July 19, 2013

***Ex Parte* Notice**

Ms. Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: *Connect America Fund*, WC Docket No. 10-90; *High-Cost Universal Service Support*, WC Docket No. 05-337

Dear Ms. Dortch:

On Wednesday, July 17, 2013, the undersigned on behalf of the NTCA–The Rural Broadband Association, together with Joshua Seidemann of NTCA, Derrick Owens on behalf of the Western Telecommunications Alliance, Douglas Meredith of John Staurulakis, Inc., and Jeff Dupree and Tatjana Curovic on behalf of the National Exchange Carrier Association (the "Rural Parties") met with Carol Mattey, Steve Rosenberg, Kim Scardino, Amy Bender, Travis Litman, Dania Ayoubi, James Eisner, Joe Sorresso, Craig Stroup, Rodger Woock, Suzanne Yelen, and Chin Yoo of the Wireline Competition Bureau to discuss a series of issues related to the use of quantile regression analysis ("QRA") to establish caps that limit high-cost support received by rate-of-return-regulated rural local exchange carriers ("RLECs"). A copy of materials shared with Federal Communications Commission (the "Commission") staff during the meeting is provided herewith.

Although the Rural Parties continue to object to the use of QRA-based caps to limit support as a mechanical matter in light of flaws in the underlying model, lingering inaccuracies in model data, and broader concerns with respect to the incentives the caps create, the Rural Parties sought this latest in a series of meetings to continue their discussion with the Commission's staff (subject to legal and appellate rights) regarding ways to examine, adjust, and refine the latest iteration of the model to improve its transparency, accuracy, predictability, and methodological integrity to the extent feasible. We noted that such an effort was contemplated by the *Sixth Reconsideration Order*, and we discussed why this work must be achieved in the very near future to develop a more robust and stable model based upon accurate data; we observed in particular that RLEC efforts at making reasonable network plans for 2014 (and beyond) will likely be frustrated and undermined by persistent regulatory uncertainty in the absence of such resolution. At the same time, the Rural Parties highlighted once again the substantial challenge of revisiting and refining or even potentially remaking such a complex mechanism "on the fly" as the model is already in effect and data updates and study area boundary corrections are still to come.

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Among the key substantive items noted in the attached presentation, we observed that initial review of the study area boundary maps recently filed indicate material differences between the areas captured in the current QRA model and most maps submitted more recently. While additional reconciliation, review, and testing remains to verify the filed maps and to understand the implication of these potential material differences on the caps, we observed that these changes are likely to have some effects on the development of variables and caps – making it difficult to test new regression formulas before such work is complete later this year. Moreover, we noted that if the substantial variations between the old and new maps in the model somehow *do not* turn out to affect the caps, this would appear to indicate that the model and its current array of variables are insensitive to many, if not all, geographic and topographic factors – which would then call into serious question whether the model in fact captures accurately the idiosyncrasies of different RLEC serving areas.

We also asserted that, consistent with sound statistical theory and in recognition of the many concerns regarding the caps and underlying data, application of confidence intervals would be appropriate if the QRA model continues to be used to establish such caps. In particular, we observed that if the model were indeed accurate, the application of the upper bound of the 95% confidence interval should have minimal or no effect on the caps – but if the model were imprecise, the confidence interval would help minimize the risk that carriers are inappropriately being captured by the model and resulting cost caps. We also continued to urge the Commission to consider other means of addressing uncertainty during the pendency of ongoing work on the QRA model and incorporated data, including using the thresholds the model generates only as a trigger for review of carrier operations and/or adopting an extended transition and "backstop" for the impact of the caps on support levels.

Pursuant to Section 1.1206 of the Commission's rules, a copy of this letter is being filed via ECFS. If you have any questions, please do not hesitate to contact the undersigned.

Sincerely,

/s/ *Michael R. Romano*
Michael R. Romano
Senior Vice President - Policy

Enclosures

cc: Carol Mattey
Steve Rosenberg
Kim Scardino
Amy Bender
Travis Litman
Dania Ayoubi
James Eisner
Joe Sorresso
Craig Stroup
Rodger Woock
Suzanne Yelen
Chin Yoo

Quantile Regression

Issues Meeting, July 17, 2013

Ex Parte

Appendix

Section 1 - Test of Synthetic Similar Situations

This section examines the performance of quantile regression when similarity of situations is induced in the data.

To illustrate, a new 90^{th} quantile model is developed using CAPEX as the dependent variable and only loops as the independent variable. "X" symbols in the first exhibit graph the actual CAPEX data against the loop count data. "+" symbols graph the model values. Comparable results are obtained by using total costs instead of CAPEX without loss of generality.

The first step in inducing similar situations is to create ten replicates of data of each study area, which by definition are absolutely similar. Next, to provide a basis of measuring the success of the quantile regression method in identifying the top ten per cent, variation is induced in each of the 726 situations. The first replicate keeps its value of CAPEX. The second replicate is given a 10% increase over the first. The third is given a 20% increase, and so forth, with the last given a 90% boost over the first. By this construction, each situation includes exactly ten data points, including 10^{th}, 20^{th}, 30^{th}, etc., percentile members. These replicates are evident as stacks of ten X's in the second exhibit, each stack corresponding to a similar situation.

To improve readability, the third exhibit displays a subset of the similar situations shown in the second exhibit.

The challenge for quantile regression is to find the 90^{th} percenter in each similar situation. This outcome is measured in the fourth exhibit, which summarizes results of eight different quantile models, each relating CAPEX to the sixteen independent variables. The shaded "Original Model" column shows the results of the model based on the actual CAPEX data, replicated as described above. For each of the ten replicate levels, the rows of this column show how many study areas were capped by this model. Among the 726 whose costs were marked up by 90%, 194 were capped. Across other replicate levels decreasing counts of study areas were capped, with six being capped even in the replicate level with no cost markup. Thus, the Bureau's quantile model succeeds in only 27% of cases in finding the 90^{th} percenters, even when built from data in real similar situations.

To further test the effectiveness of the method, datasets were created which more accurately correlated independent variables with the CAPEX variable. To do so, the residual of each study area's CAPEX cost from the OLS regression of the same structure as FCC's quantile model was first calculated. Then a new "Adjusted Actual CAPEX" value was calculated which equaled the model value plus the residual reduced by dividing by 1.2. I.e., this dataset is the same as the original data, but improves the correlation of the CAPEX with the independent variables by 20%.

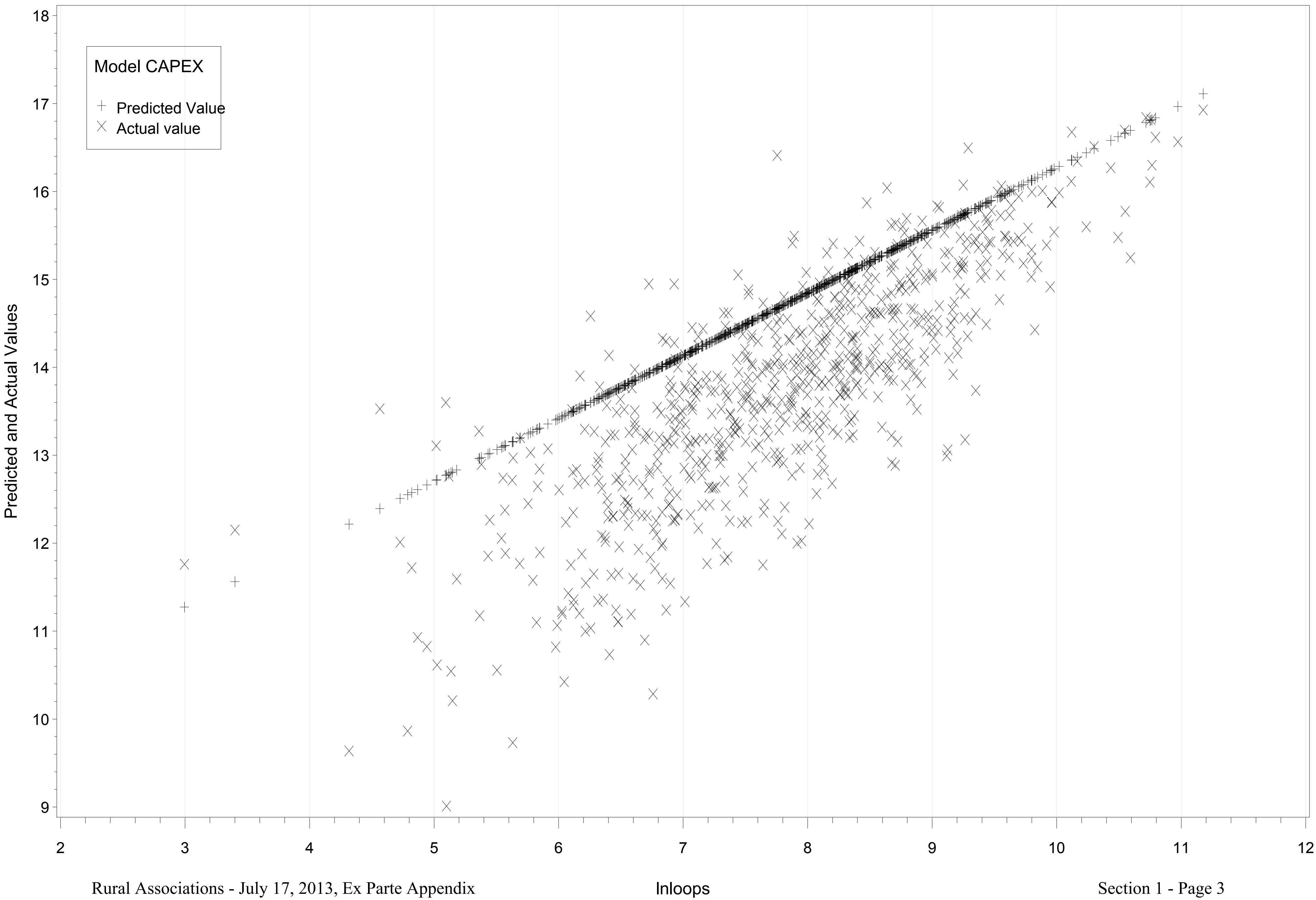
Using this Adjusted Actual CAPEX dataset, the exercise of replicating similar situations was repeated. Results are summarized in the second column of the exhibit. Subsequent columns show residual reductions between 1.5 (one-third reduction) to 50 (98% reduction). Not until the factor reached 5 (an 80% improvement in the fit of the data) did the model succeed in catching more than half of the 90th percenters. To catch all of the 90th percenters, it was necessary to reduce residuals by 98%, producing a near perfect R-squared statistic.

