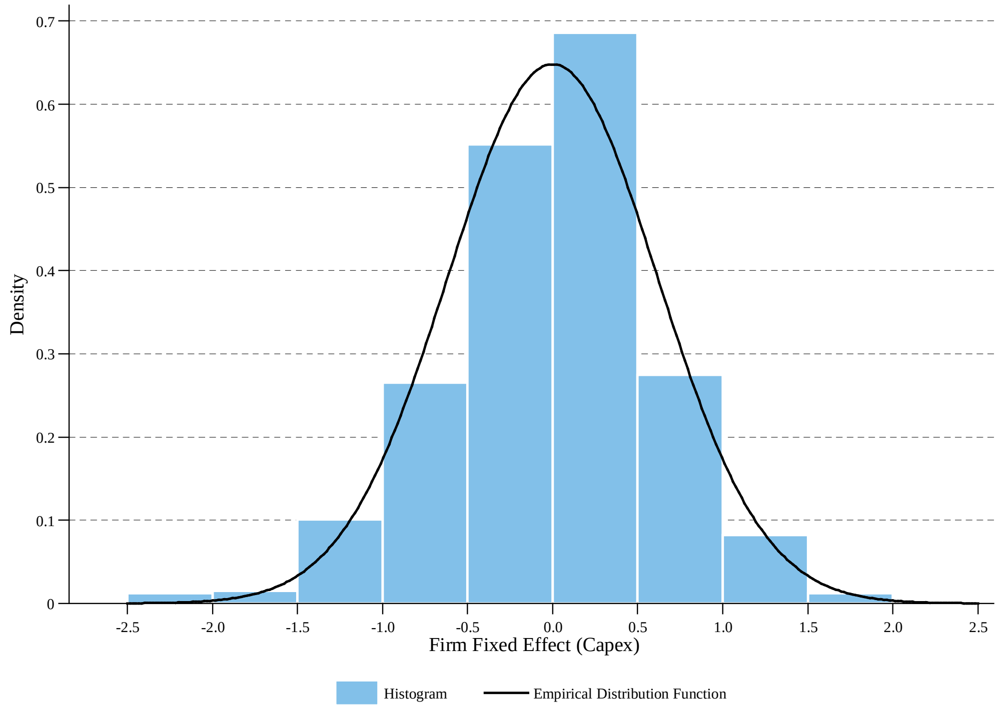
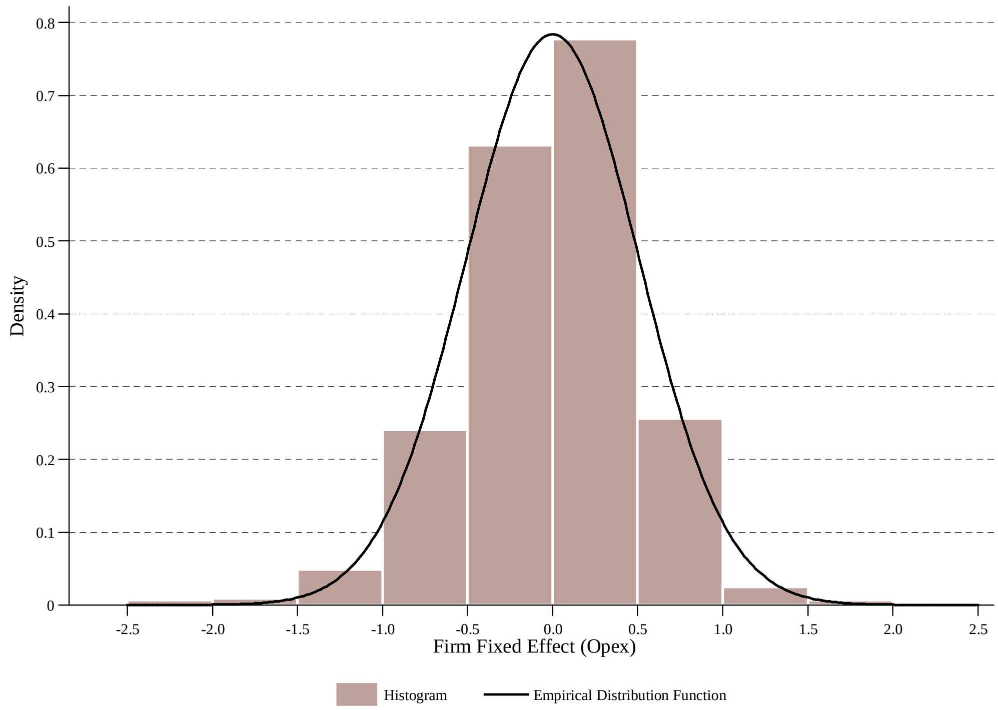


FIGURE 2
HISTOGRAM AND EMPIRICAL DISTRIBUTION FUNCTION OF OPEX FIXED EFFECTS



34. Table 9 shows the percentage of variation in firms' costs attributable to permanent versus random effects in the Capex and Opex regressions, i.e., the fraction explained by firms' fixed effects.

