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REDACTED – FOR PUBLIC INSPECTION

December 2, 2014

VIA ELECTRONIC FILING

Marlene H. Dortch
Federal Communications Commission
Office of the Secretary
445 Twelfth Street, S.W.
Washington, D.C. 20554

Re: ***Applications of Comcast Corp., Time Warner Cable Inc., Charter Communications, Inc., and SpinCo for Consent to Assign or Transfer Control of Licenses and Authorizations,*** **MB Docket No. 14-57**
REDACTED – FOR PUBLIC INSPECTION

Dear Ms. Dortch:

Comcast Corporation ("Comcast") hereby submits the enclosed analysis prepared by Dr. Mark Israel and Compass Lexecon in response to questions raised by Commission staff in connection with the above-captioned proceeding. This analysis was referenced in Comcast's recent response to Commission staff Question No. 3 filed on November 26, 2014.[1]

Comcast submits herewith one copy of the redacted, public version of this filing. The **{{ }}** symbols denote where Highly Confidential Information has been redacted. A Highly Confidential version of this filing and CD-ROM containing Highly Confidential data files supporting the analysis

[1] *See* Letter from Kathryn A. Zachem, Comcast Corporation, to Marlene H. Dortch, FCC, MB Docket No. 14-57, Response to Question No. 3 (Nov. 26, 2014).

have been submitted to the Office of the Secretary pursuant to the terms of the Modified Joint Protective Order in effect in this proceeding.[2]

Please contact the undersigned should you have any questions regarding this matter.

Respectfully submitted,

/s/ Francis M. Buono
Francis M. Buono
Counsel for Comcast Corporation

Enclosure

[2] *Applications of Comcast Corp. and Time Warner Cable Inc. for Consent to Assign or Transfer Control of Licenses and Authorizations*, Second Amended Modified Joint Protective Order, MB Docket No. 14-57, DA 14-1639 (Nov. 12, 2014) ("Modified Joint Protective Order").

Quality Controls in Cogent Interconnection Fee Regressions

December 2, 2014

Overview

Dr. Mark Israel's Reply Declaration submitted to the Federal Communications Commission ("FCC") presented empirical analysis based on data on interconnection fees between ISPs and Cogent, supplied by Dr. Farrell, Cogent's expert.[1] The central finding of this empirical analysis was that "observed price differences are explained by quality differences across ISPs and that, once such quality differences are controlled for, an ISP's size (measured as its number of broadband customers) has no significant effect on interconnection prices."[2]

In particular, Dr. Israel regressed ISP interconnection fees on the number of ISP customers and the number of private peering facilities (a measure of the quality of each ISP's network) and found that "[w]ith the control for quality in place, **{{**

}}."[3]

At meetings with the Department of Justice ("DOJ") on October 21, 2014 and the FCC on November 7, 2014, DOJ and FCC staff asked questions about this analysis, including:

- whether additional dimensions of ISP network quality—including the downstream quality (*e.g.*, connection speed) experienced by retail broadband customers—may be relevant to the value that edge providers (and their agents, such as Cogent) derive from interconnecting with an ISP's network and whether including such variables has any effect on our conclusions;
- the extent to which the right-hand-side ("RHS") variables are correlated with each other and the implications for the analysis; and
- whether it is appropriate to use non-linear regression techniques to account for truncation in the dependent variable.

We address each of these questions below.

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1 *In the Matter of Applications of Comcast Corp. and Time Warner Cable Inc. for Consent to Transfer Control of Licenses and Authorizations*, MB Docket No. 14-57, Reply Declaration of Mark A. Israel, "Economic Analysis of the Effect of the Comcast-TWC Transaction on Broadband: Reply to Commenters," Attachment to Comcast Corporation and Time Warner Cable Inc., *Opposition to Petitions to Deny and Response to Comments*, September 23, 2014 (hereinafter, *Israel FCC Reply Declaration*), § V.C.3.

2 *Israel FCC Reply Declaration*, ¶ 162.

3 *Id.*, ¶ 163.

Controlling for Additional Dimensions of Quality

In response to this inquiry, we first note that measures of downstream ISP quality are less directly relevant to the value of a direct interconnection agreement between Cogent and an ISP than are measures of the quality of the interconnection. Although retail broadband customers surely care about speed and network reliability, Cogent is in the business of providing interconnection services to its clients. Our understanding, based on interviews with Comcast engineers, is that the value of those interconnection services increases directly with the number of interconnection points, as more interconnection points both increase the value buyers derive from interconnection with the network (by offering greater redundancy) and decrease the costs associated with interconnection (by reducing the average distance to reach the interconnection points). Indeed, when asked for the relevant measures of quality that interconnection partners are willing to pay for, the number of interconnection points was at the top of the list for Comcast engineers.[4]

Nonetheless, because DOJ and FCC staff asked about the effect of including the alternative quality measures, we examine whether including additional controls changes our results. It does not. With controls for the downstream quality of the ISP's network in place, we continue to find that observed price differences are explained by quality differences across ISPs and that, once such quality differences are controlled for, an ISP's size (measured as its number of broadband customers) has no significant effect on interconnection prices.

