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September 23, 2014

VIA ECFS

Marlene H. Dortch, Esq.
Secretary
Federal Communications Commission
445 Twelfth Street, SW
Washington, DC 20554

Re: ***Applications of AT&T Inc. and DIRECTV for Consent to Assign or Transfer Control of Licenses and Authorizations,*** **MB Docket No. 14-90**
REDACTED - FOR PUBLIC INSPECTION

Dear Ms. Dortch:

Pursuant to the *Joint Protective Order* in the above-referenced proceeding,[1] AT&T Inc. ("AT&T") and DIRECTV (together, the "Applicants") are submitting (1) a DVD-ROM containing the ***unredacted***, Highly Confidential paper prepared by Professors Steve Berry and Phil Haile of Yale University entitled "Quantitative Analysis of an AT&T-DirecTV Merger: Additional Discussion of Modeling Choices, Data, and Results" ("*Quantitative Analysis*"); and (2) a hard drive containing the ***unredacted***, Highly Confidential files supporting the *Quantitative Analysis*. AT&T is filing herewith, via ECFS, a ***redacted*** public version of this submission.

On Tuesday, July 22, 2014, representatives of the Applicants met with staff from the Commission and the Department of Justice to discuss AT&T's proposed acquisition of DIRECTV. Professors Berry and Haile presented the results of their merger simulation in this matter. In particular, they explained how the complementary nature of AT&T's broadband service and DIRECTV's video service make this transaction different from so many transactions that the Commission reviews. Even before a single dollar of cost savings is considered, the merger simulation demonstrates that consumers would benefit from or, at a minimum, would not be harmed by, the combination of these assets. Then, when even a conservative estimate of cost savings is factored into AT&T's existing video business, the merger simulation predicts substantial economic benefit to consumers of between $940 million to $1.44 billion annually. Additional cost savings in

[1] *Applications of AT&T Inc. and DIRECTV for Consent to Assign or Transfer Control of Licenses and Authorizations*, Joint Protective Order, DA 14-804 (MB rel. June 11, 2014).

other aspects of the combined business (*e.g.*, cost savings benefiting DIRECTV's existing subscriber base) would increase consumer surplus even further.

At the conclusion of the meeting, economists from the Commission and the Department of Justice invited Professors Berry and Haile to provide future submissions if they thought doing so would be helpful. Accepting that invitation, Professors Berry and Haile have prepared the enclosed *Quantitative Analysis*, which discusses their model, data, and results in greater detail. Notably, the work reflected in their *Quantitative Analysis* confirms the pro-competitive effects of this transaction. Among other things, Professors Berry and Haile have shown through various tests that their results are not driven by their modeling assumptions, but by the data. Several key findings are worth highlighting:

- There is abundant evidence that consumers have distinct preferences for bundles vs. standalone products, which confirms the basis for the "nests" in the model.

- Even when the nesting parameters are relaxed, the results do not change direction, confirming that the choice of nests is not driving those results.

- Applying the model to hypothetical, randomly-generated data sets yields a range of results from positive to negative, confirming again that it is the data, rather than the modeling choices, that produces the results.

- Testing the hypothetical case in which the synthetic bundle price is determined without reference to the prices of the individual components shows that the current discount on the synthetic bundle does not solve the double-marginalization problem, although it reduces the price of the synthetic bundle below what it would be in the counterfactual case.

This submission adds to an already-substantial body of quantitative evidence demonstrating the pro-consumer benefits of the proposed transaction. Like the economic analysis presented by Professor Katz in his declaration dated June 11, 2014 and the merger simulation results presented by Professors Berry and Haile to DOJ and Commission economists on July 22, the enclosed *Quantitative Analysis* provides compelling empirical support for the intuitive proposition that this transaction predominantly involves the combination of complementary services that will lead to greater competition and benefit consumers.

An unredacted Stamped Highly Confidential copy of this submission is being hand delivered to your office. Additional copies of the unredacted submission are being delivered to the Commission staff under separate cover.

Please contact me at (202) 942-6608 or Maureen.Jeffreys@aporter.com if you have any questions. Thank you for your assistance.

Respectfully submitted,

Maureen R. Jeffreys

Maureen R. Jeffreys
Counsel for AT&T Inc.

Enclosure

Quantitative Analysis of an AT&T-DirecTV Merger: Additional Discussion Of Modeling Choices, Data, and Results

Steven T. Berry and Philip A. Haile*

September 22, 2014

1 Overview

On July 22, 2014, we presented the results of a merger simulation analysis providing an assessment of the likely effects of the AT&T-DirecTV merger on prices and consumer welfare (see Berry and Haile (2014b)). The broad conclusions of that analysis were that the merger would be beneficial to consumers. Although the conclusions were conveyed clearly, the time frame and format of the July meeting precluded adequate discussion of some key issues regarding the market, data, and modeling approach of our analysis. Here we provide supplementary discussion and analysis, building on that discussed in July (henceforth "BH").[1]

The merger simulation in BH uses standard modeling and simulation techniques from

*Berry is the James Burrows Moffatt Professor of Economics at Yale University. Haile is the Ford Foundation Professor of Economics at Yale University. Our comments are provided on behalf of AT&T.

[1]Since the presentation we discovered an error in the construction of some prices and also a coding error affecting the calculation of our GMM weight matrices and standard errors. Correcting these errors has no material effect on the results or conclusions of our analysis. In Berry and Haile (2014c) we provide a full discussion of the corrections and updated versions of all slides that displayed numbers affected by the corrections.

the academic literature. It combines a standard multiproduct oligopoly model of supply with a nested logit model of demand. The latter, an example of the general framework of Berry, Levinsohn, and Pakes (1995), has been widely used, avoids pitfalls of simpler multinomial logit models, and, as we explained in BH, is especially appropriate for studying this transaction. In our July 22 meeting there was discussion of how to further illuminate the role of our model's assumptions. Here we provide several additional analyses that address these issues, each of them indicating that the modeling approaches are appropriate and do not pre-judge the result.

We first review key features of the market that confirm that the model is appropriate to the facts of this industry. This includes a new descriptive "churn" analysis that illustrates the need to allow for consumer heterogeneity in tastes for distinct product classes—standalone broadband service, standalone video service, and combined "bundle" services. We also discuss the economic and practical motivations for the particular forms of consumer heterogeneity in our model.

We also demonstrate definitively that our modeling choices do not themselves imply any particular qualitative conclusion. Rather, the conclusion depends on the data. We demonstrate this by showing that if one applies our model to randomly generated data sets, one will sometimes obtain significant positive welfare effects and sometimes significant negative welfare effects. Thus, it is the actual data pattern in this industry that determines the qualitative conclusions of our analysis; the result is not "baked in" to the modeling approach.

In addition, we provide further sensitivity analysis demonstrating that our conclusions are robust to moderate changes in parameters. In particular, we demonstrate that our qualitative results are robust to restrictions on parameters that de-emphasize the degree of consumer heterogeneity in preferences.

Beyond these broad questions, we discuss several issues concerning data and modeling that could not be fully discussed in our meeting at the DOJ. This includes discussion of the introduction of additional sources of consumer heterogeneity and of the nature and

quality of the price indices. We also provide additional descriptive statistics on the data set used for our analysis, evaluate a hypothetical "de-linking" of prices for the merging parties' standalone products and synthetic bundle, and explore bootstrap confidence intervals for the predictions of the counterfactual simulations.

The additional discussion and analysis uniformly supports the modeling choices in BH and reinforces our conclusions. Even before considering any potential cost savings, we find that consumers would benefit from (or at a minimum be unharmed by) the merger. In particular, the AT&T-DTV bundle price will decline substantially, putting downward pricing pressure on cable service as well.[2] The benefits of these price reductions will accrue not only to current subscribers to these services, but also to customers who switch to these lower-priced products. As a result, welfare losses to purchasers of some standalone services will be more than offset by the welfare gains resulting from price reductions. This is an extraordinary situation in merger review, where harm to consumers is typically a given in the absence of significant cost synergies.

Here, the parties do expect the merger to result in cost synergies, including a significant reduction of video content costs. If we account for conservative estimates of these savings, limited to the purchase of video content for AT&T's video services, this leads to a prediction that the merger would create substantial economic benefit to consumers: between $940 million and $1.44 billion annually. That does not reflect additional cost efficiencies throughout the merged firm's line of services, for example savings on the combined firm's content costs for serving DTV as well as AT&T subscribers. Accounting for such additional savings would imply substantially larger net gains for consumers.

[2] As discussed by Katz (2014), the same forces that lead to lower prices are likely to lead to quality improvements. Our analysis does not account for these additional benefits or the added value consumers would obtain from purchasing the DTV video service and AT&T broadband service from an integrated provider.

1.1 Quantitative Merger Analysis

The BH study follows a method for prospective merger analysis that has become the standard in academic research. This method uses data on prices, quantities, and characteristics of consumer choice sets to estimate a demand system for the products under study and to estimate firms' marginal costs. With estimates of these fundamentals in hand, it is then straightforward to predict the changes in prices, quantities, and consumer welfare that would result when all firms (not just the merging parties) respond to the new incentives created by the merger.

In principle, the inputs (data and econometrics) required by this approach are not very different from those required for an analysis of upward pricing pressure (UPP).[3] However, the full merger simulation allows a quantitative assessment of the full effects of the merger rather than merely an assessment of local incentives. This difference is especially important here. Because AT&T offers multiple services, some of which are substitutes for DirecTV's service while others are complements, there are both upward and downward pricing pressures (see Katz (2014)). A full merger simulation can assess the net effects of these pressures on consumers.

1.2 Institutional Features and Modeling Choices

The model in BH is an example of the standard Berry, Levinsohn, and Pakes (1995) framework, accounting for endogenous prices, product-specific unobserved heterogeneity, consumer-level taste heterogeneity, and the supply-side incentives of multi-product oligopolists. As always, within this standard framework there remain a number of modeling choices that must be customized to the institutional features of the market and available data. Our modeling choices are driven by what we determine to be essential features of this market, balancing the abstract ideal of flexible modeling with the practical need for parsimony in analyzing any finite data set.

[3] In practice, however, UPP analysis is typically performed using much more limited data and much cruder demand estimates.

Video services and broadband services must be studied together. The merged firm will produce both video and broadband services, as do many competitors. For the cable and telco firms that offer video and broadband over the same wire, there is an obvious supply-side complementarity. This is reflected in the fact that these firms jointly market the products and offer discounts for the joint purchase of video and broadband. From a consumer's perspective, there are consumption synergies obtained from having both services and, conditional on having both services, obtaining them from a single provider. These include the ability to use video-on-demand services and the convenience of a single call to order, a single visit for installation, a single bill, and a single point of contact for service (see Guyardo (2014) and Katz (2014) for additional discussion).