This exercise of evaluating models as described above was repeated for the total cost quantile regression with small modifications and results are shown in the last table. In this simulation, total costs were modeled instead of Capex using the same structure and form of the original FCC Capex model. The dataset was modified to include only study areas that were not impacted by the original FCC quantile model, i.e. 662 study areas below the 90th percentile in the quantile regression with logarithm of total costs as the dependent variable and all 16 independent variables as defined in the FCC model.

Data replications for these study areas were performed in the same way as above, and models with higher degree of goodness of fit were induced by reducing residuals from quantile regression instead of OLS. The results of this simulation are interpreted in the same way as described above. Thirty three percent of the highest cost companies would be clipped by the current model. Also shown for each model are measures of goodness of fit expressed by Pseudo R squared statistics from the logarithmic quantile regression models and recalculated statistics to show how the model outcomes explain variation in the cost per loop. It's worth noting that near perfect or perfect success rate at identifying high cost companies among their peers is not conditioned upon finding a model with perfect fit.

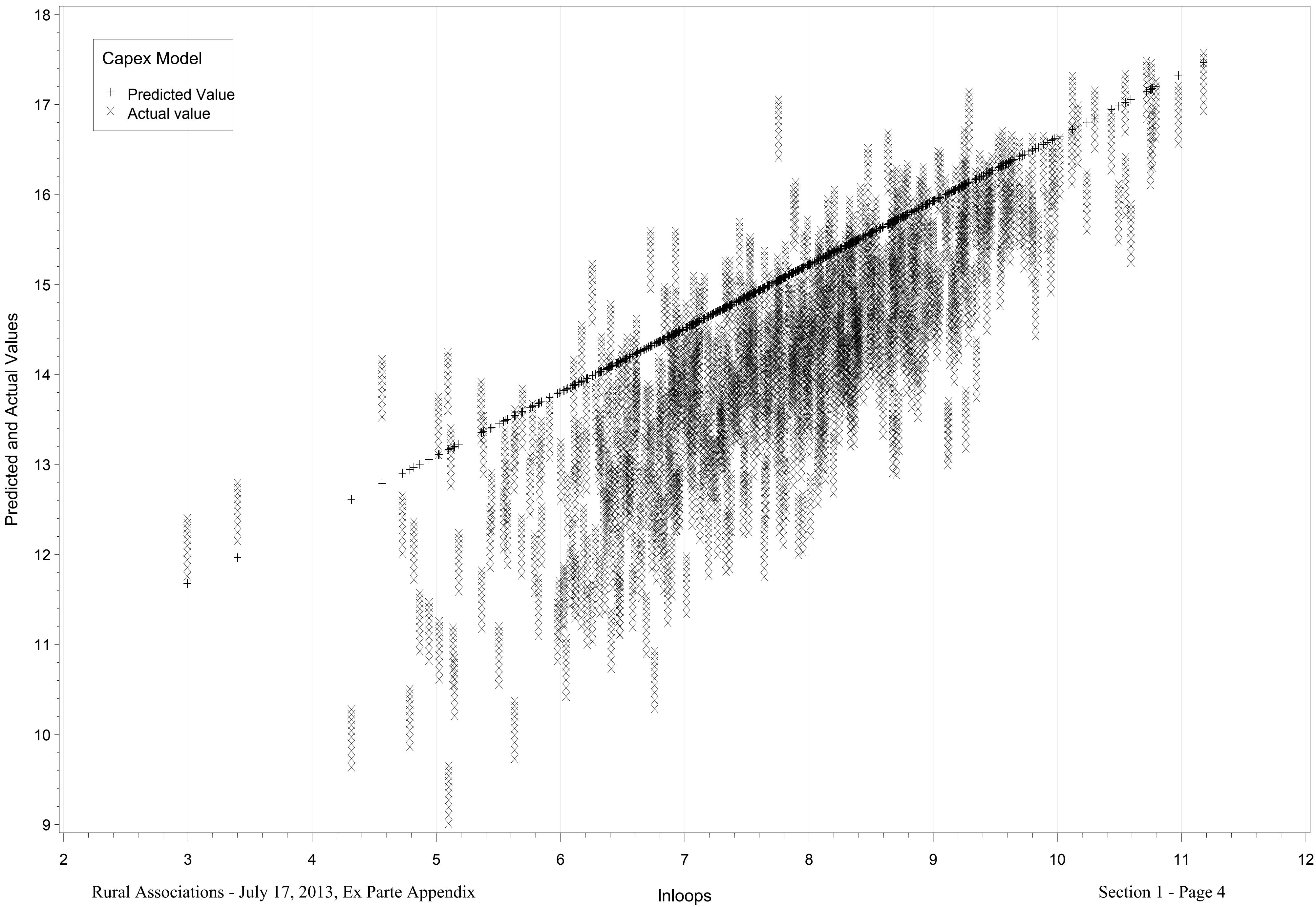
Plot of Actual and Model Values - Original Population of 726 Study Areas

LNCAPEX Versus LnLoops



Plot of Actual and Model Values For Pseudo Population of 7260 (726 groups of 10 similarly situated companies)

