PERSPECTIVES

PHOENIX CENTER FOR ADVANCED LEGAL & ECONOMIC PUBLIC POLICY STUDIES

Are Broadband Prices Declining? A Look at the FCC's Price Survey Data

George S. Ford, PhD*

October 26, 2020

Introduction

In a recent study released by USTelecom entitled *2020 Broadband Pricing Index*, Arthur Menko uses data from the Federal Communications Commission's *Urban Rate Survey* to compare average broadband prices between 2015 and 2020 (hereinafter the *Menko BPI Study*).[1] Menko's comparison is based on a sample of the largest broadband providers' most popular broadband speed tiers and on these providers' fastest speed tiers in the two years. The *Menko BPI Study* reports major declines in broadband prices: in real (2015) dollars, broadband prices for the most popular speed tiers fell by 28.1% and for the fastest speed tiers by 43.9%. These are, obviously, sizable declines.

Broadband speeds rise over time, which leads to questions about how to compare prices from different periods. The *Menko BPI Study* compares prices for the most popular broadband services in each period. While the comparison involves broadband services of *unequal* quality, the *Menko BPI Study* still finds sizable price reductions.[2] While this comparison is useful for comparing prices of the services that were actually available to—and widely consumed by—subscribers in those years, in this PERSPECTIVE I follow standard methods for constructing a price index and use the FCC's *Urban Rate Survey* data to compare prices over time for services of *equal* quality.[3] Hedonic methods are used to construct a broadband price index for years 2015 through 2020.

As in the *Menko BPI Study*, I find large price declines across a wide range of broadband speeds. Even though I use different methods and more of the survey data, my results are quite comparable to those reported in *Menko BPI Study* for the most popularly purchased speed tiers for the same time periods (BPI-Consumer Choice).[4] In all, the FCC's price survey data reveal large, statistically-significant price declines over time for broadband services, holding quality constant.

I follow standard methods for constructing a price index and use the FCC's Urban Rate Survey data to compare prices over time for services of equal quality. *** In all, the FCC's price survey data reveal large, statistically-significant price declines over time for broadband services, holding quality constant.

Methodology

Each year we observe changes in the download speeds of broadband services. Let the speed at time t be S_t and the average price for that speed be P_t. For each period we have (P_t, S_t), where P_t correlates positively to S_t, or $\Delta P_t/\Delta S_t > 0$. Typically, we expect S_t to increase over time. How do we compare average prices when speeds differ over time and higher speeds sell for higher prices? Two polar comparisons are commonly used in economic literature:

$$\Delta P(S_{t\text{-}1}) = P_t(S_{t\text{-}1}) - P_{t\text{-}1}(S_{t\text{-}1}), \quad (1)$$

and,

$$\Delta P(S_t) = P_t(S_t) - P_{t\text{-}1}(S_t). \quad (2)$$

Say, for instance, that we wish to compare prices in 2015 to those in 2020. Assume the average speed in 2015 is 50 Mbps and in 2020 is 200 Mbps. Equation (1) measures the difference in 2020 prices versus 2015 prices for a 50 Mbps service, while Equation (2) measures this price difference for a 200 Mbps service. Statistical tests may be conducted to test whether $\Delta P = 0$ under each of these speed assumptions. Borrowing from the terminology of price index construction, Equation (1) is a Laspeyres-type price index and Equation (2) is a Paasche-type index.

The FCC's survey collects a sample of broadband plans covering a range of speeds. An average of download speeds in the FCC's survey do not, therefore, reflect the average speeds used by customers. Instead, I measure average download speeds in each year with means computed from large samples of speed tests. Ookla conducts millions of speed tests in the U.S. annually, so its data is a useful proxy for average download speeds.[5]

Table 1. Average Download Speed (Ookla)

Year	Avg. Download Mbps
2015	38.71
2016	54.97
2017	64.17
2018	96.25
2019	120.00
2020	156.61

Average download speeds by year are summarized in Table 1. As expected, download speeds rise annually. In 2015, the average download speed was nearly 39 Mbps, rising to near 100 Mbps by 2018. In 2020, the final year of the sample, speeds just exceeded 150 Mbps.

Estimating the Prices

Following the standard procedure for hedonic quality adjustments for constructing a price index, average prices for various speeds are calculated using regression analysis:

$$P_{it} = f(S_{it}, S_{it}^2, D_t, X_i) + \varepsilon_{it}, \quad (3)$$

where S_{it} is speed at time t for service offering i, X_i is a technology fixed effect, D_t is a yearly dummy variable, and ε_{it} is the econometric disturbance term.[6] The speed measures are interacted with the time fixed effects creating a unique intercept and slope (for speed and speed squared) for each year. Predictions from Equation (3) may be obtained for any chosen year-speed pair.