Joint supply, bundle discounts, and consumption synergies lead many consumers to shop for video and broadband at the same time, something evidenced by the fact that single-product firms often partner with other providers in order to offer discounted "synthetic" bundles. While not as attractive to consumers as a fully integrated bundle from a single provider (i.e., a "true" bundle), these arrangements are an obvious attempt to offer something more attractive than standalone products in order to better compete for consumers seeking both services.

Although a substantial majority of households purchase both services, other households purchase only one. This is true despite the discounts offered for true and synthetic bundles. In addition, direct evidence on substitution patterns from our AMS survey reveals disproportionately heavy substitution (across time) within rather than across three classes of service: standalone video, standalone broadband, and bundles of both services. For example, when a consumer subscribing to a bundle changes one or more services, she is disproportionately likely (relative to market shares) to switch to another bundle.

The modeling choices in BH were driven by these key features of the marketplace. We model consumers' choices of video and broadband services together, but also allow consumers to be heterogeneous in their interest in each of the three classes of service just described. On the supply side, the model in BH incorporates the complex set of pricing incentives created

by the presence of multi-product firms, some of which produce complementary products. Importantly, this means that all pricing externalities are accounted for pre- and post-merger. For example, in both periods, the model accounts for the fact that part of the motivation for raising the price of one service may be the resulting gain in profit on another product. This means that both price discrimination incentives (including mixed bundling) and the "double-marginalization" problem currently faced by the merging parties (see Katz (2014)) are accounted for. The relative magnitudes of these effects are determined by free parameters that are fit to the data.

On the demand side, the model posits random coefficients on indicators for each of the three classes of service. The particular distributional assumption for these random coefficients leads to a nested logit model (see, e.g., Berry (1994)). Given the institutional facts described above, in our assessment this type of consumer heterogeneity must be incorporated in any plausible model of demand. One could imagine adding further sources of consumer heterogeneity (e.g., additional random coefficients) while still keeping the critical heterogeneity across these product groups. However, in practice the number of random coefficients is always limited by the available data.[4] In BH we present two versions of the nested logit model—one with a common nesting parameter across nests and one with three different nesting parameters. As discussed below, the latter appears to stretch the limits of the flexibility one can allow with the available demand-side data.

Below, we also provide two types of analysis aimed at evaluating the implications of our modeling choices and robustness of our qualitative conclusions. One demonstrates that different data sets will lead to different conclusions when analyzed through our model of supply and demand. In particular, we show that applying our model to randomly generated data sets sometimes leads to the conclusion that the merger is beneficial to consumers and sometimes to the conclusion that it is harmful. Thus the results produced by our merger analysis depend on the actual data. Our welfare conclusion is not "baked into" the model.

[4]In fact, the identification results in Berry and Haile (2014a) suggest that such limits may be required regardless of sample size.

The second analysis examines robustness of our conclusions to hypothetical bias in the estimated degree of consumer heterogeneity. We find that forcing the model's nesting parameters toward zero leaves the qualitative conclusions in BH unchanged. Indeed, these restrictions on the parameters generally lead to consumer welfare implications that are *more favorable* to the merger. Further, as we approach the limit of nest parameters that are zero (where the nested logit model collapses to the plain multinomial logit that implicitly underlies most UPP calculations) the implied markups are highly unreasonable and inconsistent with data from the merging parties. Thus, this additional analysis provides strong support for the modeling choices in BH and for the robustness of the qualitative conclusions.

Below we follow up on another topic touched on in the July 22 meeting and discuss the introduction of additional consumer heterogeneity. Introducing heterogeneity in the price coefficient to the demand model would have substantial costs, most importantly in eliminating our ability to use instrumental variables to address measurement error in the price data. Further, as discussed in BH (see slide 42c) random coefficients on *quality-adjusted* prices would imply unnatural substitution patterns. A practical concern is the fact that additional heterogeneity would add substantial computational burden. Finally, based on our experience with the more ambitious "three-nesting-parameter" model in BH, we believe that adding additional consumer level heterogeneity would demand too much of the available data, leading to results that are imprecise and non-robust.

1.3 Counterfactual Predictions

As discussed in BH (see also Katz (2014)), an unusual feature of this merger is the presence of complementarities that work against the usual pricing pressures that can result from a merger. As a consequence, even before consideration of merger efficiencies, the sign of the effect on consumer welfare is ambiguous from theory alone. The results in BH indicate that with no cost efficiencies the merger would still be beneficial (or at least neutral) for

consumers.[5] The first-order pricing pressure leading to this effect is the elimination of double marginalization in the pricing of the components of the AT&T-DirecTV synthetic bundle. BH (slides 93a–93c) provides evidence on the presence of this double-marginalization problem.

The elimination of the double-marginalization problem will be accomplished, post-merger, through the introduction of a new *jointly chosen* price for the bundle of AT&T broadband with DirecTV video service. This can be seen as a change involving two components. One is the de-linking of the synthetic bundle price from the prices of the standalone component services, accomplished by introducing a new price. The other is the full internalization of pricing externalities post-merger. Below we describe the results of a simulation, based on discussion in the July meeting, in which the first change (de-linking) is accomplished without merger.[6] This analysis reveals that with de-linked prices, the price of the AT&T-DTV synthetic bundle would rise, while the prices of standalone services fall. However, while purchasers of standalone products are helped by this de-linking, consumers overall are worse off. De-linking without merger (even if this were possible) is less favorable to consumers than the merger, since only the merger eliminates the double-marginalization problem.

BH includes simulations incorporating a narrowly defined set of merger-specific content cost savings, limited to AT&T's video service. With these cost savings, we estimate that the merger would yield a substantial net gain in consumer surplus of \$0.94 to \$1.44 per U.S. household per month. This aggregates to between \$940 million and \$1.44 billion in annual gains to U.S. consumers. These substantial gains arise from merger-induced incentives for price reductions, both from the merged firm and its competitors, including cable providers. If we were to further account for a standard 5% cost efficiency for the other products of the

[5] The three-nesting parameter model yields a net welfare effect that is positive but small. The one-nesting-parameter model yields a statistically and economically significant predicted gain in consumer surplus of \$0.67 per household per month.

[6] This simulation is an analytical exercise but not generally a feasible pricing strategy for the firms. This is because often (including in our simulation when we use the three-nesting-parameter model) the resulting price for the synthetic bundle will exceed the sum of the DTV video price and AT&T broadband price. In the simulation we can prevent consumers from assembling their own bundles at a lower price than that specified by the firms for the synthetic bundle. In the marketplace this would not be possible.

merged firm, the consumer welfare gains would be substantially larger.

1.4 Data

The key data for the BH merger analysis are market shares and prices. BH provided an extensive discussion of how market shares and prices (hedonic price indices) were constructed, as well as a robustness analysis focused on the market share data. Following up on discussions in the July 22 meeting, we provide additional information on the price indices below. Where it is possible for us to compare the indices to the actual quantity-weighted prices paid in each DMA®, we show that the indices do a good job capturing the actual quality-adjusted price variation.

2 Complements

An institutional feature essential to understanding this market is the presence of complementarities between the merging parties' products. Two goods are defined to be (gross) complements if an increase in the price of one good causes a reduction in demand for the other good. There are compelling reasons to believe that video and broadband services are complements generally, due to consumption synergies and consumer desire for video-on-demand and other services requiring two-way communication with a video provider. But AT&T broadband service and DirecTV video service would be complements in this market even in the absence of such synergies.

To see this, first consider an artificial world in which there are no true bundles and assume that consumers view broadband and video as independent goods: although tastes for the two goods may have arbitrary correlation, consumption of one good does not affect the desirability of the other good. In this world, AT&T broadband and DirecTV video would be independent goods and could be analyzed as separate markets.

Now introduce a cable bundle that is offered at a discount relative to the standalone cable broadband and video services. This alone results in complementarity between AT&T

broadband and DirecTV video. To see why, consider an increase in the price of AT&T broadband. Some consumers who had been purchasing AT&T broadband and DirecTV video will consider dropping AT&T broadband, and some of these will consider switching to cable broadband. Such a consumer might change only her broadband provider. But by switching *both* services to cable, the consumer gains the bundle price discount. Therefore, some fraction of the consumers will drop both AT&T broadband and DirecTV video and switch to the cable bundle. Thus, the cable price discount alone makes the two merging products complements.

Exactly the same analysis applies if there were no discount for the cable bundle, but consuming cable broadband and video together offers the consumer greater utility than the sum of the utilities for the standalone products. The sub-additive bundle pricing discussed above is just one way of obtaining super-additive utilities, and super-additive utilities lead to complements.

Similar logic applies if there is no cable discount and no cable synergy, but the consumer obtains a discount when consuming the synthetic bundle of AT&T broadband and DirecTV video. Now when the price of AT&T broadband rises, a consumer who drops AT&T broadband will lose the discount offered for combining this with DirecTV video. Thus, an increase in the AT&T broadband price causes a loss of some DirecTV video subscribers.[7]

In practice, of course, all three of these features are present: cable providers do offer bundle discounts; there is a price discount for the synthetic bundle; and consumers do benefit from the convenience of true bundles.[8] To deny that the parties' products are complements, therefore, would require arguing (implausibly) that there is strong substitution between standalone video and standlone broadband services—that the above reactions to an increase in the price of AT&T broadband would be more than offset by consumers switching from

[7]In all cases, a symmetric analysis shows that an increase in the price of DirecTV service will cause a reduction in demand for AT&T broadband.

[8]**[BEGIN AT&T HIGHLY CONFIDENTIAL INFORMATION]**[redacted] **[END AT&T HIGHLY CONFIDENTIAL INFORMATION]** for example, the two most cited reasons for purchasing a bundle are (1) discounted price and (2) use of a single bill.

standalone AT&T broadband to standalone DirecTV video.

Although a high level of such substitution seems implausible, our demand model does allow such substitution, relying on the data to reveal the extent to which consumers view broadband and video as substitutes. As is standard in the literature, our model allows idiosyncratic preferences for all products, which makes all products substitutes to some degree. By introducing additional consumer-level heterogeneity in tastes for standalone video, standalone broadband, and bundle products, we ensure that the model is flexible in the implied degree of substitution between these three classes of services.

3 Bundles and Standalone Services

Perhaps the most striking feature of this sector is the role of service bundles. According to our share estimates, [**BEGIN AT&T HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END AT&T HIGHLY CONFIDENTIAL INFORMATION**] of households in AT&T DMA®s purchase both broadband and video service. Among these, [**BEGIN AT&T HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END AT&T HIGHLY CONFIDENTIAL INFORMATION**] purchase a "true bundle," i.e., they purchase both services from the same provider—either a cable provider, AT&T, Verizon, or another telco provider. These bundles are featured prominently in these providers' advertising and web sites and account for [**BEGIN AT&T HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END AT&T HIGHLY CONFIDENTIAL INFORMATION**] of the providers' market share when the bundle is available. This is not surprising. True bundles are generally priced at a discount relative to the sum of the prices for the component standalone services. Further, consumers value the convenience of a true bundle, which offers a single bill, a single installation, and a single point of contact for customer service.