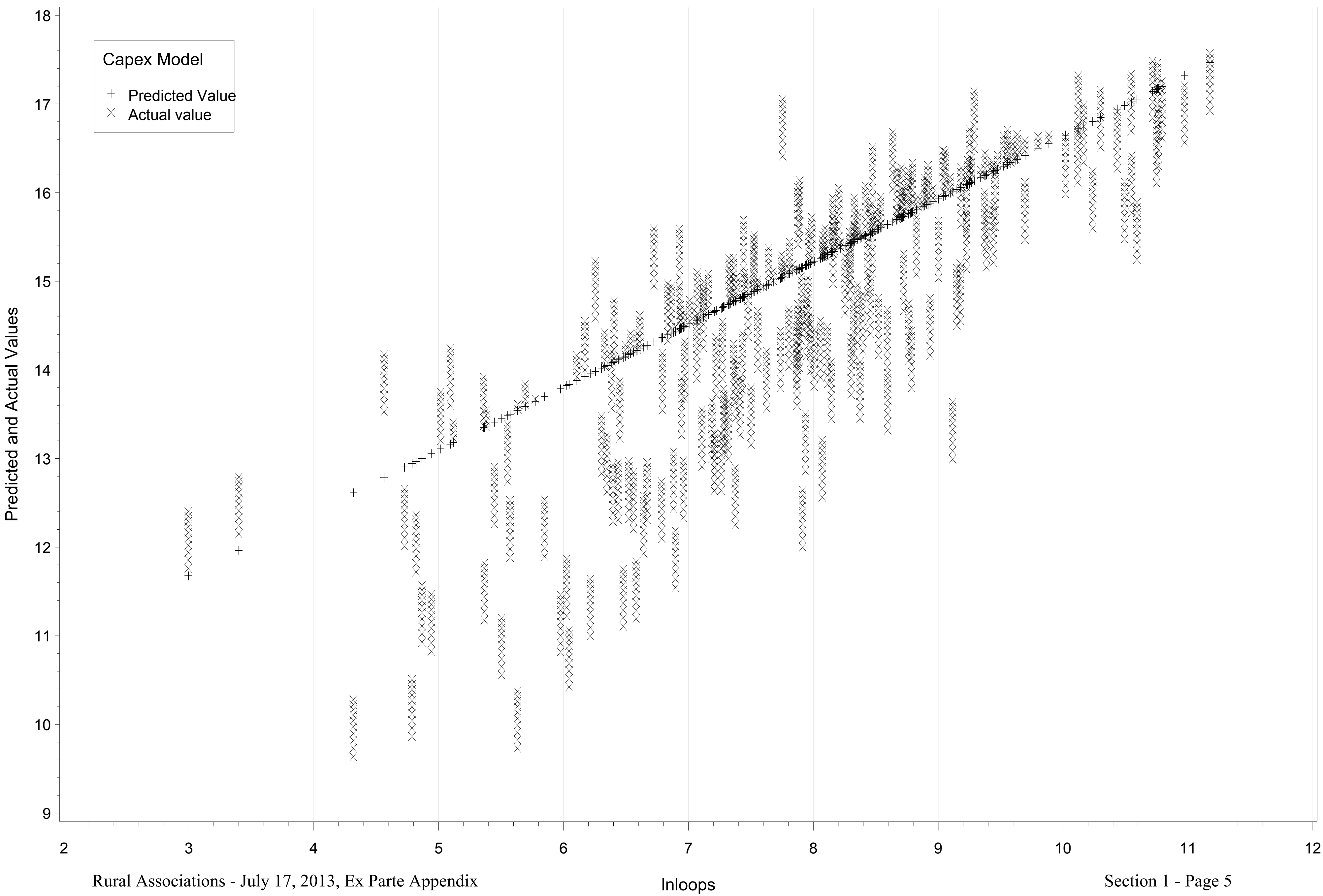
LnCapex Versus LnLoops



Plot of Actual and Model Values For Pseudo Population of 7260 (726 groups of 10 similarly situated companies)

Some Observations in Midrange and Below .9 Quantile Suppressed for Easier Reading

LnCapex Versus LnLoops



Success of FCC Capex Model in Identifying 90th Percenters from True Similar Situations
Similar Situations Formed by Replication

		Residual Adjustjment Divisor						
Factors by which variance around model was reduced	Original Model	1.2	1.5	2	5	10	20	50
R Squared (from OLS regression)	0.879	0.9127	0.9423	0.9667	0.9945	0.9986	0.9997	0.9999
Benchmarked from groups with:								
90% Cost Mark-up	194	205	231	271	414	527	651	725
80% Cost Mark-up	155	166	181	201	224	178	66	0
70% Cost Mark-up	116	121	123	119	62	11	0	0
60% Cost Mark-up	85	87	79	67	16	1	0	0
50% Cost Mark-up	61	56	46	33	3	0	0	0
40% Cost Mark-up	42	33	30	17	0	0	0	0
30% Cost Mark-up	29	25	17	8	0	0	0	0
20% Cost Mark-up	21	14	8	2	0	0	0	0
10% Cost Mark-up	11	8	3	1	0	0	0	0
NO Cost Mark-up (Original Costs)	6	3	2	0	0	0	0	0
90% Cost Mark-up Hits of Total Hits	26.72%	28.24%	31.82%	37.33%	57.02%	72.59%	89.67%	99.86%

Success of FCC QRA Model in Identifying 90th Percenters from True Similar Situations
Models Applied to Groups of 10 Formed from 662 Study Areas Originally Identified as Efficient
(Total Observations in Each Model: 6620)

		Residual Adjustjment Divisor						
Factors by which variance around model was reduced	FCC Model	1.2	1.5	2	5	10	20	50
Pseudo R Squared From Model	0.675	0.706	0.734	0.762	0.802	0.809	0.811	0.817
Pseudo R Squared Recalculated for Cost Per Loop	0.434	0.481	0.530	0.581	0.658	0.672	0.678	0.691
Benchmarked from groups with:								
90% Cost Mark-up	218	234	257	292	429	540	635	662
80% Cost Mark-up	172	183	194	203	198	113	18	0
70% Cost Mark-up	128	128	122	110	25	0	0	0
60% Cost Mark-up	78	68	62	38	0	0	0	0
50% Cost Mark-up	39	30	15	8	0	0	0	0
40% Cost Mark-up	14	9	4	1	0	0	0	0
30% Cost Mark-up	3	2	0	0	0	0	0	0
20% Cost Mark-up	1	0	0	0	0	0	0	0
10% Cost Mark-up	0	0	0	0	0	0	0	0
NO Cost Mark-up (Original Costs)	0	0	0	0	0	0	0	0
90% Cost Mark-up Hits of Total Hits	32.93%	35.35%	38.82%	44.11%	64.80%	81.57%	95.92%	100.00%

Quantile Regression Caps with TomTom and EC Maps For Study Area Shown on Slide 15

	CAPEX	CAPEX Per Loop	OPEX	OPEX Per Loop	Cost Per Loop
Actual Cost Data (2011 USF)	1,197,876	275.44	2,011,273	462.47	737.91
FCC Cap (April 25, 2012)	2,147,222	493.73	3,028,891	696.46	737.91
Calculation with EC Provided Boundary	1,790,646	411.74	2,672,339	614.47	737.91

Comparison of Serving Territory Between TomTom and EC Map

	Area in Square Miles	Area as % of EC Map Area
Tom Tom Map	11,522	633.08%
EC Map	1,820	
Overlap Area	1,522	83.63%
Erroneously Excluded	298	16.37%
Erroneously Included	10,000	549.45%

Quantile Regression Coefficients and Data For Study Area Shown on Slide 15

Models Coefficients

SEQ	PARAMETER	CAPEX Model	OPEX Model
1	lnloops	0.78783	0.59578
2	lnroadmiles	-0.20798	-0.24703
3	lnroadcrossing	0.24044	0.27234
4	lnstatesacs	-0.07015	-0.07775
5	pctundepplant	0.03069	0.00766
6	lndensity	-0.15783	-0.12757
7	lnexchanges	0.11775	0.12501
8	pctbedrock36	-0.07241	0.27888
9	diff	0.11838	0.11406
10	climate	0.08864	0.13512
11	pcttriballand	0.00048	0.00194
12	pctparkland	0.01759	0.00642
13	pcturban	0.00058	0.00248
14	alaska	-0.62233	0.29887
15	midwest	0.09175	0.1338
16	northeast	-0.30902	0.01494
17	Intercept	6.03898	8.19808

Notes:

The highlighted variables are dependent on study area boundaries

* Not directly used in the regression

Values of Independent Variables Associated With TomTom and EC Map
(Using FCC Methodology of Mapping Census Blocks to Study Area Boundaries)

SEQ	Variable	FCC Data (TomTom Map)	Data Based on Company's Map
1	lnloops	8.37770	8.37770
2	lnroadmiles	9.687286261	7.79009
3	lnroadcrossing	10.57387775	8.72762
4	lnstatesacs	0	0
5	pctundepplant	15.41839129	15.41839129
6	lndensity	-1.029160564	-0.20408
7	lnexchanges	2.397895273	2.397895273
8	pctbedrock36	0.003957918	0.00000
9	diff	1.07444688	1.00542
10	climate	4.089233303	4.09190
11	pcttriballand	11.53250506	23.29103263
12	pctparkland	0	0
13	pcturban	0	0
14	alaska	0	0
15	midwest	0	0
16	northeast	0	0
17	Intercept	1	1
	In level form if in logarithmic form above		
1	loops	4,349	4,349
2	roadmiles	16,111	2,417
3	roadcrossings	39,100	6,171
4	statesacs	1	1
6	density	0.36	0.82
7	exchanges	11	11
	census blocks*	4,927	997

Quantile Regression Caps with TomTom and EC Maps For Study Area Shown on Slide 16

	CAPEX	CAPEX Per Loop	OPEX	OPEX Per Loop	Cost Per Loop
Actual Cost Data (2011 USF)	348,598	2,087.41	672,825	4,028.89	6,116.31
FCC Cap (April 25, 2012)	199,956	1,197.34	360,682	2,159.77	3,357.11
Calculation with EC Provided Boundary	205,886	1,232.85	374,215	2,240.81	3,473.66