TABLE 9
PERMANENT FRACTION OF VARIATION

Variable	Sample Variance	Percentage of Total
Capex Regression		
Firm Fixed Effect	0.38	90.29%
Residual	0.04	9.71%
Opex Regression		
Firm Fixed Effect	0.26	91.75%
Residual	0.02	8.25%

35. To decompose firm fixed effects into explained and unexplained components, we regress the effects on the time-averaged PUP and the natural log of time-averaged LOOPS as shown in Table 10.

TABLE 10

FIXED EFFECTS DECOMPOSITION INTO EXPLAINED AND UNEXPLAINED COMPONENTS

Variable	Dependent Variable: Firm Fixed Effect from Capex Regression	Dependent Variable: Firm Fixed Effect from Opex Regression
Constant	-2.664***	-1.829***
	(0.149)	(0.133)
Ln(Time-Averaged Loops)	0.301***	0.205***
	(0.017)	(0.015)
Time-Averaged PUP	0.008***	0.006***
	(0.002)	(0.001)
Number of Observations	656	656
R-squared	0.342	0.234

Note:
Symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels respectively.

36. The number of loops in a study area is a significant variable in explaining the level of fixed effects—that variable alone explains approximately 30% of the variance in Capex fixed effects. This is consistent with the hypothesis that there are economies of scale missed by the Bureau's model.[13] Thus, the Bureau's approach likely introduces a selection bias. In particular, suppose that a new technology is developed, then there will typically be a declining cost of deployment over time. Such new technology generally is first adopted in high-density areas and later deployed in lower-density areas. Often adoption of new technology involves making new fixed or sunk cost investments that lower marginal or incremental costs. Because of Moore's Law, these fixed capital costs tend to fall over time. For example, the cost of DSLAMs fell by a factor of ten over the last decade, and deployment moved from population dense wire centers to less dense areas as costs fell. However, in contrast, it is unlikely that the cost of deploying a new loop in a remote area fell over the last decade. This means in the interim until

[13] See, e.g., slide #18 of the Rural ex parte for a finding that nonlinearities in loop densities affect costs.

the price of the capital good has fallen such that the new technology is fully deployed in low-density study areas, the marginal cost of firms operating in high-density study areas will be falling over a period of time, whereas the marginal costs of firms operating in low-density areas will not be falling over that same time period. Since the FCC's quantile methodology applies to all firms, this change in the panel of firms' costs will affect the calculated cost threshold for each firm and end up punishing firms operating in low-density areas even if they are efficient.

37. Because the HCLS fund covers a large fraction of costs at the margin, this effect will bias the optimal technology adoption decisions of firms operating in low-density study areas. Such firms would choose a technology mix not based on their own cost data and the challenges faced by their own consumers in a unique high-cost area, but rather a technology mix based on an artificially constructed firm serving some approximation of a high-cost area that does not take fully into account unique characteristics of the actual area served.

D. *Relevant Time Frame*

38. Finally, even accepting the regression-based cap approach, there is the question of whether there is a means to apply the computed caps over a period of time to provide greater predictability without creating other adverse consequences. Telecommunications firms often make very long-term sunk cost investments, e.g., the life of optical fiber may be thirty years. To finance these investments, firms need to be able to make reliable discounted cash flow projections over several years. Yet recalculating the current unstable model year-over-year introduces a new degree of randomness that could have significant effects on a firm's projected revenue streams, which likely will deter investment.

39. Consider a firm with a cost level above the 150% NACPL threshold undertaking a $100K investment today with a life span of ten years. With linear depreciation this would add

$10K to its Capex costs for the next ten years. Absent the cap, the firm could count on recovering $7.5K from the HCLS fund (or at least estimate what its HCLS receipts would be based upon the historical operation of the program), and so would undertake the investment if it could raise new revenue streams of $2.5K per year (and perhaps some additional incremental amount in later years) from its end users and other sources. Under the proposed revisions, however, the firm may be capped in future years even if this is an efficient investment today. Indeed, as indicated above, the risk that a firm will be capped in at least one out of seven years may be as high as 24%. Moreover, capped firms are not eligible for redistributed HCLS support. The simulation results reported above using the past seven years of data imply that the caps introduce new significant revenue risks for a significant fraction of the firms receiving HCLS funds.