The importance of true bundles is also illustrated by the efforts of DBS providers to partner with internet service providers to offer "synthetic bundles" that can better compete

with true bundles. These synthetic bundles lack some of the benefits of a true bundle (they typically involve separate installations, separate sources of customer service, and in some cases separate bills—see Katz (2014) for additional discussion).[9] But for many households these synthetic bundles currently offer the only reasonably close substitute for the cable bundle.

Of course, not all consumers purchase or even desire to have both broadband and video services. Almost [**BEGIN AT&T HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END AT&T HIGHLY CONFIDENTIAL INFORMATION**] purchase neither service, while nearly [**BEGIN AT&T HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END AT&T HIGHLY CONFIDENTIAL INFORMATION**] purchase just one of the two. We estimate that [**BEGIN AT&T HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END AT&T HIGHLY CONFIDENTIAL INFORMATION**] purchase only video service while [**BEGIN AT&T HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END AT&T HIGHLY CONFIDENTIAL INFORMATION**] purchase only broadband. Reasons for purchasing only one service include weak taste for one service (e.g., elderly households unfamiliar with the internet) or availability of high quality over-the-air (OTA) video service.

3.1 Churn Data

One possible way to gauge the importance of the three product classes—standalone broadband, standalone video, and bundles—is to examine customer "churn" using responses to the AMS survey. That survey included a question asking [a] whether the consumer has the same video/broadband service now as one year ago and [b] if not, what was the prior-year service choice? This question allows us to look at a classic notion of "churn," which involves the observed pattern of transitions in product choices over time.

[9] Consumer surveys support the view that the synthetic bundle is less satisfactory than a true bundle: according to AT&T's 1Q13 *U-verse Inwards Research*, [**BEGIN AT&T HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END AT&T HIGHLY CONFIDENTIAL INFORMATION**]

The intuitive appeal of churn data is that consumers may, in some cases, transition between products that are "close" in the product space. When this is true, churn data provides "direct" data-based evidence on which products are close substitutes, without needing to estimate a full demand model. However, churn data must be interpreted very carefully, as different consumers are changing their choices for different reasons in different situations. For example, churn patterns for a subset of consumers leaving a given product will replicate price-substitution patterns if those consumers are moving away from the product due only to an exogenous change in its price, unrelated to changes in product quality, product availability, or other product prices. In addition, the change must be unrelated to changes in household attributes that affect preferences for different products.

However, there are many potential motives that can underlie observed customer churn which will imply patterns very different from the price substitution patterns of interest. For example new household formation causes consumers to transition from the "outside good" of no video/no broadband to some bundle. This does not suggest that the outside good and bundles are particularly close *price* substitutes for these consumers; rather it is the change in household circumstances that motivates the transition.

With this important caveat in mind, we turn to some churn analysis based on the AMS survey. We present results for the unweighted AMS survey sample. Recall that the AMS survey underweights respondents who do not have broadband access, so the results should be interpreted in that light.[10] For example, as compared to the general population the survey will find many fewer transitions to "no broadband" product choices.

Table 1 shows results for consumers who switch away from some bundle product (any combination of video plus broadband) and choose some new product. We will refer to these consumers as "bundle droppers" although many of these are simply switching from one bundle to another.

[10]Recall from BH that in constructing DMA®-level shares, we use estimated survey weights together with DMA®-level party, Nielsen, and copyright data on product choices. We do not have analogs for the latter data sources for the churn data and we do not want to rely solely on the estimated AMS weights. The unweighted churn data has a clear interpretation as the behavior of a very large group of consumers who chose to participate in the AMS survey.

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Indeed, in the AMS sample over [**BEGIN AT&T HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END AT&T HIGHLY CONFIDENTIAL INFORMATION**] of bundle droppers stay within the bundle (joint product) category. For comparison, in each DMA® we construct a benchmark "logit" share-based counterfactual. Specifically, the second row of the table shows a share-based diversion to each other product category, created by distributing the switchers to each other product choice in the DMA® in proportion to the shares of each other choice in the DMA®. The weighted average shares (across DMA®s) are then calculated using the number of bundle droppers in the DMA® as weights.[11]

The finding that [**BEGIN AT&T HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END AT&T HIGHLY CONFIDENTIAL INFORMATION**] percent of droppers transition to another bundle is consistent with our nested logit model, which allows for an estimated degree of bundle-to-bundle substitution that is higher than that implied by a multinomial logit model. As shown in Table 1, the DMA®-level "logit" benchmark would imply bundle-to-bundle transitions of only [**BEGIN AT&T HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END AT&T HIGHLY CONFIDENTIAL INFORMA-**

[11] For this table and the next, we use the base year (prior year) AMS shares for the calculation; this seems preferable to switching the benchmark year across tables. The prior year unweighted AMS shares also have the advantage of less severe selection on broadband usage. Note that the benchmark shares vary slightly across the tables because the DMA® weights vary with the number of switchers in the table.

TION] .[12]

We also note the low degree of substitution in Table 1 from bundles to standalone video and standalone broadband. The latter transition is the act of "cord cutting," i.e., dropping video while keeping broadband; active cord-cutters are, of course, only a subset of the consumers making the "broadband and no video" choice. In Table 1 it appears that, once purchasing a bundle, very few households leave the bundle category: there are extremely low transition rates from bundles to any standalone product or to the outside good.

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Table 2 shows the transitions from non-bundle product categories *to* bundles. A striking finding here is the large percentage of transition to bundles that come from the "outside good" (no video, no broadband). One hypothesis is that this partly reflects changes in households' conditions, for example younger households moving from apartment buildings (or college dormitories) that provide broadband and video to owner-occupied houses that do not.

[12]The logit benchmark is included for reference only. Note that we have to use DMA® level shares to create the benchmark, as AMS sample sizes become very small at the sub-DMA® choice-set level. The lack of choice-set level shares will exaggerate the likelihood of certain transitions relative to a logit (share-based) baseline that accounts for sub-DMA product availability. For example, suppose in some DMA® certain neighborhoods have access to AT&T video and other (non-overlapping) neighborhoods have access to "other telco" video. The DMA®-level logit shares will suggest that some portion of switchers away from AT&T video should switch to other telco video, whereas in truth no one can possibly make that switch. Thus, the [**BEGIN AT&T HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END AT&T HIGHLY CONFIDENTIAL INFORMATION**] baseline bundle-to-bundle share overstates the logit baseline. This only reinforces the conclusions we draw from Table 1.

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This age-based hypothesis about "bundle adders" is confirmed by Figures 1 and 2. Figure 1 shows that age distribution of the bundle droppers in Table 1 is very similar to the overall age distribution of the AMS sample. However, as shown in Figure 2, bundle adders are disproportionately young, as compared to the overall sample. Moreover, this is particularly true of bundle adders coming from the outside good.[13] A similar age analysis of those transitioning from "no broadband plus some video" to a bundle product shows that

[13] We do not display transitions to the outside good in Figure 1 because there is only one such transition among all bundle droppers.

these consumers are older than the sample average. They may represent long-time video subscribers who have recently become more interested in the internet.

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These patterns suggest that the churn patterns seen for bundle adders is significantly driven by factors other than price and, therefore, less indicative of true price-driven substitution patterns.

Tables 3 and 4 show the same type of churn analysis for standalone broadband products. Standalone broadband droppers and adders stay quite disproportionately within the standalone broadband product group. There is also, as with bundled goods, a noticeable

movement from the outside good to broadband only products when we examine adders of standalone broadband.

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Tables 5 and 6 show remarkably similar churn results for standalone video products. Standalone video droppers and adders stay disproportionately within the standalone video product class and, once again, the adders are drawn disproportionately from the outside good.

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Subject to all the usual strong caveats of churn analysis, the churn data are strongly consistent with our definitions of product groups and with our treatment of these groups as a first-order feature of this sector. Churn transitions are disproportionately within our nests, although there are still noticeable transitions across nests. This is consistent with the qualitative implications of our moderately high nesting parameters. In addition to within-nest transitions, there are disproportionate transitions from the outside good to each of the product nests, as may be consistent with natural household transitions associated with age rather than responses to price changes.

3.2 Bundles and Idiosyncratic Shocks in the Nested Logit

The facts discussed above must be respected by any model used to study this sector. Our choice of the nested logit model—with distinct nests for the outside good, standalone video, standalone broadband, and bundles—provides a parsimonious specification allowing consumer heterogeneity in the dimensions that the institutional details and available direct evidence on substitution patters suggest are most important. Regardless of the need for parsimony, this type of heterogeneity must be in any plausible model of this sector.

The remaining questions are then (a) what functional form and distributional assumptions does one make regarding this heterogeneity (e.g., normal random coefficients on these product classes vs. the non-normal random coefficients of the nested logit) and (b) what additional sources of heterogeneity can be incorporated given the data available. This does not mean that other sources of heterogeneity are absent in the marketplace or that allowing for these would be undesirable in studying ideal data. Rather, in practice one always makes modeling choices to deal with data that are more limited than an abstract ideal, and good modeling choices are driven by the first-order features of the marketplace.

One feature of the nested logit model—indeed, of almost all standard models of discrete choice—is the presence of idiosyncratic tastes for each product. Here this includes an idiosyncratic taste shock for each bundle that is not equal to the sum of the idiosyncratic tastes for the broadband and video components of the bundle. Is it reasonable to have idiosyncratic taste shocks for the product bundles? Here both practical considerations and economic considerations are relevant, and both lead to the same conclusion.

From an economic standpoint, these idiosyncratic shocks have their usual interpretation as a way to capture idiosyncratic tastes, idiosyncratic shocks to information (e.g. exposure to advertising and word of mouth recommendations), and optimization error. These features are relevant here, just as in other markets. Idiosyncratic valuations for bundles seem particularly important. In the case of true and synthetic bundles, these combinations of services are advertised and promoted as distinct products with distinct prices, features, and contract terms. It is likely that different consumers understand and value these features and

terms in a heterogeneous way.

A second economic argument is the fact that models without such idiosyncratic shocks lead to very strong *a priori* restrictions on consumer substitution patterns. In particular, a model without such shocks imposes, *a priori,* that particular pairs of products will feature zero cross-price elasticities.[14] This is a particularly strong *a priori* restriction on substitution patterns and, therefore, contrary to the goal of letting the data determine the substitution patterns that drive the merger analysis.

It is true that the presence of idiosyncratic valuations for all the products (including the bundles) leads each of the product combinations to be imperfect substitutes for all of the other product combinations. Depending on the product shares, this in turn implies some degree of complementarity between some of the merging parties' products. This minimal degree of complementarity is not of concern to us because, as we have already discussed, these products surely do exhibit some degree of complementarity. Furthermore, the estimates obtained by fitting the model to the data imply much more complementarity than the minimum. Whatever concern one might have if the estimated parameters were pushing up against the minimum degree of complementarity allowed by the model, this is not the case here.