According to the Fisher-ideal index, in 2020 average price was 36% less than in 2015.

For the Laspeyres-type price index (as in Equation 1), predictions are based on the 2015 average speed values in any year-to-year comparison. Alternately, for the Paasche-type index (as in Equation 2), predictions from Equation (3) are based on the 2020 average speed levels. The geometric mean of the Laspeyres and Paasche index is the Fisher-ideal price index. This index measures price changes that occur over the 2015-2020 period, while accounting for the changing nature of broadband quality over this period.

Data

Data are obtained from the FCC's *Urban Rate Survey* for years 2015 through 2020.[7] All prices are converted to 2020 dollars using the Consumer Price Index.[8] As in the *Menko BPI Study*, I limit the sample to the fifteen largest BSPs.[9] A few restrictions are placed on the sample. First, with only two observations for fixed wireless service, I exclude these from the sample. Second, the "other" category for broadband delivery technology appears only in years 2015 and 2016 (244 observations total). These are excluded as well. Third, very few observations have speeds above 1 Gbps, and these are excluded.[10] The final sample includes cable, DSL, and FTTH delivery technologies, which are the primary broadband modalities. Annual samples are large and range from 880 observations (2016) to 2,605 observations (2019). There are 8,657 observations in the final sample. Sample details are provided in Table 2.[11]

Table 2. Sample Sizes

Year	Total	Cable	DSL	FTTH
2015	1,140	491	465	184
2016	880	514	247	119
2017	923	400	425	98
2018	1,580	903	420	257
2019	2,605	1,135	966	504
2020	1,529	785	459	285

Along with the way I compare prices over time, my treatment of the data also differs somewhat from the *Menko BPI Study*. First, the *Menko BPI Study* for its BPI-Consumer Choice index uses only the most popular speed plans offered by each provider when computing prices. I use all the data and account for speed differences using regression analysis. Second, I use average speed data from Ookla, where the *Menko BPI Study* determines speeds for the most popular plans based on FCC Form 477 reports. Third, the *Menko BPI Study* converts nominal prices to real prices in terms of 2015 dollars, whereas I convert to 2020 dollars. Fourth, the *Menko BPI Study* uses national provider subscriber shares as weights, while sampling weights are not used in my analysis since the speed data are obtained outside the FCC survey and regression analysis is used.

Based on these differences in index construction, statistical methods, and data handling, the price levels and price changes computed here may differ than those reported in the *Menko BPI Study*. That I find comparable results despite such differences, however, lends credence to the findings of both studies.

Year-Pair Price Comparisons

To begin, I compare mean prices using Equation (1), where prices are constructed to reflect the average speed level in 2015 (S_{t-1}). These mean prices are computed using estimates from Equation (3) and the results are summarized in Table 3.[12]

Table 3. Results, Equation (1)
(Base year = 2015)

Year	S_{2015}	P_{t-1}	P_t	ΔP	$\%\Delta P$
2015	38.71	71.48	71.48	…	…
2016	38.71	71.48	67.72	-3.76*	-5.26%
2017	38.71	71.48	69.28	-2.20*	-3.08%
2018	38.71	71.48	61.86	-9.62*	-13.46%
2019	38.71	71.48	59.92	-11.57*	-16.18%
2020	38.71	71.48	54.17	-17.32*	-24.23%

* Statistically Significant 5% level.

In all years, the price is less in that year than it was in 2015 for the same level of service. In every year but 2017, the average price for a broadband service with a speed of 38.71 Mbps is declining (i.e., quality constant). And, in all cases, the price difference is statistically different from zero at the 5% level. The price change between 2015 and 2020 for a 38.7 Mbps connection is -24.23%.

> ***[T]hese data show that the price for both low- and high-speed broadband are falling over time, but the price for high-speed broadband is falling faster.***

As an alternative comparison, I use Equation (1) to compute the average price of broadband service in period t at the average speed in period $t-1$. These computations represent annual price changes holding quality constant from year-to-year rather than holding speed constant at its 2015 level. Mean prices are summarized in Table 4. Again, the average price declines each year (though the small change between 2016 and 2017 is not statistically different from zero). Between 2019 and 2020, the average broadband price fell by $5.38 or 7.1%. The largest observed change in between 2017 and 2018 at -14.53%. On average, real prices fall by 7.4% annually.