Comparison of Serving Territory Between TomTom and EC Map

	Area in Square Miles	Area as % of EC Map Area
Tom Tom Map	175.54	29.30%
EC Map	599.15	
Overlap Area	147.80	24.67%
Erroneously Excluded	451.35	75.33%
Erroneously Included	27.74	4.63%

Quantile Regression Coefficients and Data For Study Area Shown on Slide 16

Models Coefficients

SEQ	PARAMETER	CAPEX Model	OPEX Model
1	lnloops	0.78783	0.59578
2	lnroadmiles	-0.20798	-0.24703
3	lnroadcrossing	0.24044	0.27234
4	lnstatesacs	-0.07015	-0.07775
5	pctundepplant	0.03069	0.00766
6	lndensity	-0.15783	-0.12757
7	lnexchanges	0.11775	0.12501
8	pctbedrock36	-0.07241	0.27888
9	diff	0.11838	0.11406
10	climate	0.08864	0.13512
11	pcttriballand	0.00048	0.00194
12	pctparkland	0.01759	0.00642
13	pcturban	0.00058	0.00248
14	alaska	-0.62233	0.29887
15	midwest	0.09175	0.1338
16	northeast	-0.30902	0.01494
17	Intercept	6.03898	8.19808

Values of Independent Variables Associated With TomTom and EC Map
(Using FCC Methodology of Mapping Census Blocks to Study Area Boundaries)

SEQ	Variable	FCC Data (TomTom Map)	Data Based on Company's Map
1	lnloops	5.11799	5.11799
2	lnroadmiles	6.24636	7.17341
3	lnroadcrossing	7.91972	8.59526
4	lnstatesacs	0.69315	0.69315
5	pctundepplant	41.2273	41.2273
6	lndensity	0.82859	0.69872
7	lnexchanges	0	0
8	pctbedrock36	0.43266	0.47101
9	diff	1	1.13930
10	climate	4.02325	4.30977
11	pcttriballand	0	0
12	pctparkland	0	0
13	pcturban	0	0
14	alaska	0	0
15	midwest	0	0
16	northeast	0	0
17	Intercept	1	1
	In level form if in logarithmic form above		
1	loops	167	167
2	roadmiles	516.13	1304.29
3	roadcrossings	2751	5406
4	statesacs	2	2
6	density	2.29	2.01
7	exchanges	1	1
	census blocks*	376	723

Notes:

The highlighted variables are dependent on study area boundaries

* Not directly used in the regression

Comparison of Cost Impacts Between FCC Model Benchmarks With and Without Confidence Interval Alowance

	Count of Affected Study Areas	Costs Cut By The Caps: Total $ Amount	Per Loop	% Of Total Costs
FCC Model	64	$81,636,603	$246.71	19.01%
Plus 1.645 x STD	36	$45,061,216	$216.92	15.08%
Plus 1.96 x STD	31	$38,949,811	$196.91	13.71%

Top Four Hits In Terms of Relative Cut Costs

Clipped Costs Per Loop

FCC Model Id	FCC Model Amount	Plus 1.645 STD Id	Plus 1.645 STD Amount	Plus 1.96 STD Id	Plus 1.96 STD Amount
644	$2,750.83	531	$887.13	446	$809.43
582	$2,884.42	489	$1,137.06	489	$1,041.66
724	$3,303.65	582	$2,025.05	536	$1,753.25
536	$4,285.02	536	$2,194.63	582	$1,836.10

Clipped Costs as Percent of Total Costs

FCC Model Id	FCC Model Percent	Plus 1.645 STD Id	Plus 1.645 STD Percent	Plus 1.96 STD Id	Plus 1.96 STD Percent
601	38.36%	601	32.13%	601	30.87%
446	40.62%	582	33.11%	123	30.98%
143	45.18%	446	33.30%	446	31.80%
582	47.16%	143	37.95%	143	36.46%

Follow-up Items from May 29, 2013 Rural Associations QRA Issues Meeting

1. Cumulative predictability tests over multiple years
2. Model predictability tests based on separate CapEx and OpEx models
3. Corrected slide 10 in the Ex Parte presentation
    a. The 2012 column erroneously reported coefficients from the OpEx model instead of the Total Cost model. The error was only in the reported coefficients for this year and not in the analysis that followed.

Impact of Model Coefficients Updates on Study Areas' Benchmarks

Total Cost Model - FCC Variables and Structure

Actual Year to Year Impact for All Study Areas (shown in the 5/29 Ex Parte)

		% CHANGE IN BENCHMARKS EXPRESSED AS TOTAL COSTS			
Number of Study Areas	Years Compared	Average Impact	Minimum Impact	Maximum Impact	Standard Deviation
659	2006 - 2007	4.1%	-15.1%	112.4%	11.0%
678	2007 - 2008	3.6%	-20.7%	142.1%	13.0%
692	2008 - 2009	2.1%	-44.6%	69.1%	11.3%
707	2009 - 2010	4.0%	-28.7%	421.6%	24.3%
722	2010 - 2011	0.2%	-25.9%	57.8%	10.9%
724	2011 - 2012	0.4%	-29.1%	258.1%	14.6%

Actual Cumulative Multi-Year Impact for All Study Areas

		% CHANGE IN BENCHMARKS EXPRESSED AS TOTAL COSTS			
Number of Study Areas	Years Compared	Average Impact	Minimum Impact	Maximum Impact	Standard Deviation
657	2006 - 2012	13.7%	-41.9%	344.9%	38.2%
676	2007 - 2012	10.0%	-42.6%	379.0%	37.6%
690	2008 - 2012	6.9%	-50.2%	252.9%	33.8%
705	2009 - 2012	5.0%	-48.5%	536.7%	35.2%
720	2010 - 2012	0.6%	-37.2%	294.0%	20.1%
724	2011 - 2012	0.4%	-29.1%	258.1%	14.6%

		% CHANGE BENCHMARKS ON PER LOOP BASIS			
Number of Study Areas	Years Compared	Average Impact	Minimum Impact	Maximum Impact	Standard Deviation
657	2006 - 2012	43.8%	-25.7%	412.7%	42.0%
676	2007 - 2012	34.8%	-64.6%	311.7%	37.8%
690	2008 - 2012	26.9%	-63.0%	317.3%	35.0%
705	2009 - 2012	19.1%	-59.9%	573.1%	35.6%
720	2010 - 2012	9.3%	-59.3%	367.9%	21.2%
724	2011 - 2012	4.5%	-63.9%	290.3%	15.4%

Year to Year Impact of Model Coefficients Updates on Study Areas' Benchmarks

For CapEx, OpEx, and Total Cost Models - Same variables and structure as current FCC models used for CapEx and OpEx

Holding Loops and % Undepreciated Plant Constant at Prior Year Levels

		Total Cost Model % CHANGE IN TOTCOST BENCHMARKS				CapEx Model % CHANGE IN CAPEX BENCHMARKS				OpEx Model % CHANGE IN OPEX BENCHMARKS			
Number of Study Areas	Years Compared	Average Impact	Minimum Impact	Maximum Impact	Standard Deviation	Average Impact	Minimum Impact	Maximum Impact	Standard Deviation	Average Impact	Minimum Impact	Maximum Impact	Standard Deviation
659	2006 - 2007	7.6%	-8.4%	37.8%	4.4%	7.8%	-15.6%	56.0%	6.6%	6.7%	-13.0%	22.3%	5.5%
678	2007 - 2008	7.9%	-12.4%	50.4%	7.2%	9.1%	-0.8%	21.9%	3.6%	5.0%	-18.1%	29.3%	5.0%
692	2008 - 2009	7.2%	-21.3%	25.1%	5.1%	7.0%	-11.7%	39.8%	7.2%	5.2%	-28.2%	35.3%	7.7%
707	2009 - 2010	7.8%	-20.9%	56.5%	5.8%	10.5%	-17.0%	34.9%	7.2%	7.0%	-23.4%	56.4%	9.4%
722	2010 - 2011	4.7%	-18.1%	41.7%	7.0%	6.8%	-7.7%	32.5%	5.6%	5.2%	-20.2%	53.1%	7.6%
724	2011 - 2012	3.3%	-31.2%	134.5%	9.2%	6.1%	-26.7%	41.3%	7.0%	5.1%	-18.5%	21.2%	5.0%