Therefore, based on *a priori* economic reasoning and on the estimates obtained, we see no economic justification for omitting the traditional idiosyncratic shocks. Further, doing so would lead to substantial computational challenges (see Berry and Pakes (2007)). This is an additional reason that empirical models without idiosyncratic shocks for all choices are virtually never used in practice.

A remaining question is whether there should be additional sources of heterogeneity in the demand model. We turn to this topic in the next section.

[14]See, for example, Caplin and Nalebuff (1991) and Berry and Pakes (2007).

4 Additional Sources of Demand Heterogeneity?

In the July 22 meeting, two additional sources of demand heterogeneity were discussed. One is price-coefficient heterogeneity, which represents cross-consumer differences in the marginal value of wealth. The second is heterogeneity in tastes for specific products, using groups of products that differ from our nesting structure. Regarding the latter, one suggested idea is an idiosyncratic preference for specific broadband or video components (e.g., idiosyncratic tastes for cable broadband service vs. telco broadband service, independent of the video provider). Another version would be tastes for particular brands (e.g., a taste for cable products over telco products generally.)

Each of these would add layers of possibly realistic substitution patterns. However, a number of issues have kept us from introducing further heterogeneity into our model. These include

1. concern that such model complexity would push the available data past its limits
2. measurement error in prices
3. computational intensity.

A researcher is always limited in the empirical approach by the information contained in the data, and there will always be more complex models that cannot in practice be implemented. It is important, therefore, to begin with the most empirically relevant sources of heterogeneity and then determine whether it is feasible to add additional complexity. Parameters governing additional sources of consumer heterogeneity have to be estimated from the observed variation in the data. A general feature of demand analysis is that the data available may not be rich enough to estimate a more complicated model, even if the more complicated model were in some ways desirable. Estimating a model that is too richly specified for the available variation in the data leads to estimates that are imprecise and non-robust.

We have found that the "three-nesting-parameter" nested logit is already somewhat sensitive to changes in the demand specification, as well as to changes in data measurement (see BH). This can be seen in the (corrected) standard error estimates as well: important parameters, including the coefficient on price and the nesting parameters have large confidence intervals in the three-nesting-parameter model. This sensitivity is the reason we also emphasized the "one-nesting-parameter" model, which is less flexible but asks less of the data. We believe strongly that it would be a mistake to ignore the first-order heterogeneity in preferences for broadband, video, and bundles. Adding additional heterogeneity would be desirable only to the degree that the data can support such efforts, and we see that in our richest specifications we are already pushing the data to the limits of what one should be comfortable with in demand analysis.

There is a further issue specific to the issue of "price coefficient" heterogeneity. The available data, the large number of service tiers offered, and the large observed quality differences in products across markets leads us to utilize quality-adjusted price indices. The use of price indices is common practice but always introduces a degree of measurement error. As noted in BH (slide 39), use of a single linear price coefficient (combined with instrumental variable methods) allows us to control for classical measurement error in prices. This is a significant advantage of the model without price coefficient heterogeneity.

An additional concern is that introducing further sources of heterogeneity would require us to adopt computational methods for approximating the integral defining the expected market shares, as in Berry, Levinsohn, and Pakes (1995). These methods add substantial computational time to estimation of even one empirical specification. Computational time then limits robustness analysis. Given these computational demands, it is an open question as to whether models of such complexity are appropriate for a regulatory proceeding.

Finally, we want to caution against naive speculation regarding the likely effects of introducing (or excluding) certain sources of heterogeneity. It can be tempting to try to guess how the introduction of additional modeled heterogeneity would change the predictions of the merger analysis using the logic of comparative statics. However, it is extremely difficult

to correctly predict how a modeling change will affect the counterfactual results since that effect is intermediated by estimation of the model using the actual data. Re-estimating the model with additional heterogeneity would cause all the parameters of the model to change. For example, adding heterogeneity to a model while holding all other parameters fixed might lead to a predictable change, but is also almost certain to imply price elasticities and markups that are no longer consistent with the data. Re-estimating the entire model, however, will change the coefficient on price to offset other changes implied by the new model. This will, in turn, change all of the counterfactual results in ways that are difficult to predict.

5 Sensitivity Analysis

At the July 22 meeting there was discussion of several issues relating to the sensitivity of our conclusions to modeling choices and to the values of some model parameters. One important issue was whether our nested logit model might restrict the set of qualitative results that the merger simulation could produce—i.e., whether important conclusions might be inadvertently "baked in" through the model specification. Below we show definitively that this is not the case.

We were also encouraged to explore a particular type of sensitivity analysis, maintaining the nested logit model but forcing the nesting parameters to be smaller than those obtained by fitting the model to the data. Motivating this suggestion was a pair of conjectures by some in attendance: (a) that imperfections in instrumental variables could lead to nesting parameter estimates with upward bias and (b) that such upward bias could produce results that were misleading. We report below the results of additional analysis examining this question, showing that our conclusions are highly robust and that any bias in the conjectured direction would generally imply even larger benefits to consumers from the merger.

A third, and closely related, issue was what results would be obtained using a simple multinomial logit model rather than the nested logit model. Despite the well known short-

comings of the multinomial logit model, it is a natural starting point,[15] and below we discuss the results obtained from that model.

5.1 Is the Result Baked In?

We first address the question of whether the assumptions of our nested logit model might somehow impose, *a priori*, a result that the merger is beneficial to consumers. We demonstrate via a simple random-data exercise that depending on what is observed in the data the sign of the predicted welfare change resulting from the merger could be positive or negative. Thus, the assumptions of our nested logit model do not impose any particular qualitative result.

We begin by specifying a grid of values for the nesting parameters (here we set all three nesting parameters to the same value) and for the coefficient on price. For the nesting parameter, we consider values 0.3, 0.4, 0.5, 0.6, and 0.7; for the price coefficient, we consider 0.001, 0.051, 0.101, 0.151, and 0.201. This yields 25 combinations of parameter values to consider. We then generate random normal draws for the mean gross utility (gross of price) for each product. We do this three times, using seed values of 1,12, and 123.[16] This yields 75 different "treatments." For each treatment, we use the pre-merger model of supply to generate prices, using the marginal costs we estimated from the real data using our one-nesting-parameter model. We then use the demand model to calculate the implied market shares and consumer surplus. The final step of our exercise is, for each treatment, to use the model to calculate the post-merger equilibrium and consumer surplus.

This exercise can be interpreted as performing our merger analysis on randomly generated data sets, using our demand and supply model as the assumed data generating process.[17] The exercise says nothing about the AT&T-DTV merger itself, since the patterns found in the randomly generated data need not bear any relation to the patterns in the actual

[15] It is also the model typically assumed implicitly when calculating diversion ratios directly from market shares in order to calculate measures of upward pricing pressure.

[16] The same three vectors of random draws are used for each of the 25 combinations of parameters.

[17] We do not actually estimate the model parameters and marginal costs here, since we know them.

market. However, the exercise does provide a sample of the results one can obtain within the modeling framework we use to study the merger.

Table 7: Summary Statistics:
Predicted Effects of the Merger on Consumer Surplus
With Randomly Generated Data

	Predicted Change in Consumer Surplus
mean	-0.244
standard deviation	0.678
minimum	-2.072
25th percentile	-0.116
median	0.000
75th percentile	0.051
maximum	0.428

Predicted consumer surplus changes are in dollars per household per month.

The results are summarized in Table 7. The mean predicted welfare effect is -$0.24 and the adverse predicted effects are as large as -$2.07. The median across all 75 treatments is zero. Clearly the nested logit model can produce negative predicted welfare effects, but this depends on the data. Depending on the actual prices and quantities and on the model parameter values implied by fitting the model to the data, the model could predict significant positive or negative welfare effects from the merger. However, when the model is fit to the actual data, the simulation results uniformly show an absence of harm to consumers, and in many cases substantial net gains.

5.2 Robustness to Hypothetical Bias in Estimated Nesting Parameters

We next consider the "robustness to bias" issue discussed in the July 22 meeting: what are the implications of nesting parameters that are somewhat lower than our estimates (as would be relevant if somehow the estimation procedure generated nesting parameters that

were biased upwards). Our analysis shows that, contrary to the July 22 conjecture, such lower parameter values do not change the qualitative conclusions of our analysis.

For this analysis, we re-estimated the two nested logit models in BH, constraining the nesting parameters to be smaller than the estimates obtained from the data. This re-estimation allows the other model parameters to adjust as best they can to fit the data within the confines of the constrained model.

Table 8: Results with Constrained Nesting Parameters
One Nesting Parameter Model

scaling factor applied	implied ψ	estimated $\widehat{\alpha}$	predicted change in consumer surplus
100%	0.6117	0.0180	0.67
95%	0.5812	0.0169	0.77
90%	0.5506	0.0159	0.89
85%	0.5200	0.0148	1.01
80%	0.4894	0.0138	1.15
75%	0.4588	0.0127	1.31
70%	0.4282	0.0117	1.49
65%	0.3976	0.0106	1.70
60%	0.3670	0.0096	1.95
55%	0.3365	0.0085	2.25
50%	0.3059	0.0075	2.25
45%	0.2753	0.0064	3.13
40%	0.2447	0.0054	3.81
35%	0.2141	0.0044	4.80
30%	0.1835	0.0033	6.39
25%	0.1529	0.0023	9.43
20%	0.1223	0.0012	17.59
15%	0.0918	0.0002	115.28

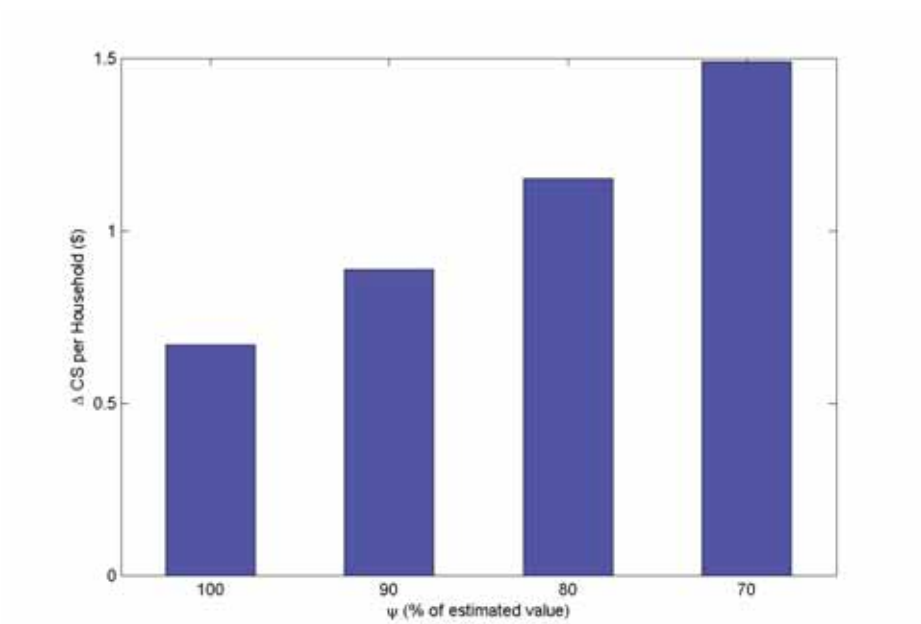
Table 8 shows the results for the one-nesting-parameter model. We scaled down the estimated nesting parameter ψ, multiplying by factors moving in 5% increments from 100% to 15%. The table shows the implied (constrained) value of ψ, the estimated price coefficient, and the predicted change in consumer surplus resulting from the merger. In every case the predicted change in consumer surplus is positive. Further, as the nesting parameter is shrunk toward zero, the predicted welfare gains from the merger increase monotonically. Of course, the price coefficient required to fit the variation in the data adjusts to the constraints on ψ,

and for very small ψ the estimated price coefficient is vanishingly small, implying markups wildly larger than those in the data obtained from the parties. For scaling factors close to zero, the required $\hat{\alpha}$ is so small that the counterfactual simulation could not even be performed due to the extremely small price coefficients required to fit the model to the data.