Table 4. Results, Equation (1)
(Base year = *t* - 1)

Year	S_{t-1}	P_{t-1}	P_t	ΔP	$\%\Delta P$
2015	…	…	…	…	…
2016	38.70	71.48	67.72	-3.76*	-5.26%
2017	55.00	77.35	77.27	-0.08	-0.11%
2018	64.17	81.68	69.81	-11.87*	-14.53%
2019	96.25	79.39	71.42	-7.97*	-10.04%
2020	120.0	75.88	70.5	-5.38*	-7.09%

* Statistically Significant 5% level.

Table 5 summarizes the results from Equation (2), where prices are computed at the 2020 average speed (S_t = 156.61 Mbps). Again, for every year in the sample, the average price in 2020 is below the average prices in earlier years for the same quality of service. For the 156.6 Mbps service, the price in 2020 is $66.26 less than in 2015—a decrease of about 46% (nearly half). And, between 2019 and 2020, there is a statistically-significant price decline of $5.22 (or 6.3%).[13] As before, all the price differences are statistically different from zero at the 5% level.

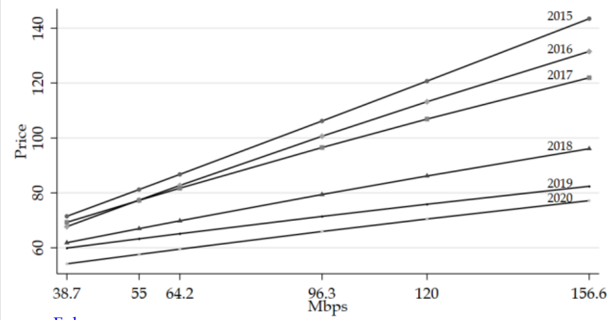
Table 5. Results, Equation (2)
(Base year = 2020)

Year	S_{t-1}	P_{t-1}	P_t	ΔP	$\%\Delta P$
2015	156.61	143.44	77.18	-66.26*	-46.19%
2016	156.61	131.52	77.18	-54.34*	-41.32%
2017	156.61	121.94	77.18	-44.76*	-36.71%
2018	156.61	96.09	77.18	-18.91*	-19.68%
2019	156.61	82.40	77.18	-5.22*	-6.34%
2020	156.61	77.18	77.18	…	…

* Statistically Significant 5% level.

Average prices across download speeds and years as predicted by Equation (3) are illustrated in Figure 1. Predictions are made at all analyzed speeds for each year in the sample. The figure shows that the price-speed relationship is generally getting flatter over time, so these data show that the price for both low- and high-speed broadband are falling over time, but the price for high-speed broadband is falling faster. And, the figure shows that prices at each speed level are falling over time.

Figure 1. Price-Speed Relationship by Year



Enlarge

While my approach differs from the *Menko BPI Study* in several ways, the broad conclusions are the same: the price of broadband services has declined over time. My analysis shows that average prices for broadband services, with rare exceptions at lower speeds, are falling annually, and these changes are statistically-significant and not mere reflections of sampling variability.

My analysis shows that average prices for broadband services, with rare exceptions at lower speeds, are falling annually, and these changes are statistically-significant and not mere reflections of sampling variability.

Broadband Price Index

The data and procedures described here may be used to construct a Fisher-ideal broadband price index F_t, which is a geometric mean of the Laspeyres and Paasche indexes. To account for changes in average quality, as measured in download speeds, the hedonic method is used. This procedure employs exponentiated predictions from Equation (3) to account for product differences over time. Nominal prices are used for consistency with the standard price index methodology.

Table 6 summarizes the price indexes.[14] Base speeds are 38.71 Mbps for the Laspeyres-type and 156.61 Mbps for the Paasche-type index. The percentage change in the price index between two periods may be computed as (F_t/F_{t-k} - 1).

Table 6. Broadband Price Index

Year	Laspeyres Index	Paasche Index	Fisher Index
2015	100.00	100.00	100.00
2016	94.74	91.69	93.20
2017	96.92	85.01	90.77
2018	86.54	66.99	76.14
2019	83.82	57.45	69.39
2020	75.77	53.81	63.85

All the price indexes constructed here are falling over time revealing large and consistent price reductions when holding quality constant. According to the Fisher-ideal index, in 2020 average price was 36% less than in 2015. Between 2019 and 2020, the Fisher price index falls by 8%. The largest change in the Fisher index is between 2017 and 2018 where the index falls by 16%. On average, prices fall by about 8.5% annually. Based on the FCC's price survey data, it appears that broadband prices—quality held constant—are falling each year by a sizable amount.

On average, prices fall by about 8.5% annually. Based on the FCC's price survey data, it appears that broadband prices—quality held constant—are falling each year by a sizable amount.