Actual Year to Year Impact for All Study Areas

		Total Cost Model % CHANGE IN TOTCOST BENCHMARKS				CapEx Model % CHANGE IN CAPEX BENCHMARKS				OpEx Model % CHANGE IN OPEX BENCHMARKS			
Number of Study Areas	Years Compared	Average Impact	Minimum Impact	Maximum Impact	Standard Deviation	Average Impact	Minimum Impact	Maximum Impact	Standard Deviation	Average Impact	Minimum Impact	Maximum Impact	Standard Deviation
659	2006 - 2007	4.1%	-15.1%	112.4%	11.0%	3.7%	-30.9%	227.5%	19.7%	3.9%	-18.9%	78.5%	8.6%
678	2007 - 2008	3.6%	-20.7%	142.1%	13.0%	3.8%	-27.2%	361.5%	22.1%	1.4%	-19.1%	112.1%	8.8%
692	2008 - 2009	2.1%	-44.6%	69.1%	11.3%	2.1%	-53.1%	150.2%	20.7%	1.1%	-37.2%	38.4%	9.3%
707	2009 - 2010	4.0%	-28.7%	421.6%	24.3%	7.7%	-37.7%	1064.0%	52.1%	3.3%	-27.6%	175.4%	12.6%
722	2010 - 2011	0.2%	-25.9%	57.8%	10.9%	1.0%	-32.7%	110.1%	16.5%	1.8%	-22.1%	47.3%	8.8%
724	2011 - 2012	0.4%	-29.1%	258.1%	14.6%	1.6%	-29.8%	745.2%	32.9%	1.9%	-17.0%	134.8%	7.9%

Actual Year to Year Impact for Study Areas Experiencing Change in Loops and Undepreciated Plant Within 3% During Each Pair of Years

		Total Cost Model % CHANGE IN TOTCOST BENCHMARKS				CapEx Model % CHANGE IN CAPEX BENCHMARKS				OpEx Model % CHANGE IN OPEX BENCHMARKS			
Number of Study Areas	Years Compared	Average Impact	Minimum Impact	Maximum Impact	Std Dev	Average Impact	Minimum Impact	Maximum Impact	Std Dev	Average Impact	Minimum Impact	Maximum Impact	Std Dev
225	2006 - 2007	4.4%	-7.8%	20.5%	5.0%	3.9%	-11.8%	24.9%	6.9%	4.7%	-12.8%	19.9%	5.6%
166	2007 - 2008	6.1%	-11.6%	34.1%	8.0%	5.7%	-6.5%	20.2%	6.0%	3.6%	-11.2%	32.2%	5.4%
106	2008 - 2009	5.7%	-15.3%	19.5%	6.8%	3.3%	-15.0%	28.8%	7.6%	2.9%	-28.7%	27.3%	10.6%
81	2009 - 2010	5.8%	-12.6%	19.2%	7.0%	7.7%	-12.1%	25.5%	8.6%	4.1%	-15.2%	27.1%	7.4%
116	2010 - 2011	1.4%	-10.9%	21.3%	6.4%	2.8%	-8.7%	21.6%	7.2%	3.3%	-10.5%	19.4%	6.3%
113	2011 - 2012	2.7%	-14.4%	16.0%	6.0%	3.5%	-15.7%	34.0%	8.5%	3.8%	-8.7%	20.9%	4.8%

In the original slide, the 2012 column erroneusly included the coefficients from the OpEx model instead of Total Cost Model.

Issue 2: Predictable Results (continued)

- Coefficients vary in significance over time

Variable	2006	2007	2008	2009	2010	2011	2012
lnloops	0.760	0.710	0.740	0.805	0.741	0.676	0.664
lnroadmiles	-0.303	-0.305	-0.318	-0.350	-0.350	-0.217	-0.059
lnroadcrossing	0.295	0.327	0.315	0.312	0.366	0.242	0.155
lnstatesacs	-0.041	-0.037	-0.066	-0.051	-0.077	-0.076	-0.101
pctundepplant	0.014	0.016	0.015	0.016	0.017	0.018	0.017
lndensity	-0.191	-0.170	-0.197	-0.246	-0.211	-0.140	-0.092
lnexchanges	0.092	0.109	0.106	0.077	0.101	0.136	0.079
pctbedrock36	0.083	-0.052	0.169	0.034	-0.012	0.185	0.049
diff	0.173	0.262	0.201	0.183	0.122	0.136	0.128
climate	0.135	0.125	0.141	0.136	0.113	0.112	0.108
pcttriballand	0.002	0.002	0.002	0.001	0.001	0.002	0.002
pctparkland	0.007	0.007	0.009	0.010	0.010	0.011	0.009
pcturban	-0.001	0.000	0.001	0.000	0.002	0.002	0.002
alaska	-0.031	0.095	0.091	-0.219	-0.114	-0.033	0.186
midwest	0.170	0.142	0.146	0.134	0.121	0.115	0.158
northeast	0.062	0.042	0.053	-0.020	-0.049	-0.117	-0.070
Intercept	7.168	7.267	7.304	7.254	7.512	7.929	7.770

Shaded gray are variables that were not statistically significant at 90% level

QUANTILE REGRESSION

Issues Meeting with Rural Associations

July 17, 2013

Agenda

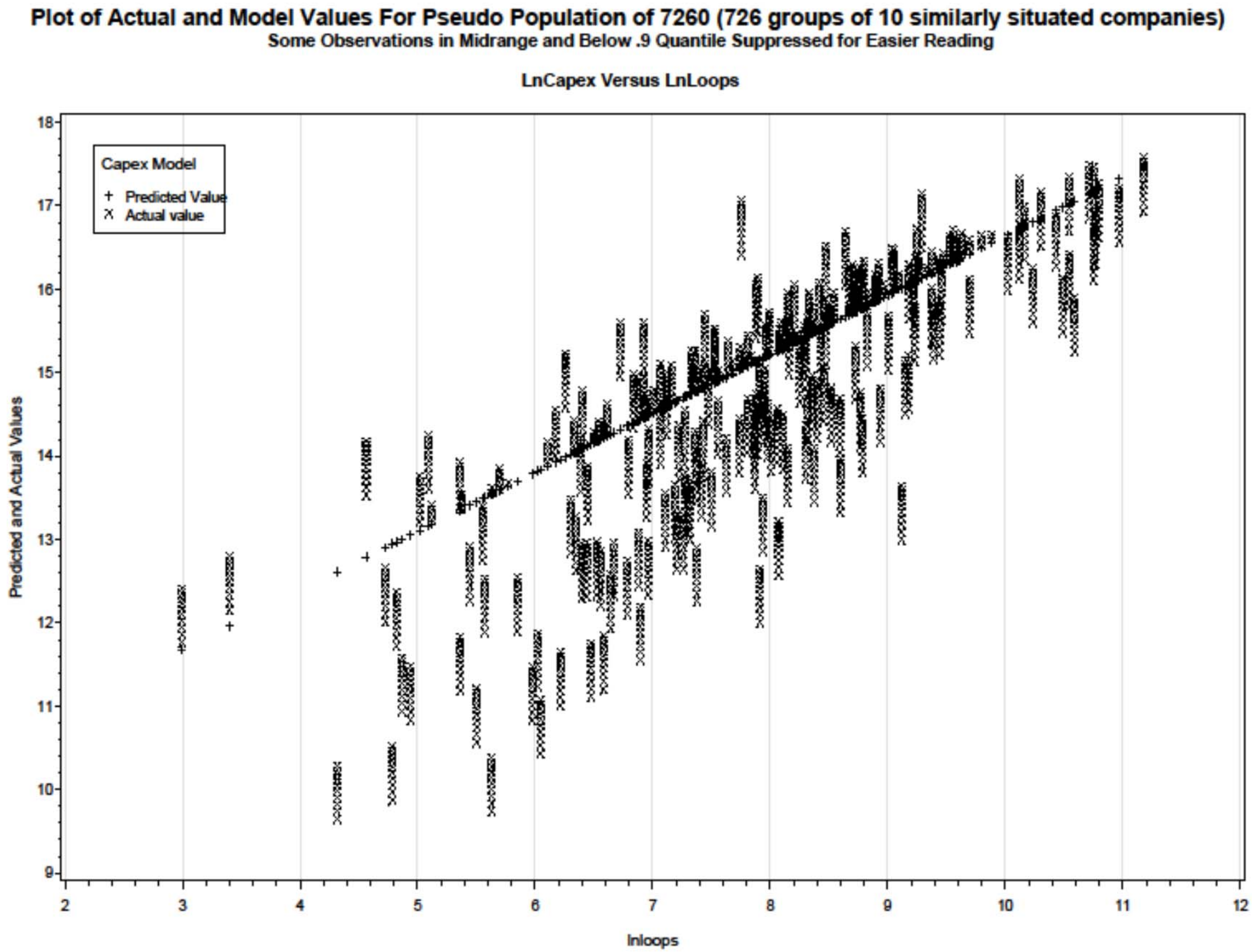
- Introduction
- Quantile Regression Output
  - 1. Follow-up on simulation
    - Results suggest a problem with the "similarly situated carriers" concept
- Quantile Regression Inputs
  - 2. Mapping update shows significant differences
- Quantile Regression Modeling
  - 3. Application of confidence intervals for 90^{th} percentile estimated value