Of course, the plain multinomial logit model is obtained from a scaling factor of zero; in that case the model yields a price coefficient with the wrong sign. This finding is a strong rejection of the multinomial logit model.

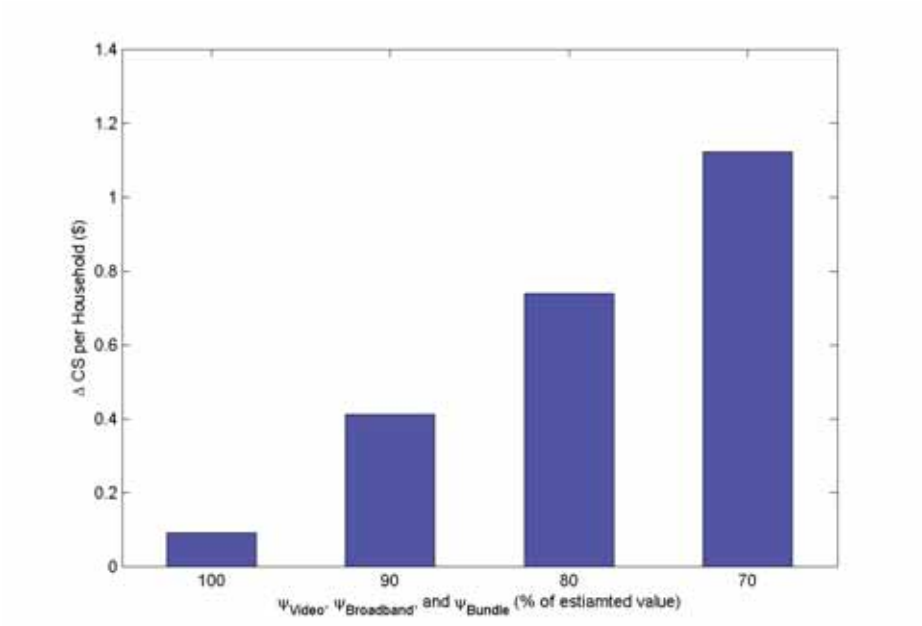
These results strongly support the robustness of our qualitative conclusions. In fact, constraining the nesting parameters toward zero only *enhances* the estimated consumer gains from the merger. This is illustrated in Figure 3 below, which summarizes the predicted welfare gains under nesting parameters between 70% and 100% of the value estimated in our 1-nesting-parameter specification.

Figure 3: Predicted Welfare Effects w/Constrained Nesting Parameters
One Nesting Parameter Model



We considered a similar exercise using the three-nesting-parameter model. This is a

Figure 4: Predicted Welfare Effects w/Constrained Nesting Parameters
Three Nesting Parameters Model

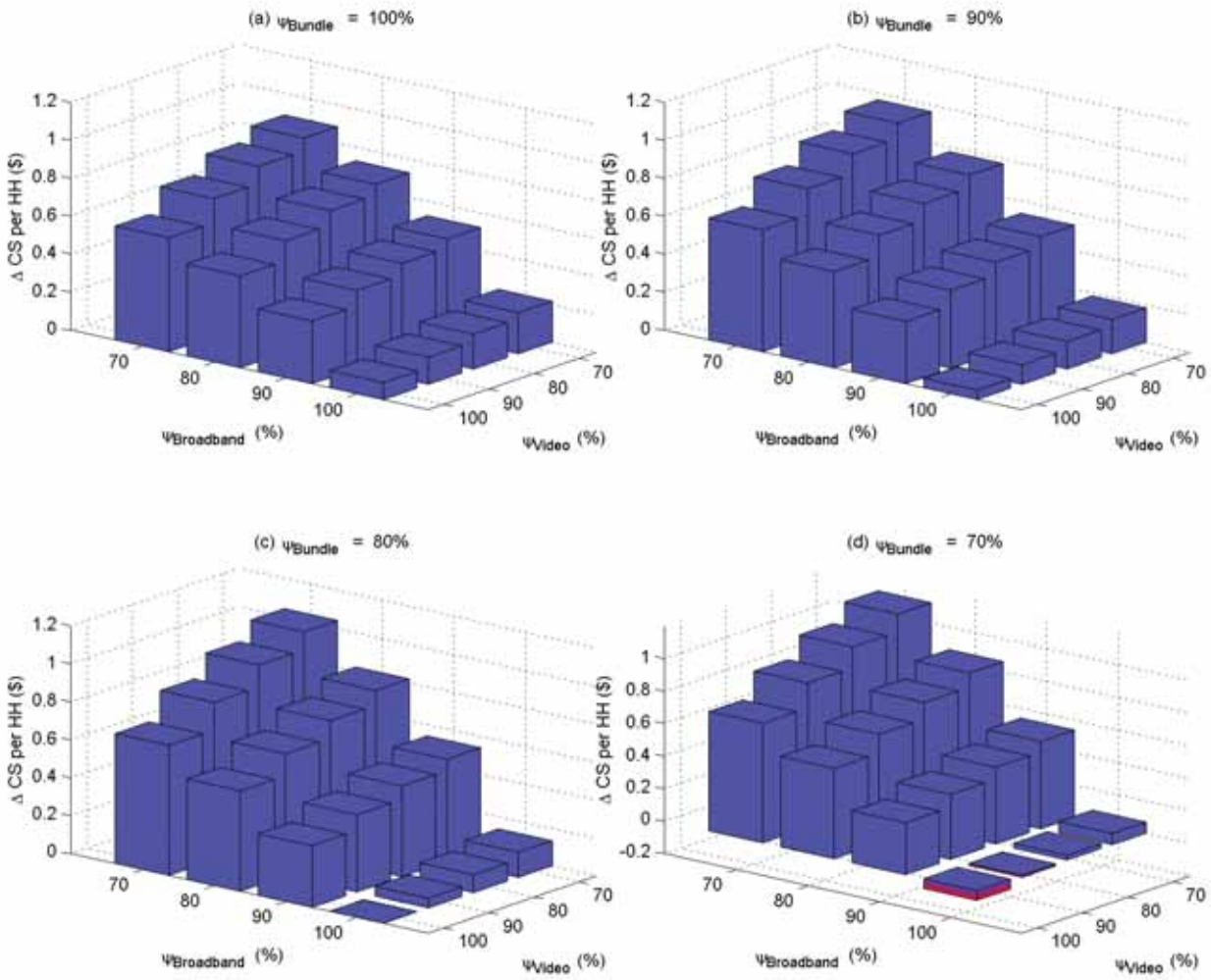


more extensive exercise since there are many combinations of nesting parameters to consider. Figures 4 and 5 show what happens when the three nesting parameters take on values between 70% and 100% of the values we estimated.[18] In Figure 4 we illustrate the predicted effect on average consumer surplus when all three nesting parameters are shrunk in lock-step. The figure shows that this type of reduction in nesting parameters would imply substantially larger estimated welfare gains than those from our base estimates.

Figure 5 then considers all 64 possible combinations of nesting parameters in the 70% to 100% range. Of these, all but two lead to positive predicted gains in monthly per-capita consumer surplus. For the two leading to predicted welfare losses, the point estimates are losses of 6 cents and 1 cent—values of no economic or statistical significance.

[18]Results follow the same pattern with smaller values of the scaling factor. The only exception is when the broadband nesting parameter is held at 100% of its estimated value while the other two nesting parameters are shrunk towards zero. In that case, when the bundle nesting parameter is sufficiently small the estimated welfare effect is sometimes negative. However, for those parameter values the implied markups are unreasonably large; [**BEGIN DIRECTV HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END DIRECTV HIGHLY CONFIDENTIAL INFORMATION**] This strongly rejects these extreme specifications.

Figure 5: Predicted Welfare Effects w/Constrained Nesting Parameters
Three Nesting Parameter Model



5.3 Discussion

The analysis above provides uniformly strong support for the validity and robustness of the qualitative conclusions of our analysis. There is no sense in which consumer gains are implied by our modeling choices. There are (counterfactual) data sets that could have led to parameter estimates that implied significant welfare losses from the merger prior to consideration of efficiencies. However, the actual data do not do this. When the model parameters are fit to the actual data, there is no evidence of harm to consumers; when cost savings are considered, the model predicts substantial economic benefits to consumers—benefits that are also statistically significant in the one-nesting-parameter model. Furthermore, these results are highly robust to hypothetical upward bias in our estimates of the nesting parameters. Indeed, constraining the estimated parameters in a fashion consistent with biases conjectured by some at the July meeting leads almost uniformly to the conclusion that the merger is even more favorable to consumers.

6 Supply Model: Multi-Product Pricing

Both pre- and post-merger, firms in our model face the usual incentives involved with multi-product pricing. These include the effect that changing one product price has on the prices of other jointly owned products. These incentives are discussed, sometimes in a highly stylized way, in the applied theory literatures on multi-product oligopoly and mixed-bundle pricing. However, they are fully incorporated in the standard empirical models of multiproduct oligopolists, such as our model of supply. As emphasized in the BH presentation, the merger further introduces a new price (the true bundle price) that did not exist before the merger. Incorporating this in the standard model is straightforward. All these incentives jointly influence the difference between the pre- and post-merger equilibrium.

The results do show that a pre-merger double marginalization (or joint-product pricing) problem provides an important incentive for the merger. Our results in BH slides 93a-c show that, starting from the pre-merger equilibrium and holding all other prices fixed, an increase

in the size of the synthetic bundle discount drives up joint profit in all or almost all DMA®s. The necessary increase is substantial— [**BEGIN AT&T AND DIRECTV HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END AT&T AND DIRECTV HIGHLY CONFIDENTIAL INFORMATION**]. As our slides note "Although this calculation demonstrates the presence of a double-marginalization problem, it is a limited exercise, looking only at local incentives holding all other prices fixed. Prediction of actual post-merger changes in (all) prices is addressed by the full merger simulation."