40. The new revenue risk implies that a prudent firm should use a higher cost of capital to discount expected revenue streams when undertaking a cost-benefit analysis of any new long-lived network investment. However, the use of a higher cost of capital means that more projects will fail to have a positive Net Present Value and so will not be undertaken. Thus, given that much network investment at this point in time also facilitates broadband deployment, this year-by-year recalculation of the caps, combined with the significant variance of the identity of the capped firms over time, works against the Commission's goals in seeking to reorient universal service to stimulate sustainable broadband investments.

41. If a firm is in a study area with a declining population, then its costs per loop will tend to increase over time because any fixed Opex costs and the sunk capital costs being depreciated or amortized must be divided by a smaller number, Thus, cost per loop will increase. A firm in this situation that is not capped today will realize that it may be capped in the future.

This will induce the firm to reduce its future investments, but it also may lead the firm to accelerate deployment inefficiently if it can invest today while it is not capped and lower future Opex expenses, i.e., through capital/labor substitution. On the other hand, if there are not sufficient Opex savings, then the threat of the future caps will deter investment and the firm will opt to shut down once the number of lines falls below the threshold where marginal costs are not covered.

42. A firm serving a growing population faces the opposite distortion—efficient investment will be delayed. Consider a firm that, if uncapped, would invest in a network upgrade today. However, suppose the number of lines is such that the firm is capped today. By delaying its investments, the number of lines will rise and costs per loop will fall, so the firm may reach a point where in future years it will not be capped. In this case, the firm's optimal strategy is to delay the investment until the cap is relaxed.

43. A further dynamic distortion is introduced by the annual setting of caps pursuant to the current version of the model. The FCC's approach does not distinguish between firms in growing markets versus those in shrinking markets. In the data we find many study areas that have a declining loop count. This is not surprising given the trend of declining rural populations. However, some markets show a dramatic increase in the number of lines. A declining number of lines could be caused by a declining population, a factor outside the firm's control, or greater migration to a competitive service provider in a portion of its service area. In a market with a rate of decline in the number of loops greater than that of the 90% quantile, an efficient firm today may artificially appear to be inefficient in the future.

44. Key questions then are: (1) would holding the caps constant for a period of time increase predictability? and (2) can this be done without creating consequences that increase the

number of firms affected by them and thus make the capping mechanism only more of a deterrent to rural broadband investment over time? Given the distribution of costs over the last seven years, an annual cap induces too much risk and volatility. However, given the decline in rural populations, if the caps are held constant for a period of years, with the dynamics of line loss and lumpy investment, we run the risk of companies floating upwards and hitting the caps over time, as recognized previously by the Commission.

45. Recalculating the firm's specific cost characteristics every a certain period of years after a major investment combined with an annual true-up for systemic loop loss should perhaps be evaluated, although substantial testing and analysis would need to be done to ensure it does not have the effect of penalizing carriers for line loss or create other unintended consequences that harm rural consumers or undermine efficient rural broadband investment. Another modification that could improve the mechanism would be to ensure those firms that were not capped at the time of significant new investment should not be precluded from access to high cost support funds in future years (even if they are subsequently capped at some point over the life of that investment) as long as that investment also facilitates broadband deployment.

IV. CONCLUSIONS AND POLICY RECOMMENDATIONS

46. The FCC has undertaken an ambitious and important task—how to reformulate its regulatory framework given the complex interaction between inter-carrier compensation, universal service, competition, and the increasing importance of broadband. The goals of the Bureau's reform are laudatory. However, some of the proposed reforms create high degrees of revenue risk and regulatory uncertainty for the rate-of-return carriers.

47. I have undertaken an analysis of the likely impact of the reforms by simulating the effects using the past seven years of cost data in HCLS study areas. I find that the risk that a firm

is capped is higher than the FCC analysis suggests, and that the adverse financial effects are significantly higher than the FCC suggests. This degree of uncertainty undercuts the incentives of even "efficient" rate of return carriers (as defined by the model) to invest in network infrastructure, which undercuts the goals of both universal service and increased broadband deployment. Moreover, I find that the dynamic equilibrium effects may be even worse than the historical data suggest. When firms at the margin have an incentive to cut capital costs, this drives down the quantile estimates of efficient costs for all firms and, thus, induces a "race to the bottom" as carriers' fear being capped in the future. This effect is exacerbated by the proposal that capped firms be excluded from the redistributed HCLS funds. The amount of redistributed funds to be allocated is too small to stimulate sufficient new investment so as to overcome the adverse incentive effects identified here.

48. Finally, the calculation of firm-specific caps via the annual quantile regression introduces two dynamic distortions. First, the calculation fails to allow for the fact that new technology will be efficiently deployed at different points in time given the differences in population density across study areas. Second, the "one size fits all approach" fails to distinguish between firms operating in growing markets versus firms operating in declining markets, which will introduce dynamic distortions in the timing of network investments.