Introduction

- In a series of meetings and filings since early this year, the Rural Associations have sought to continue a dialogue regarding concerns with the current use of regression methodology to limit high cost loop support.
- While Associations in the first instance do not believe a regression model—at least as currently structured—can satisfy statutory mandates of predictability and sufficiency, improvements in the current model must be sought and implemented to the extent it will continue to govern distribution of USF support.
- While there are many issues, we have identified three issues for this meeting that address output, input and modeling concerns
- In addition to this document, we have prepared an appendix document with additional materials for those interested in further analysis
- The Associations have attempted to use these meetings to isolate and address issues in different inputs, variables, and structural matters related to the regression formulas, in addition to continuing and related policy discussions

Issue 1: Simulation

- This issue is a follow-up to prior discussion with staff regarding model failures to capture "similarly situated" carriers
- The concept of similarly situated carriers can be tested with a simulation using hypothetical perfectly similar situations
  - Carriers that are equal are by definition similar
  - Creation of 10 equal carriers with slight variation in cost
  - One of the 10 equal carriers is hypothetically inefficient (being above the 90th percentile for the similar carriers)


Plot of Actual and Model Values For Pseudo Population of 7260 (726 groups of 10 similarly situated companies)
Some Observations in Midrange and Below .9 Quantile Suppressed for Easier Reading
LnCapex Versus LnLoops
Capex Model
+ Predicted Value
X Actual value
Predicted and Actual Values
lnloops
18
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Issue 1: Simulation (continued)

- Model goodness of fit must be improved if intent is to capture alleged outliers among similarly situated companies

Success of Current FCC Model in Identifying Carriers above the 90th Percentile from True Similar Situations
Similar Situations Formed by Replication

		Residual Adjustjment Divisor						
Factors by which variance around model was reduced	Original Model	1.2	1.5	2	5	10	20	50
R Squared (from OLS fit)	0.879	0.9127	0.9423	0.9667	0.9945	0.9986	0.9997	0.9999
Benchmarked from groups with:								
90% Cost Mark-up	194	205	231	271	414	527	651	725
80% Cost Mark-up	155	166	181	201	224	178	66	0
70% Cost Mark-up	116	121	123	119	62	11	0	0
60% Cost Mark-up	85	87	79	67	16	1	0	0
50% Cost Mark-up	61	56	46	33	3	0	0	0
40% Cost Mark-up	42	33	30	17	0	0	0	0
30% Cost Mark-up	29	25	17	8	0	0	0	0
20% Cost Mark-up	21	14	8	2	0	0	0	0
10% Cost Mark-up	11	8	3	1	0	0	0	0
NO Cost Mark-up (Original Costs)	6	3	2	0	0	0	0	0
90% Cost Mark-up Hits of Total Hits	26.72%	28.24%	31.82%	37.33%	57.02%	72.59%	89.67%	99.86%

Issue 1: Simulation (continued)

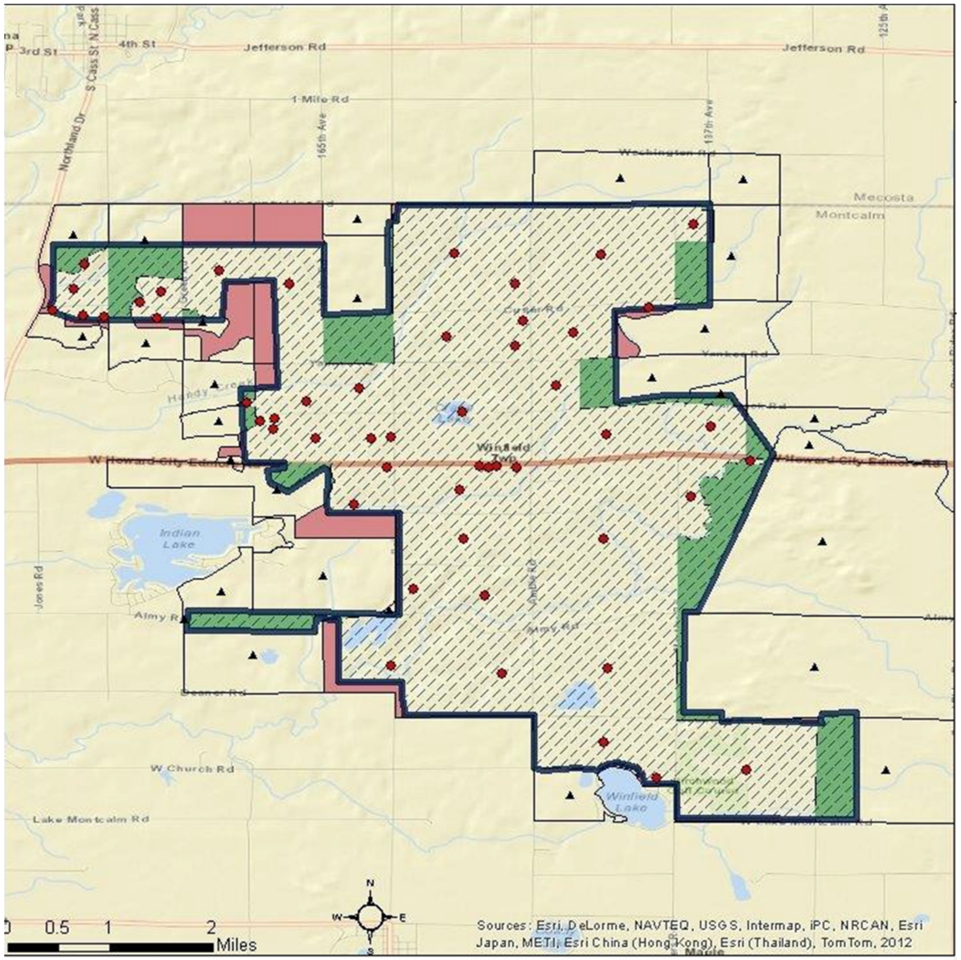
- The simulation demonstrates the error in supposing that if there were 100 carriers with identical independent values, 10 of them would be impacted by QRA
  - Only 26 percent of the simulated high-cost carriers were correctly identified

- An accurate model is critical to any analysis used to impact a carrier

Issue 2: Study Area Boundary Errors

Recall prior discussion of Census Block Errors (Exchange Ex.)

- Two overlap errors exist



Red: included areas outside exchange area

Green: excluded areas inside exchange area

Issue 2: Study Area Boundary Errors

- Rural carriers' submissions of study area maps permits verification of FCC QRA boundary maps
- Significant differences between what FCC has used for QRA and what rural carriers' actual boundaries are
- Finding presents difficult problem in modeling
  - Need to have accurate inputs BEFORE attempting to model costs

Issue 2: Study Area Boundary Errors

- Comparison of TomTom® and Rural Carrier Provided Maps

Distribution of Study Areas by Percent Difference in Total Area

Percent Area Difference Range	SA Counts	Cost Companies in 2013	Included in FCC Model	Study Areas Impacted by the Models* Separate Capex/Opex	Combined Capex/Opex	Single Total Cost
< −90%	1	1	1	1	0	1
−90% to −60%	6	6	5	1	1	1
−60% to −30%	21	16	15	2	2	2
−30% to −10%	64	50	50	8	4	7
−10% to −5%	63	47	39	10	3	4
−5% to −2%	68	58	52	9	3	4
−2% to 0%	72	46	37	6	3	3
0% to 2%	66	51	44	9	3	3
2% to 5%	51	39	31	3	3	3
5% to 10%	40	29	24	7	2	2
10% to 30%	57	43	37	3	0	1
30% to 60%	25	20	18	3	3	3
60% to 90%	12	10	10	1	1	1
90% to 100%	3	3	2	1	0	0
> 100%	42	30	26	2	1	0
Total Analyzed Maps	591	449	391	66	29	35
Percent of SA within ±5%	43%	43%	42%	41%	41%	37%
Percent of SA within ±10%	61%	60%	58%	67%	59%	54%

Issue 2: Study Area Boundary Errors

Distribution of Study Areas by Percent Area Overlap of the Two Maps

Percent Area Overlap Range	SA Counts	Cost Companies in 2013	Included in FCC Model	Study Areas Impacted by the Models*		
				Separate Capex/Opex	Combined Capex/Opex	Single Total Cost
0% to 10%	8	8	7	3	0	1
10% to 20%	4	3	2	0	0	0
20% to 30%	3	3	3	1	1	1
30% to 40%	5	2	2	0	0	0
40% to 50%	9	9	7	1	1	0
50% to 60%	20	16	16	2	1	1
60% to 70%	26	22	20	2	1	1
70% to 80%	46	38	37	4	2	3
80% to 90%	147	109	95	19	8	12
90% to 95%	181	141	121	17	7	8
95% to 99%	123	89	75	17	8	8
99% to 100%	19	9	6	0	0	0
Total Analyzed Maps	591	449	391	66	29	35
Percent of SA overlapping 90% +	55%	53%	52%	52%	52%	46%
Percent of SA overlapping 95%+	24%	22%	21%	26%	28%	23%

*The numbers of study areas in the population impacted by the models are 119, 50 and 64, respectively.