In our July 22 discussion it was suggested that we consider a counterfactual analysis aimed at separating two roles played by the pre-merger component prices. Pre-merger, one role for AT&T's broadband price is to set part of the price of the AT&T-DTV synthetic bundle; another is to set the price of AT&T broadband sold as a standalone product. The DirecTV video price plays two analogous roles. The merger would "de-link" these two roles, as the merged firm will set a new separate price for the new integrated AT&T-DTV bundle.

The suggested counterfactual is aimed at isolating the effect of this de-linking of prices. A concern expressed at the meeting was that the pre-merger pricing arrangement might be holding down the AT&T broadband price due to an incentive to create a low price for the AT&T-DTV synthetic bundle. If this were the case, the "de-linking" of prices under the merger might create a force tending to drive up the prices of the individual components.[19]

In the suggested counterfactual simulation, the first-order conditions reflect the pre-merger ownership of products, but each firm (AT&T and DirecTV) is permitted to set a price for its part of the synthetic bundle which is not tied in any way to the price of the corresponding standalone service. In the hypothetical simulation, AT&T sets a price for "broadband with DTV" and a different price for "broadband without DTV," while DirecTV sets two prices for service with and without AT&T broadband. In this hypothetical setting,

[19] In our merger simulations, which account for the incentives from de-linking, incentives resulting from elimination of double marginalization, and the equilibrium responses of all firms in the industry, the AT&T broadband price goes up in the one-nesting-parameter model but goes down in the three-nesting-parameter model.

there is no [**BEGIN AT&T AND DIRECTV HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END AT&T AND DIRECTV HIGHLY CONFIDENTIAL INFORMATION**]. Note that in order to separate the effects of de-linking from the other effects of the merger, the firms in the simulation are not merged and so set prices without regard to the profits of the other firm.

This is an unrealistic and purely illustrative arrangement since in practice the un-merged firms could not prevent consumers from combining the two components into a "do it yourself" bundle (whereas in the simulation the firms are allowed to prevent this.) The question we were encouraged to examine is whether the prices for standalone AT&T broadband and standalone DirecTV rise or fall.

A summary of results from this simulation is given in Table 9. The first row gives the simulated change in the standalone AT&T broadband price (the simulated hypothetical price of AT&T broadband purchased without DirecTV video minus the actual price of AT&T broadband). The second row gives the simulated change in the standalone DirecTV video price. The third row gives the simulated change in the price of the AT&T-DTV synthetic bundle (accounting for the [**BEGIN AT&T AND DIRECTV HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END AT&T AND DIRECTV HIGHLY CONFIDENTIAL INFORMATION**] pre-merger). Net changes in consumer surplus relative to the pre-merger equilibrium are shown at the bottom.

Table 9: De-Linking Standalone and Synthetic Bundle Prices, Without A Merger

	1-nesting-param model	**3-nesting-param model**
	Counterfactual Price Changes	
Standalone AT&T BB	-$0.71	-$3.42
Standalone DTV	-$0.24	-$2.07
Synthetic Bundle	$1.76	$20.28
	Counterfactual Change in Consumer Surplus	
	-$0.02	-$0.38

The results show that in the counterfactual scenario the two firms would *reduce*, not raise, the prices of their standalone services. In the one-nesting-parameter model the two new prices whose sum defines the price of the ATT-DTV synthetic bundle are lower than the existing standalone prices, but not by enough to offset the loss of the [**BEGIN AT&T AND DIRECTV HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END AT&T AND DIRECTV HIGHLY CONFIDENTIAL INFORMATION**]. The simulated price change for the synthetic bundle is therefore slightly positive. In the 3-nesting parameter model, the new de-linked synthetic bundle prices are significantly higher than actual prices, leading to an increase in the synthetic bundle price of more than $20. As noted, this result is unrealistic as in reality AT&T and DTV could not prevent consumers from building their own bundles at lower cost through separate purchases of the two standalone services.

In this counterfactual scenario, the increase in the price of the synthetic bundle arises through the full set of counterfactual equilibrium incentives. In the three-nesting-parameter case, it may be viewed as consistent with incentives for AT&T to divert bundle consumers from the synthetic bundle to its own integrated bundle; with the hypothetical de-linked prices this can be done without creating losses on any other products. But with linked prices, driving up the price of the synthetic bundle requires AT&T to raise the price of its standalone broadband service as well, resulting in substantial losses of broadband subscribers to other providers.

Taken together, the results in this section indicate that the [**BEGIN AT&T AND DIRECTV HIGHLY CONFIDENTIAL INFORMATION**] [redacted] [**END AT&T AND DIRECTV HIGHLY CONFIDENTIAL INFORMATION**] [1] does not solve the double-marginalization problem, but [2] reduces price of the synthetic bundle below what it would be if the firms did not negotiate a contract price and instead firms set separate component prices for the synthetic bundle. These results are consistent with the analysis in Katz (2014) of the pre- and post-merger pricing incentives for the combination of AT&T broadband with DTV video. Further, the results in table indicate that the cur-

rent AT&T broadband price is not being "held down" by a desire to attract users to the AT&T-DTV bundle. Rather, in both specifications the de-linking of prices benefits consumers purchasing standalone services while (in the absence of a merger) harming consumers purchasing the synthetic bundle.

7 Price Indices

The calculation of price indices for goods whose quality varies over time and space is a classic and difficult problem in economics. We follow the traditional price index literature, at all times guided by the principle that we ultimately want the best possible estimates of the demand model. Because we include a full set of product dummies in the utility specification, we focus on obtaining price indices that will do a good job of capturing the within-product variation of prices across DMA®s. Our demand analysis does not make any use of the *cross-DMA®* average level of product prices, but does exploit cross-DMA® differences in prices and also makes use of DMA®-product differences-in-differences for prices.

The linear specification for prices in the utility function allows the product dummies to fully control for average price levels and also (given the instrumental variables strategy) to control for "classical" measurement error (BH slides 37-39).

Recall that we cannot use a traditional "fixed weight price index" across a defined set of plans because we do not have any data on the quantities sold of non-party products. Further, we do not have any sensible list of fixed "products" that would apply across all firms. Different firms define tiers of products in very different ways, including (for video) the number of channels and what kinds of premium channels are bundled into a product. Broadband is if anything even more difficult, as often only a small subset of broadband speeds are available from a given provider, and there is no standard speed that is offered by each provider in each DMA® in which they operate.

Nonetheless, we can measure the quantities sold of relatively well-defined plans for the merging parties. Table 10 reports the correlation of our price indices with fixed-weight

indices of party prices, where the weights are national shares of the various party products. We see that our price indices are highly correlated with the fixed-weight AT&T price indices. The correlation with DTV price variation is positive, but lower than with the AT&T prices. The reason for the lower correlation of our DTV price indices may be the lower actual cross-DMA® variation in DTV prices. For DTV, both the actual prices and our index have very little variation across DMA®s. Because DTV uses national pricing, a reasonable approach would have been to use a DTV price with no variation across markets in our demand estimation. However, there clearly is some minimal cross-DMA® variation in DTV prices and our price index picks up some of this, allowing us to better capture the actual choice sets faced by consumers.

Table 10 includes a column showing the AT&T prices used to "re-center" our price indices. However, recall from BH (e.g., slide 37) that the prices used for re-centering have no meaningful effect on the results—re-centering is done *only* for the descriptive purpose of displaying "prices" (price indices). In the estimation, the coefficients on a full set of product fixed-effects adjust to entirely offsets any change in the prices used for re-centering. The re-centering also differences out of the calculation of price *changes* in the merger simulation. The only calculations affected by the choice of re-centering are the *level* of marginal costs and the *percentage change* in price. Therefore, in the context of this analysis, one should prefer the use of prices change in levels rather than percentages.

The fixed-weight price index of the actual AT&T and DTV prices is, itself, somewhat arbitrary as there is no "ideal price index" that we can measure prior to the demand analysis. However, the generally strong positive correlation of our index with a second sensible index for the merging parties' prices is evidence that our index is capturing actual variation in prices.

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7.1 Background on Hedonics

For purposes of demand estimation, prices p_{jkm} are constructed as standard hedonic price indices. Hedonic price indices provide a way of comparing quality-adjusted prices. They are used here to create a single price for each DMA® and product. This is necessary because each provider typically offers a range of tiers even within a given product class—e.g., multiple tiers of video-only service. An ideal approach would be to estimate a demand system where each tier of service is a different choice. However, this would require market shares at the tier level. We have access to such data for AT&T and DTV but not for any other providers, and any attempt to construct such shares would require substantially larger sample sizes than those available from any known source. Thus, we aggregate tiers to the coarser matrix of products discussed throughout BH. This aggregation over tiers follows standard practice in the literature on demand estimation (see, e.g., Berry, Levinsohn, and Pakes (1995), Nevo (2001), Goolsbee and Petrin (2004)). However, rather than using a representative product's price as a proxy for the price of the aggregated product,[20]

[20]Berry, Levinsohn, and Pakes (1995) combine trim levels of different car models, using the list price of the base model as the product's price. Goolsbee and Petrin (2004) take a similar approach, considering two tiers of video service from each provider type and using the price of a representative product. Nevo (2001) combines different package sizes for a given breakfast cereal as a single product, using the average price per

we use advertised prices across multiple tiers to create a hedonic price index that captures quality-adjusted price differences across products and DMA®s.

We here provide a very brief discussion of the connection between our hedonic price index and the classic literature on this topic. Key early references include Court (1939) and Griliches (1961). Griliches (1961) discussed the problem of creating a price index for a good with changing characteristics. While the classic setting involves measurement of quality adjusted price changes over *time*, changes across firms and space (here, DMA®s) are completely analogous.

Using his notation, Griliches proposes a simple hedonic price regression of the form

$$ln(p)_{jt} = \alpha_t + x_{jt}\alpha + u_{jt} \tag{1}$$

where p_{jt} is price of good j at time (place) t and the vector x_{jt} contains associated product characteristics. Griliches proposes a simple unweighted regression of products offered. The estimated coefficients α_t on the time dummies then serve as price indices, reflecting the change in the average price level across time, "corrected for" associated changes in characteristics x_{jt}. Although some of the hedonics literature attempts to give the regression equation a structural interpretation, this is not generally applicable in imperfectly competitive markets. Thus, the interpretation of α is as a purely descriptive coefficient, a point emphasized, e.g., by Pakes (2003).