To control for the impact of retail broadband network quality, we have collected data on network quality from several sources:

- The FCC's Measuring Broadband America report, which provides data on ISPs' realized speeds as a percentage of advertised speeds.[5]
- The Netflix ISP Speed Index, which reports average speeds for Netflix usage by ISP.[6]
- Ookla, which collects and reports broadband speed and quality statistics by ISP.[7]

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4 See *id.*, ¶ 154.

5 *Available at* http://www.fcc.gov/measuring-broadband-america/2014/charts-fixed-2014. The report also contains data on latency (another dimension of network quality), but because the data are limited and not easily aggregated, we do not use them in this analysis.

6 *Available at* http://ispspeedindex.netflix.com/usa. We use the Netflix ISP Speed Index data for this limited purpose, notwithstanding the fact that the data are both imperfect and opaque. They are imperfect because the Speed Index measures the average speed at which Netflix's traffic is delivered to an ISP's end user, which in significant part is determined by traffic routing and delivery choices Netflix makes in its sole discretion. They are opaque because Netflix does not disclose the methodology it uses to compute the results.

7 *Available at* http://www.netindex.com/.

To conduct our analysis, we used the FCC's validated September 2013 test results, which the FCC cleaned to remove any anomalies. In cases where the FCC does not report data on an ISP in the Cogent dataset, we drop the observation. These drops result in a very small sample when using control variables derived from the FCC data. For the analysis using the Netflix and Ookla data, we use an average over the most recent three months of available data to remove any anomalous network performance in a specific month.[8] We again drop observations for those ISPs in the Cogent data for which the relevant data are unavailable. The results of our supplemental regression analysis are shown in Table 1 below.

Table 1: Supplemental Regression Analysis of Cogent Interconnection Data

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Columns (1) and (2) of Table 1 replicate the results reported in the Israel FCC Reply Declaration. Column (1) indicates that, without controlling for any other factors, increasing the number of ISP customers by one million **{{**

}}. Column (2) controls for the size of the network and demonstrates that once network quality is controlled for, the purported relationship between interconnection fees and the number of ISP customers disappears. The subsequent columns each add one additional measure of downstream ISP quality to the specification in Column (2). With the exception of Column (7), the additional controls for the quality of the retail broadband network are not statistically significant. Column (7) indicates that each additional Mbps of

[8] Netflix data include July through September; Ookla data include August through October.

upload speed **{{ }}**, consistent with the idea that ISPs with higher quality networks are able to obtain better interconnection terms, as expected.

More importantly, in *all* specifications in which we control for network quality (regardless of how measured), we find no statistical support for the hypothesis that ISPs with larger subscriber bases are able to negotiate more favorable prices with Cogent. Moreover, the lack of statistical significance does not arise because of imprecise estimates in small samples. Controlling for network quality reduces the magnitude of the coefficient on number of ISP customers toward zero without dramatically increasing the associated standard errors. Thus, our initial findings continue to hold.

Correlation between RHS Variables

FCC staff asked us to report the correlation between the number of ISP subscribers and the number of interconnection points of each network. Figure 6 of the Israel FCC Reply Declaration illustrates the correlation graphically. While there is a clear positive correlation between the two RHS variables, the correlation of 0.89 is less than one, indicating that the variables are not perfectly collinear. Indeed, the fact that the variables are correlated illustrates why it is critical to separately control for both variables. Failure to do so would induce omitted variable bias and risk falsely attributing the effect on interconnection prices from variation in the size of the network to the size of the customer base.[9]

Multiple regression analysis is specifically designed to tease apart the effect of separate variables, even if highly correlated, as long as there is some independent variation in the two. In the present case, the regression measures the effect of number of interconnection points on interconnection prices by looking at how interconnection prices vary with just that portion of the number of interconnection points variable that is uncorrelated with the number of subscribers.[10] And, analogously, it identifies the effect of number of subscribers on interconnection prices by looking at how interconnection prices vary with just that part of the number of subscribers variable that is uncorrelated with number of interconnection points. Although, in theory, one might worry that there is not enough such independent variation to enable the effects to be measured precisely, the fact that the effect of number of interconnection points is statistically significant means that the effect has been measured precisely enough to be certain, at generally accepted levels, that number of interconnection points affects interconnection prices. The same cannot be said for number of subscribers, which has no significant effect on interconnection prices once number of interconnection points is controlled for.