All three types of models based on data underlying April 25, 2012 FCC Order

Issue 2: Study Area Boundary Errors

Distribution of Study Areas by Degree of Erroneously Excluded Areas in the FCC Models
Measured as Percent of Company-Provided Areas

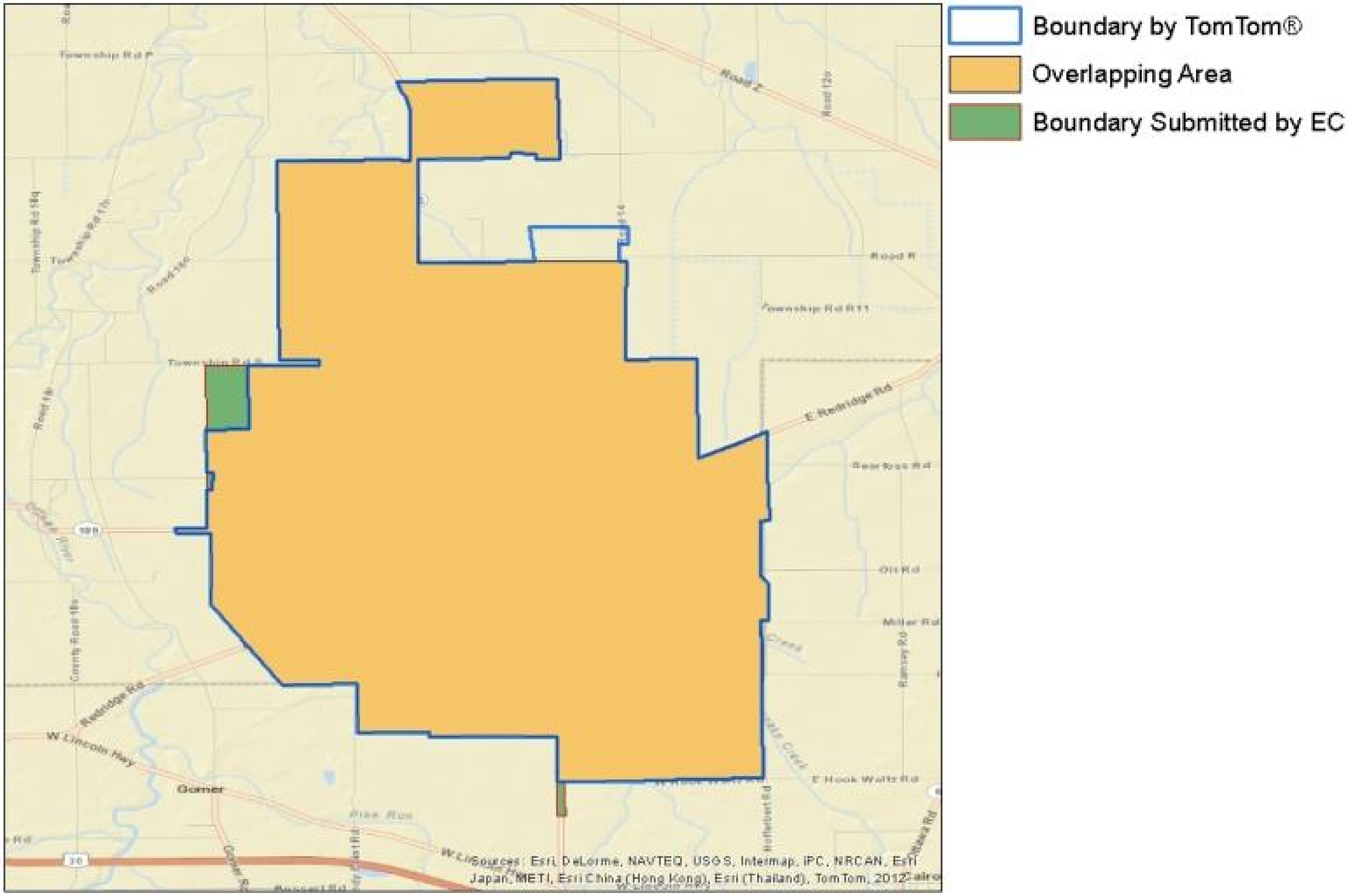
Percent Erroneously Excluded Range	SA Counts	Cost Companies in 2013	Included in FCC Model	Study Areas Impacted by the Models*		
				Separate Capex/Opex	Combined Capex/Opex	Single Total Cost
0% to 2%	36	20	14	2	2	2
2% to 5%	106	78	67	15	6	6
5% to 10%	181	141	121	17	7	8
10% to 20%	147	109	95	19	8	12
20% to 30%	46	38	37	4	2	3
30% to 40%	26	22	20	2	1	1
40% to 50%	20	16	16	2	1	1
50% to 60%	9	9	7	1	1	0
60% to 70%	5	2	2	0	0	0
70% to 80%	3	3	3	1	1	1
80% to 90%	4	3	2	0	0	0
90% to 100%	8	8	7	3	0	1
Total Analyzed Maps	591	449	391	66	29	35
Percent of SA within 5%	24%	22%	21%	26%	28%	23%
Percent of SA within 10%	55%	53%	52%	52%	52%	46%

Issue 2: Study Area Boundary Errors

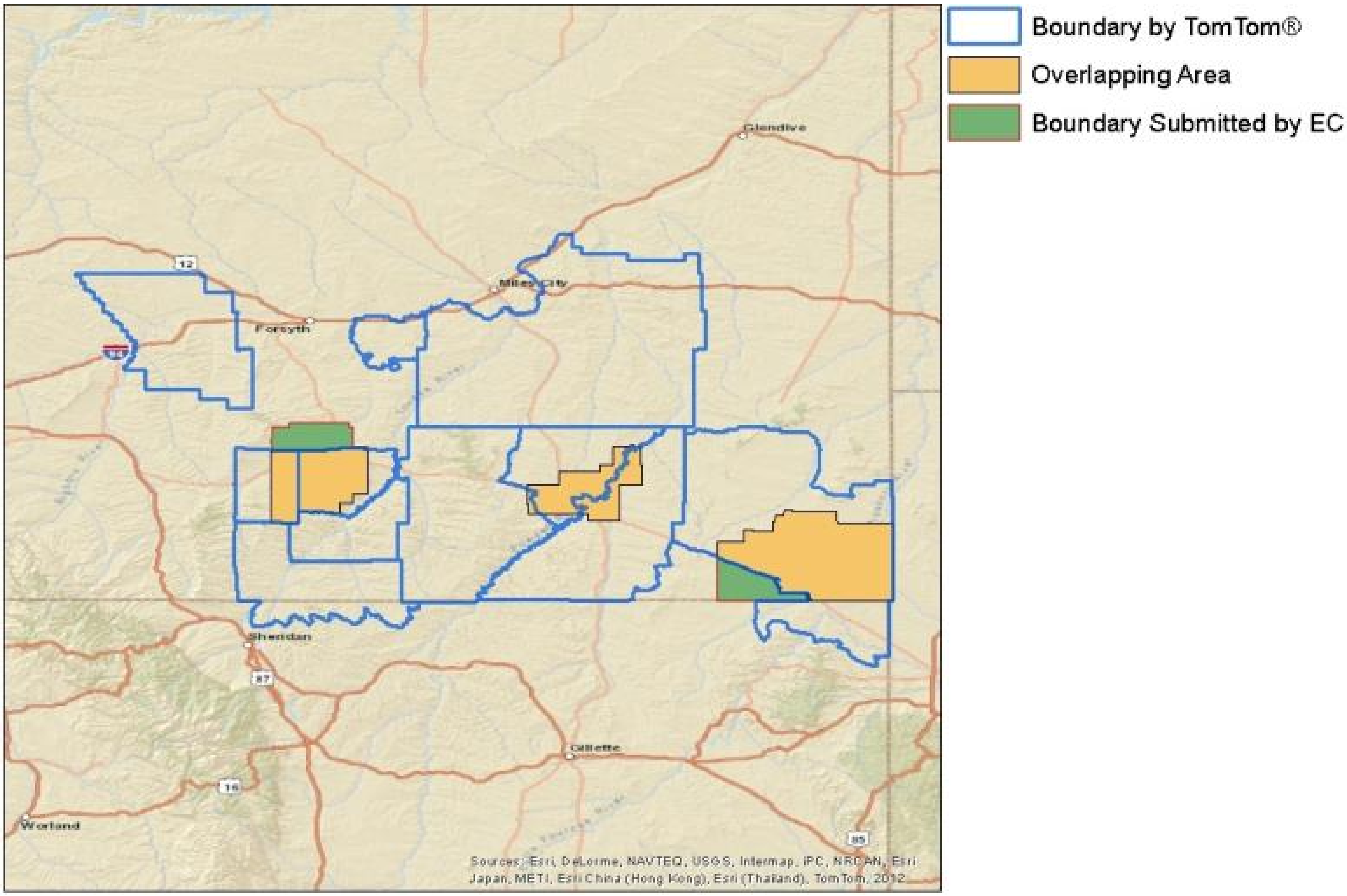
Distribution of Study Areas by Degree of Erroneously Included Areas in the FCC Models
Measured as Percent of Company-Provided Areas