This approach to construction of hedonic price indices has been widely used and is sometimes called the "time dummy hedonic price index" approach (Diewert, Heravi, and Silver (2009)). Various alterations of the functional form in (1) have been explored, including linear and log-log specifications. One variation of particular interest adds flexibility by letting the "slope" parameters differ by time period (see Diewert, Heravi, and Silver (2009) for discussion and references). This approach, sometimes called the "hedonic imputation" approach, can be seen as a special case of the general approach proposed by Pakes (2003), who proposed a regression of the form

$$p_{jt} = h^t(x_{jt}) + \epsilon_{jt},$$

where $h^t(\cdot)$ is a flexible functional form that is allowed to change over time. He considers the

serving as that product's price. This is a kind of hedonic price index.

predicted change in price (from period $(t-1)$ to t) of the period $(t-1)$ goods. That is, for each period $(t-1)$ good he considers

$$h^t(x_{j(t-1)}) - h^{t-1}(x_{j(t-1)}).$$

Unlike the time dummy hedonic index, comparisons of prices between the two periods may now depend on the particular values of the characteristics x plugged into the two hedonic functions. A standard approach is to use a weighted average, weighting either by the time t sales or time $t-1$ sales (yielding either a Paasche or Laspeyres type index). An alternative is to average these two weighted indices (see e.g., Diewert, Heravi, and Silver (2009)). Pakes uses time $t-1$ sales, and (in an application to personal computer prices) estimates the hedonic functions $h^t(\cdot)$ and $h^{t-1}(\cdot)$ by unweighted least squares on linear, log-log or "power" specifications in x.

In may circumstances the hedonic imputation approach will be preferable, as it provides more flexibility in the specification of the hedonic price surface. Often the two approaches will yield very similar indices – for example when the slope coefficients are similar in the two time periods or when the sales-weighted average values of x are similar in the two periods. In the case of a linear specification of the RHS of the regression equation, the two approaches will yield *identical* indices if *either* (a) the sales-weighted average values of the product characteristics x are the same in the two time periods, or (b) the common slope parameter α for the time-dummy regression model is equal to the mean of the time specific parameters α_{t-1} and α_t from the more flexible specification.

The hedonic imputation approach can also have drawbacks. One can arise from the requirement of sufficient sample sizes in each time period to allow reasonably precise estimation of time-specific slopes and intercepts.[21] If only a few products are offered in each time period, separate regressions for each time period may not be appropriate. Another is the requirement of quantity data. A minimal data requirement includes quantities for a single time period which could then serve as the "base period." However, in this case one could not accommodate variation in product characteristics over time, and only one possible weighted average could be constructed. This would rule out averaging over potentially conflicting indices.[22]

[21] What actually matters is the estimation of the price surface, not the precision or bias of any particular parameter estimate.

[22] See Diewert, Heravi, and Silver (2009) and Pakes (2003) for additional discussion. Pakes recommends

In our application, we have both the problem of very limited "within period" sample sizes and the problem of limited quantity data. In our setting, the analog of "time period" is a firm-product-type-DMA® combination. Within a firm-product-type-DMA® combination, we typically have only a few observations—the list of product tiers obtained from the first page of our web-scrape. This suggests that estimation of separate regressions (even linear regressions) for each firm-product type-DMA® combination would introduce substantial sampling error. Further, because we have tier-specific quantities only for a fraction of the firm-product type-DMA® combinations that might serve as the "base year" for the index calculation, it is impossible for us to solve the problem of inconsistent indices through averaging. Along with concern for transparency of our choices regarding price measurement, these considerations led us to purse the traditional time-dummy hedonic index approach described above.

7.2 Prices (and Qualities) of the AT&T-DTV Synthetic Bundle

Our analysis of the correlation between our price indices and actual prices excluded the AT&T-DirecTV synthetic bundle. While each party knows how many households subscribe to the product component that makes up its half of the synthetic bundle, neither knows the fractions of these customers who purchase this service alone, as part of a joint marketing agreement, or as part of a "do-it-yourself" bundle.

We do know the details of pricing under the joint-marketing agreement. As discussed in BH, this involves a fixed discount for the synthetic bundle relative to the standalone prices of the component services. Because the details of the discount are different depending on whether the bundle is purchased through AT&T or DirecTV, we approximate the discount in our analysis by assuming that everyone purchasing this combination of services receives a $5 per month discount. This approximation introduces some additional measurement error—both because the level and term of the discount varies by firm and because we do not know that every purchaser of the synthetic bundle receives any discount. Fortunately, as discussed above, our model allows us

the hedonic imputation approach but acknowledges that practical considerations may sometimes dictate use of the time dummy approach. Diewert et al (2009) argue for the hedonic imputation approach except when the available degrees of freedom are very limited (as ours are). They dismiss the issue that index values depend on the choice of characteristics, arguing that averaging the Laspeyres and Paasche indices is widely accepted. However, as previously discussed, such averaging is impossible in our case.

to address measurement error in prices through instrumental variables techniques. Further, the product-specific constant (fixed effect) for the AT&T-DTV bundle in our demand model will pick up any systematic difference in the price level of this bundle relative to the level of our price index.

This last point is closely related to another issue discussed in the July meeting: whether purchasers of the AT&T-DTV bundle are systematically choosing different tiers of service as compared to purchasers of the standalone components. We cannot know the answer to this question; as discussed above, we do not know which subscribers are purchasing both services. However, the model already accounts for any such differences through the product-specific constants. These fixed effects are free parameters of the model capturing the average utility of the product, including that arising from its average price (see the previous discussion of re-centering) and that arising from its average quality. Thus, the product-specific constant for the AT&T-DTV bundle already accounts for the average level of service purchased by consumers purchasing the AT&T-DTV bundle, as well as the average price paid.

8 Bootstrap Confidence Intervals

Following up on discussion in the July meeting, we have explored construction of bootstrap confidence intervals on the output of our counterfactual simulations. In particular, for the one-nesting-parameter of the model, we employ a version of the parametric bootstrap. The resulting confidence intervals show that, even in the absence of cost savings, the predicted positive welfare effect of the merger is statistically significant.

To compute the confidence regions, we draw parameter vectors repeatedly from the multivariate normal distribution obtained as the asymptotic approximation to the sampling distribution of our parameter estimates. For each draw of the parameters, we simulate the post-merger equilibrium and implied changes in prices, quantities, and consumer surplus.

Based on 2,000 bootstrap replications, Table 11 shows the resulting bootstrap 90% confidence intervals for post-merger shares and price changes in the one-nesting-parameter model without cost savings. Table 12 shows analogous results for the simulation with AT&T video content cost saving. In a few cases the confidence intervals are quite wide. However, the intervals almost always exclude zero, implying that the direction of the price changes is determined with statistical significance.

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Table 11: Bootstrap Confidence Intervals for Price Changes and Shares Without Cost Savings, One-Nesting-Parameter Model

	Post-Merger Shares		Price Changes ($)	
	0.05 Quantile	**0.95 Quantile**	**0.05 Quantile**	**0.95 Quantile**
DTV Video + Cable BB	[redacted]	[redacted]	0.89	12.37
DTV Video + AT&T BB	[redacted]	[redacted]	-56.70	-4.08
DTV Video + Telco BB	[redacted]	[redacted]	0.90	13.44
DTV Video + Other BB	[redacted]	[redacted]	1.04	14.57
DTV Video + no BB	[redacted]	[redacted]	1.04	14.57
DISH Video + Cable BB	[redacted]	[redacted]	-1.97	-0.10
DISH Video + AT&T BB	[redacted]	[redacted]	0.33	12.04
DISH Video + Telco BB	[redacted]	[redacted]	-0.89	-0.08
DISH Video + Other BB	[redacted]	[redacted]	0.05	0.29
DISH Video + No BB	[redacted]	[redacted]	0.05	0.29
Cable Video + Cable BB	[redacted]	[redacted]	-3.53	-0.20
Cable Video + AT&T BB	[redacted]	[redacted]	0.14	9.48
Cable Video + Telco BB	[redacted]	[redacted]	-3.50	-0.25
Cable Video + OtherBB	[redacted]	[redacted]	-2.39	-0.11
Cable Video + No BB	[redacted]	[redacted]	-2.39	-0.11
AT&T Video + Cable BB	[redacted]	[redacted]	1.52	13.55
AT&T Video + AT&T BB	[redacted]	[redacted]	1.46	15.19
AT&T Video + Other BB	[redacted]	[redacted]	1.68	15.92
AT&T Video + No BB	[redacted]	[redacted]	1.68	15.92
Telco Video + Cable BB	[redacted]	[redacted]	-3.16	-0.22
Telco Video + Telco BB	[redacted]	[redacted]	-1.23	-0.08
Telco Video + Other BB	[redacted]	[redacted]	-0.96	-0.06
Telco Video + No BB	[redacted]	[redacted]	-0.96	-0.06
No Video + Cable BB	[redacted]	[redacted]	-2.20	-0.16
No Video + AT&T BB	[redacted]	[redacted]	0.26	11.80
No Video + TelcoBB	[redacted]	[redacted]	-1.10	-0.14
No Video + OtherBB	[redacted]	[redacted]	0.00	0.00

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Table 13 shows confidence intervals for our estimates of the merger effect on consumer welfare. We see that even in the absence of cost savings, the predicted effect of the merger is statistically significantly different from zero.

We attempted the same bootstrap procedure for the three-nesting-parameter model. However, consistent with the large estimated standard errors for our parameter estimates from that model, draws from the normal distribution approximating the sampling distribution of the parameter estimates frequently produced nesting parameters outside the unit interval that is consistent with the nested logit model. This suggests that the normal asymptotic approximation providing the theoretical foundation for the parametric bootstrap serves poorly in the three-nesting-parameter model, consistent with our assessment that the three-nesting-parameter model may be pushing the limits of the data.