Conclusion

In recent years, the FCC has collected a sample of broadband prices and reported the data in its *Urban Rate Survey*. The *Menko BPI Study* used these data to compare broadband prices between 2015 and 2020, reporting large price decreases in real prices between 28.1% and for the fastest speed tiers by 43.9%.

In this PERSPECTIVE, I construct average broadband prices and a broadband price index over time using hedonic methods so that quality is held constant, where quality is measured by download speed. My findings are comparable to the *Menko BPI Study* even though the methods materially differ. Between 2015 and 2020, for example, I find that the average decline in prices is about 36% when using a Fisher-ideal price index. Broadband prices across a wide range of speeds have fallen over time, and the price reductions are, in most cases, sizable.

NOTES:

[*] **Dr. George S. Ford** ***is the Chief Economist of the Phoenix Center for Advanced Legal and Economic Public Policy Studies. The views expressed in this*** **PERSPECTIVE** ***do not represent the views of the Phoenix Center or its staff. Dr. Ford may be contacted at*** ford@phoenix-center.org.

[1] A. Menko, *2020 Broadband Pricing Index*, Study Commissioned by USTelecom (2020) (available at: https://www.ustelecom.org/wp-content/uploads/2020/09/USTelecom-2020-Broadband-Pricing-Index.pdf).

[2] In additional analysis, the *Menko Study* uses price-per-megabit as a price measure, but for several reasons price-per-megabit is a deeply flawed measure of price (primarily, consumers do not pay for broadband by the megabit of download speed). On the problems with price-per-megabit, *see* G. S. Ford, *The Open Technology Institute's Cost of Connectivity 2020 Report: A Critical Review,* PHOENIX CENTER PERSPECTIVE NO. 20-06 (July 20, 2020) at pp. 7-8 (available at: https://www.phoenix-center.org/perspectives/Perspective20-06Final.pdf).

[3] On selection bias in price studies, *see e.g.*, G.S. Ford, *A Review of the Berkman Center's Price Survey of Municipal Broadband Markets*, PHOENIX CENTER POLICY PERSPECTIVE No. 18-01 (January 24, 2018) (available at: https://www.phoenix-center.org/perspectives/Perspective18-01Final.pdf).

[4] Because my study employs data from all of the speed tiers reported in the FCC *Urban Rate Survey*, these results should be compared against those developed in the *Menko Study* for the most popular speed tier (BPI-Consumer Choice) and not those developed for just the fastest speed tier (BPI-Speed). Note also that this study examines the differences in prices that are available to subscribers, while the *Menko Study* examines the differences in the price paid for the most popularly-purchased broadband speed. To the extent that broadband customers are slower to adopt faster services than providers are in rolling out the availability of such services, it is completely understandable why the price reductions that I find are slightly larger than those found in the *Menko Study*.

[5] Information on Ookla's Speedtest data is available at: www.speedtest.net.

[6] Specification analysis indicated that a linear specification of price quadratic in speed best fit the data. A log-log model provides for similar results.

[7] Data available at: https://www.fcc.gov/economics-analytics/industry-analysis-division/urban-rate-survey-data-resources.

[8] January data is used: https://fred.stlouisfed.org/series/CUUS0000SA0.

[9] Firms included are: Charter, Altice (Cablevision and Suddenlink), Comcast, Mediacom, WOW, Cable One and Cox, AT&T, Verizon, CenturyLink, Frontier, Windstream, Consolidated and TDS.

[10] For about 8,600 observations, only 2 observations had speeds exceeding 1 Gbps. The results are little affected by the exclusion, but a 2 Gbps circuit is not typically considered a consumer product.

[11] By using speeds obtained outside the survey data and relying on regression analysis, I do not use the weights provided in the FCC survey. Because the FCC developed its *Urban Rate Survey* data to be able to verify that urban prices are comparable to rural ones, the weightings employed by the FCC are quite complex. Further, they vary somewhat from year to year to keep up with evolving service qualities. (See the 2014-2020 Broadband Methodology documents presented on https://www.fcc.gov/economics-analytics/industry-analysis-division/urban-rate-survey-data-resources).

[12] Equation (3) is estimated using 8,657 observations, has an R^2 of 0.55, and an F-statistic of 805.8 (significant at better than the 1% level).

[13] In nominal prices, the price difference between 2019 and 2020 is $2.8, so inflation accounts for less than 20% of the price difference between those two years.

[14] The Laspeyres price index is $100 \cdot [P_t(S_{t-1})/P_{t-1}(S_{t-1})]$ and the Paasche price index is $100 \cdot [P_t(S_t)/P_{t-1}(S_t)]$.