Percent Erroneously Included Range	SA Counts	Cost Companies in 2013	Included in FCC Model	Study Areas Impacted by the Models*		
				Separate Capex/Opex	Combined Capex/Opex	Single Total Cost
0% to 2%	49	36	28	6	1	2
2% to 5%	119	88	80	18	9	10
5% to 10%	153	112	96	15	9	12
10% to 20%	115	91	80	15	5	7
20% to 30%	43	33	29	1	0	0
30% to 40%	20	18	16	2	1	1
40% to 50%	12	10	7	1	0	0
50% to 60%	8	5	5	1	1	1
60% to 70%	4	3	2	1	1	1
70% to 80%	6	5	5	0	0	0
80% to 90%	4	3	3	0	0	0
90% to 100%	7	6	5	2	1	1
> 100%	51	39	35	4	1	0
Total Analyzed Maps	591	449	391	66	29	35
Percent of SA within 5%	28%	28%	28%	36%	34%	34%
Percent of SA within 10%	54%	53%	52%	59%	66%	69%

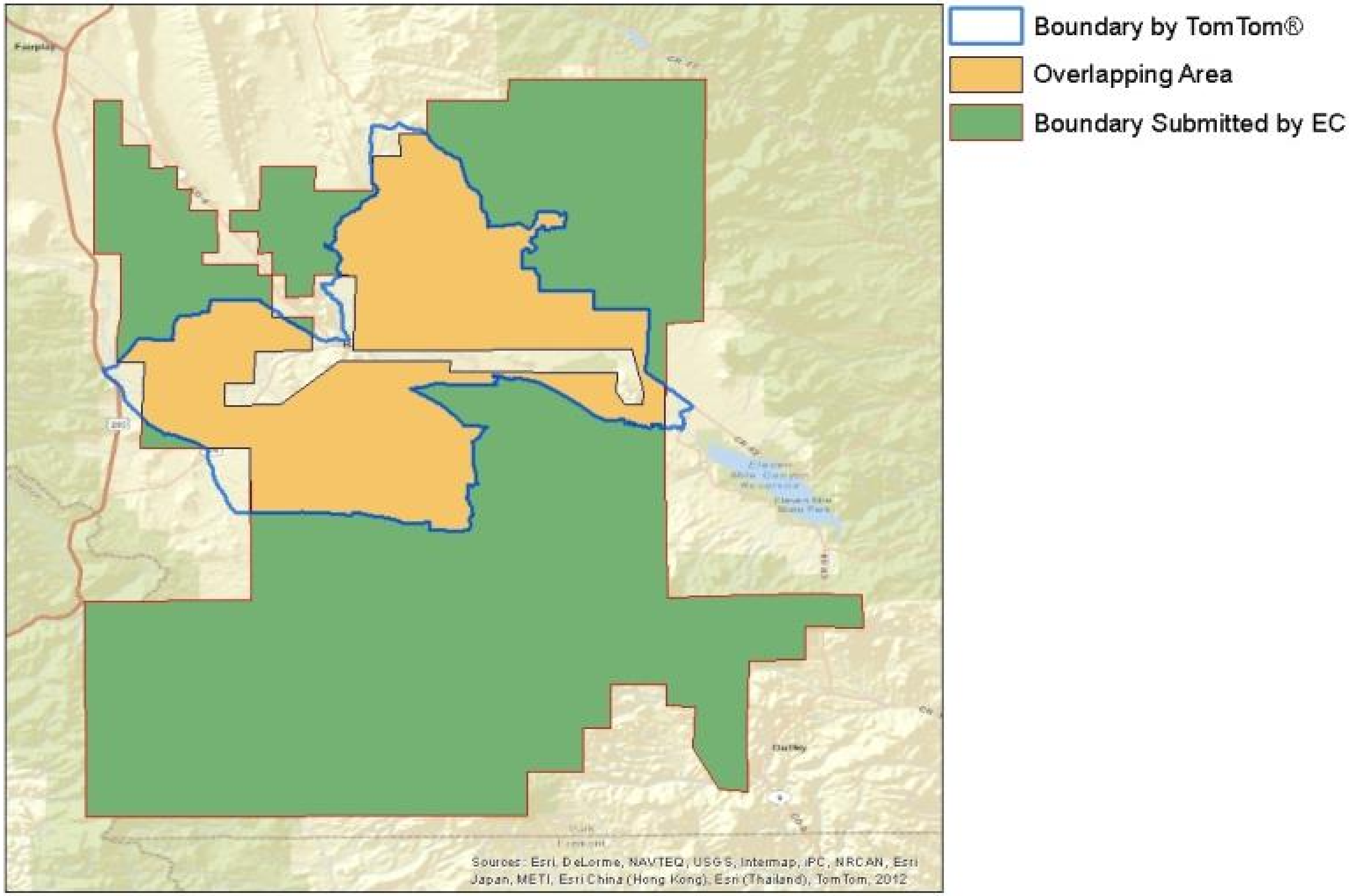
Issue 2: Study Area Boundary Errors



Issue 2: Study Area Boundary Errors



Issue 2: Study Area Boundary Errors



Issue 2: Study Area Boundary Errors

- Using incorrect study area boundaries to define QRA inputs will affect the QRA results
- Correct boundaries should be used when developing the next version of the QRA
- Ideally, the boundaries should be used to define the QRA inputs prior to further modeling development
  - How quickly can the FCC develop a new geographic dataset using carrier study area boundaries?
  - Can this new data be released in time prior to QRA modeling efforts using total cost?

Issue 3: Confidence Intervals

- Given the FCC's current reliance on statistical modeling to limit funding, standard confidence intervals should be employed to mitigate regression errors

- Confidence intervals, easily calculated and applied, reduce impact of model errors on cost limits

Issue 3: Confidence Intervals

- The QRA 90th percentile predicted value has a standard deviation that can be used to develop a confidence interval upper-bound
  - If QRA modeling achieves a high degree of accuracy, the standard deviation for the predicted value will be small
  - However, if QRA modeling is not accurate, the standard deviation for the predicted value tends to be large
- Given the QRA predicted value is used to define whether and to what extent a carrier will be negatively impacted, if a QRA is to be used at all in such circumstances, the FCC should at least use the 95th percent upper-bound confidence interval to determine whether a carrier is "clipped"

Issue 3: Confidence Intervals

- Using a limit based on the standard deviation of the predicted value is necessary to provide assurance that the FCC is 95 percent confident that a carrier's observed value exceeds a reasonable cost value for the carrier
- If there is uncertainty about what the reasonable cost value for a carrier is   the benefit should be given to the carrier and not to the model
- Operationally, the 95th percent upper-bound is calculated by the product of the model reported standard deviation, 1.645 (one-tail) and the QRA 90th percentile predicted value

Issue 3: Confidence Intervals

- Application of the confidence interval can be done irrespective of the structural form of the model
- As shown below, the current FCC model (applied to total cost) would negatively affect 64 carriers; however, 36 are still negatively affected with a 95 percent level of confidence

		Costs Cut By The Caps		
	Count of Affected Study Areas	Total $ Amount	Per Loop	% Of Total Costs
FCC Model	64	$81,636,603	$246.71	19.01%
Plus 1.645 x STD	36	$45,061,216	$216.92	15.08%

QUESTIONS / DISCUSSION

Thank You