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Table 12: Bootstrap Confidence Intervals for Price Changes and Shares With Cost Savings, One-Nesting-Parameter Model

	Post-Merger Shares		Price Changes ($)	
	0.05 Quantile	0.95 Quantile	0.05 Quantile	0.95 Quantile
DTV Video + Cable BB	[redacted]	[redacted]	0.80	12.30
DTV Video + AT&T BB	[redacted]	[redacted]	-55.96	-2.81
DTV Video + Telco BB	[redacted]	[redacted]	1.14	13.62
DTV Video + Other BB	[redacted]	[redacted]	1.45	14.86
DTV Video + no BB	[redacted]	[redacted]	1.45	14.86
DISH Video + Cable BB	[redacted]	[redacted]	-2.41	-0.68
DISH Video + AT&T BB	[redacted]	[redacted]	1.02	12.51
DISH Video + Telco BB	[redacted]	[redacted]	-1.04	-0.31
DISH Video + Other BB	[redacted]	[redacted]	-0.02	0.23
DISH Video + No BB	[redacted]	[redacted]	-0.02	0.23
Cable Video + Cable BB	[redacted]	[redacted]	-4.12	-1.08
Cable Video + AT&T BB	[redacted]	[redacted]	0.27	9.58
Cable Video + Telco BB	[redacted]	[redacted]	-4.02	-1.06
Cable Video + OtherBB	[redacted]	[redacted]	-2.82	-0.75
Cable Video + No BB	[redacted]	[redacted]	-2.82	-0.75
AT&T Video + Cable BB	[redacted]	[redacted]	-7.57	4.67
AT&T Video + AT&T BB	[redacted]	[redacted]	-6.66	6.31
AT&T Video + Other BB	[redacted]	[redacted]	-6.81	7.61
AT&T Video + No BB	[redacted]	[redacted]	-6.81	7.61
Telco Video + Cable BB	[redacted]	[redacted]	-3.61	-0.84
Telco Video + Telco BB	[redacted]	[redacted]	-1.33	-0.22
Telco Video + Other BB	[redacted]	[redacted]	-1.04	-0.17
Telco Video + No BB	[redacted]	[redacted]	-1.04	-0.17
No Video + Cable BB	[redacted]	[redacted]	-2.57	-0.67
No Video + AT&T BB	[redacted]	[redacted]	1.02	12.36
No Video + TelcoBB	[redacted]	[redacted]	-1.19	-0.31
No Video + OtherBB	[redacted]	[redacted]	0.00	0.00

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We are unaware of an adjustment to our bootstrap procedure that would allow valid inference in this case and so we do not provide bootstrap standard errors for simulation results from the three-nesting-parameter model. Given the size of the predicted consumer welfare effects from the three-nesting-parameter model, the size of the estimated standard errors for the parameters of that model, and the width of the confidence intervals on welfare predictions from the one-nesting-parameter model, we conjecture that proper confidence regions on the predicted change in consumer surplus from the three-nesting-parameter model would include zero. This result would remain consistent with our conclusion throughout that while some of our simulations predict significant *benefits* to consumers, none of our simulations predicts significant harm.

Table 13: Bootstrap Confidence Intervals
Consumer Welfare Changes: One-Nesting-Parameter Model

	0.05 Quantile	0.95 Quantile
Without Cost Savings		
All DMA®s w/ AT&T Availability	$0.09	$2.21
DMA®s w/ AT&T Video Availability	$0.09	$2.39
With Cost Savings		
All DMA®s w/ AT&T Availability	$1.11	$2.89
DMA®s w/ AT&T Video Availability	$1.29	$3.19

9 Descriptive Statistics

In Tables 14 and 15 (presented at the end of this document), we provide additional descriptive statistics on the data used in our analysis.

10 Conclusion

We have provided additional discussion and analysis related to issues discussed during the July presentation of our merger analysis. This new analysis provides strong additional support for the modeling choices and analysis in BH and for the robustness of our conclusions. Our analysis shows that this merger, unlike most mergers, would lead to net benefits for consumers (or at least an absence of harm) even without consideration of the cost efficiencies that will arise from the merger. Further, when we consider cost efficiencies limited to narrowly defined content cost savings on AT&T video services, we predict substantial consumer welfare gains of $940 million and $1.44 billion annually. Consideration of cost efficiencies for other products of the merged firm—e.g., a 5% savings often serving as a default value of plausible savings—would add to our predicted consumer gains. In addition, objective improvements in the quality of the AT&T-DirecTV bundle—a benefit not accounted for in our analysis—will increase the merger's benefits even further.

Table 14: Variable Definitions

Variable Name	Variable Definition
Price	average price index from hedonic regressions
Speed	average broadband speed across providers
Channels	average number of channels across providers
DBS_latitude	DBS*latitude (DBS is 1 if product contains DISH or DTV video and 0 otherwise)
DBS_urbanPct	DBS*UrbanPercent (UrbanPercent is the percentage of DMA® which is urban)
DBS_ownerPct	DBS*OwnerPercent (OwnerPercent is the percentage of HHs who own the house in DMA®)
ATT_ATTBB_prodDummy	1 if product is AT&T Video + AT&T BB, 0 otherwise
Cable_ATTBB_prodDummy	1 if product is Cable Video + AT&T BB, 0 otherwise
Cable_CableBB_prodDummy	1 if product is Cable Video + Cable BB, 0 otherwise
Cable_TelcoBB_prodDummy	1 if product is Cable Video +Telco BB, 0 otherwise
Cable_noBB_prodDummy	1 if product is Cable Video + No BB, 0 otherwise
DISH_ATTBB_prodDummy	1 if product is Dish Video + AT&T BB, 0 otherwise
DISH_CableBB_prodDummy	1 if product is Dish Video + Cable BB, 0 otherwise
DISH_TelcoBB_prodDummy	1 if product is Dish Video + Telco BB, 0 otherwise
DISH_noBB_prodDummy	1 if product is Dish Video + No BB, 0 otherwise
DTV_ATTBB_prodDummy	1 if product is DTV Video + AT&T BB, 0 otherwise
DTV_CableBB_prodDummy	1 if product is DTV Video + Cable BB, 0 otherwise
DTV_TelcoBB_prodDummy	1 if product is DTV Video + Telco BB, 0 otherwise
DTV_noBB_prodDummy	1 if product is DTV Video + No BB, 0 otherwise
Telco_TelcoBB_prodDummy	1 if product is Telco Video + Telco BB, 0 otherwise
noVideo_ATTBB_prodDummy	1 if product is No Video + AT&T BB, 0 otherwise
noVideo_CableBB_prodDummy	1 if product is No Video + Cable BB, 0 otherwise
noVideo_TelcoBB_prodDummy	1 if product is No Video + Telco BB, 0 otherwise
vidTelcoVZN	1 if product contains Telco video and top Telco video provider is Verizon, 0 otherwise
vidCableTWC	1 if product contains Cable video and top Cable provider is TWC, 0 otherwise
vidCableCC	1 if product contains Cable video and top Cable provider is Comcast, 0 otherwise
vidCableCharter	1 if product contains Cable video and top Cable provider is Charter, 0 otherwise
vidCableCOX	1 if product contains Cable video and top Cable provider is COX, 0 otherwise
bbTelcoVZN	1 if product contains Telco BB and top Telco BB provider is Verizon, 0 otherwise
bbCableTWC	1 if product contains Cable BB and top Cable provider is TWC, 0 otherwise
bbCableCC	1 if product contains Cable BB and top Cable provider is Comcast, 0 otherwise
bbCableCharter	1 if product contains Cable BB and top Cable provider is Charter, 0 otherwise
bbCableCOX	1 if product contains Cable BB and top Cable provider is COX, 0 otherwise
ageOver65Pct_BBonly	percentage of population over 65 years old if product contains no video (only BB), 0 otherwise
ageOver65Pct_vidOnly	percentage of population over 65 years old if product contains no BB (only video), 0 otherwise
ageOver65Pct_bundle	percentage of population over 65 years old if product contains both video and BB (bundle), 0 otherwise
eduMasterPlusPct_BBonly	percentage of population with master degree or higher if product contains no video (only BB), 0 otherwise
eduMasterPlusPct_vidOnly	percentage of population with master degree or higher if product contains no BB (only video), 0 otherwise

Table 14: Variable Definitions (cont)

Variable Name	Variable Definition
eduMasterPlusPct_bundle	percentage of population with master degree or higher if product is bundle, 0 otherwise
medianInc_BBonly	median HH income (in $1,000) if product contains no video (only BB), 0 otherwise
medianInc_vidOnly	median HH income (in $1,000) if product contains no BB (only video), 0 otherwise
medianInc_bundle	median HH income (in $1,000) if product contains both video and BB (bundle), 0 otherwise
latitude_nonDBSVid_hasBB	latitude if product contains non DBS video and BB* , 0 otherwise
latitude_nonDBSVid_noBB	latitude if product contains non DBS video and no BB*, 0 otherwise
latitude_noVid	latitude if product conains no Video (only BB), 0 otherwise
ownerPct_nonDBSVid_hasBB	OwnerPercent if product contains non DBS video and BB, 0 otherwise
ownerPct_nonDSBVid_noBB	OwnerPercent if product contains non DBS video and no BB, 0 otherwise
ownerPct_noVid	OwnerPercent if product contains no Video, 0 otherwise
urbanPct_nonDBSVid_hasBB	UrbanPercent if product contains non DBS video and BB, 0 otherwise
urbanPct_nonDSBVid_noBB	UrbanPercent if product contains non DBS video and no BB, 0 otherwise
urbanPct_noVid	UrbanPercent if product contains no Video, 0 otherwise
attTelcoCov_CableBundle	AT&T/Telco video coverage** if product is Cable video + Cable BB, 0 otherwise
attTelcoCov_Cable_noBB	AT&T/Telco video coverage if product is Cable video + no BB, 0 otherwise
attTelcoCov_Cable_nonCableBB	AT&T/Telco video coverage if product contains Cable video and BB but not Cable BB, 0 otherwise
attTelcoCov_DBS_noBB	AT&T/Telco video coverage if product contains DTV or DISH video (DBS video) + no BB, 0 otherwise
attTelcoCov_DBS_anyBB	AT&T/Telco video coverage if product contains DTV or DISH video (DBS video) and BB, 0 otherwise
attTelcoCov_noVideo	AT&T/Telco video coverage if product contains no Video, 0 otherwise
attTelcoBBCov_nonATTTelcoBB	AT&T/Telco BB coverage***if product contains BB but not AT&T or Telco BB, 0 otherwise
attTelcoBBCov_noBB	AT&T/Telco BB coverage if product contains no BB, 0 otherwise
attTelcoBBCov_CableBundle	AT&T/Telco BB coverage if product is Cable video + Cable BB, 0 otherwise
cableCov_nonCableBB	cable coverage if product contains BB but not cable BB, 0 otherwise
cableCov_noBB	cable coverage if product contains no BB, 0 otherwise
cableCov_attTelcoBundle	cable coverage if product is AT&T video + AT&T BB or Telco video + Telco BB, 0 otherwise
avgChannels_containsVid	avgChannels if product contains video, 0 otherwise
avgChannels_noVid	avgChannels if product does not contain video, 0 otherwise
maxChannels_containsVid	maxChannels if product contains video, 0 otherwise
maxChannels_noVid	maxChannels if product does not contain video, 0 otherwise
avgSpeed_containsBB	avgSpeed if product contains BB, 0 otherwise
avgSpeed_noBB	avgSpeed if product does not contain BB, 0 otherwise
maxSpeed_containsBB	maxSpeed if product contains BB, 0 otherwise
maxSpeed_noBB	maxSpeed if product does not contain BB, 0 otherwise
dmaBigCable_nonCableVid	1 if top cable provider**** and product contains video but not Cable video, 0 otherwise
dmaBigCable_nonCableBB	1 if top cable provider is one of TWC, Comcast, Charter, or COX and product contains BB but not Cable BB, 0 otherwise

* *non DBS video is 1 if product contains video but none of DTV or DISH video, 0 otherwise*
** *Maximum of AT&T and Telco video coverage*
*** *Maximum of AT&T and Telco BB coverage*
**** *Top cable providers are TWC, Comcast, Charter, or COX*

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Other Attachments Redacted in their Entirety as Confidential and Highly Confidential Information