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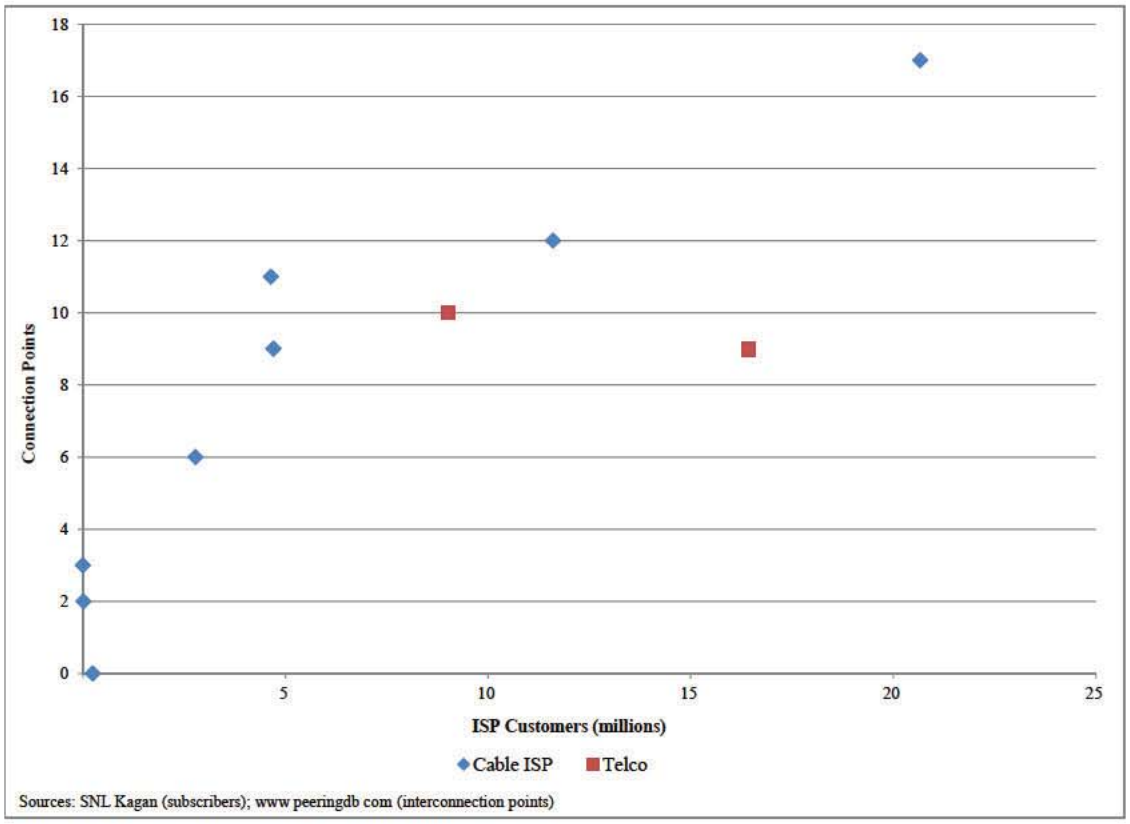
9 See William H. Greene (2010), *Econometric Analysis*, 7th Ed., Pearson, § 4.3.2.

10 See Greene (2010), § 3.3.

Figure 1: Comparison of ISP Customer Base to Number of Interconnection Points
[Reproduced from Figure 6 of the Israel FCC Reply Declaration]



Truncated Interconnection Fees

FCC staff asked how the regression results would change if we accounted for the fact that interconnection fees are truncated at zero (under the hypothesis that prices cannot be negative). Truncation arises when the estimation sample is drawn from a subset of the full distribution and is used to make inferences about the full sample.[11]

Because interconnection fees are not truncated at zero, however, models accounting for truncation are not relevant to the analysis here. Indeed, we observe many instances of both positive fees (e.g., {{ }}) and negative fees (e.g., Comcast charges Netflix). Notably, the recent discussions between Comcast, Cogent, and Netflix have been focused on the establishment of a positive price paid to Comcast by whatever firm handles Netflix traffic (whether Netflix directly or Cogent)—that is, the establishment of a *negative* price paid by

[11] See Greene (2010), p. 833 ("'Truncation' effects arise when one attempts to make inferences about a larger population from a sample that is drawn from a distinct subpopulation… Truncation is essentially a characteristic of the distribution from which the sample data are drawn.").

Comcast to Netflix/Cogent. Hence, there is no truncation and our original OLS approach is appropriate.

Moreover, even under the incorrect assumption that interconnection fees are truncated at zero, the data yield no basis for concern. **{{**

}}. Thus, if prices were truly truncated at zero, there would be no basis to conclude that the proposed transaction would lead to worse interconnection terms for Cogent.