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Do three-part tariffs improve efficiency in residential broadband networks?

Jacob B. Malone *, John L. Turner, Jonathan W. Williams

Department of Economics, University of Georgia, United States

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ABSTRACT

We analyze subscriber usage data from an Internet Service Provider that sells service using three-part tariff and unlimited plans. Subscribers facing three-part tariffs have lower average usage than subscribers on unlimited plans, and differences among heavy users explain nearly all the overall difference. Hence, the three-part tariff saves network costs and narrows the gap, between light and heavy users, in price per Gigabyte used. However, subscribers facing three-part tariffs cut usage similarly during peak and off-peak hours. Since off-peak usage adds no network costs, these off-peak usage reductions lower welfare. Differentially pricing peak usage could further enhance efficiency.

1. Introduction

The Internet is now an integral part of modern life. Recent research estimates the average American spends over 3 h online daily.[1] Moreover, with the proliferation of faster access speeds and bandwidth intensive applications like online video, which now comprise over 60% of peak usage, subscribers use more data than ever before.[2] This growth in subscriber demand puts pressure on Internet Service Providers (ISPs) to manage demands placed on their networks.

In response, a sizable number of US providers now sell service via usage-based pricing plans. The most typical "three-part tariff" plan specifies an access fee, a usage allowance and an overage price. Subscribers who use less data than the allowance pay just the access fee for service, while subscribers who use more pay the overage price for each additional GB used.[3]

ISPs typically argue that such plans lower overall and peak usage, helping to reduce network costs, and reduce the level of cross-subsidization between light and heavy users, more closely linking subscriber costs to usage. Government agencies such as the US Federal Communications Commission (FCC) are closely watching to see how usage-based pricing affects costs and efficiency (OIAC, 2013). Yet, there is little empirical evidence to date.

In this paper, we analyze subscriber-specific usage data from a North American ISP during May 2011–May 2013. Importantly, this provider sells service via a menu of three-part tariff plans but also sells service via unlimited plans to a group of grandfathered customers. In comparing usage behavior across groups of subscribers, we identify key effects of three-part tariff pricing. We also analyze how subscriber usage changes across the day and across the month for a single billing cycle.

* Corresponding author.
E-mail addresses: jbmalone@uga.edu (J.B. Malone), jlturner@uga.edu (J.L. Turner), jonwms@uga.edu (J.W. Williams).

[1] See http://www.emarketer.com/Article/Social-Usage-Involves-More-Platforms-More-Often/1010019.

[2] See https://www.sandvine.com/downloads/general/global-internet-phenomena/2013/sandvine-global-internet-phenomena-report-1h-2013.pdf.

[3] Some plans bill for overage more crudely. For example, Comcast's XFINITY plan bills $10 for additional 50 GB blocks of data, and also gives subscribers three warnings before imposing the fees.

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First, we analyze monthly data. Despite enjoying faster connection speeds, the top ten (one) percent of users on unlimited plans use about 56% (74%) more data in May 2013 than the top ten (one) percent of users facing three-part tariffs. In contrast, the median user who faces a three-part tariff uses just 10% less data than the median user on an unlimited plan. Other than the top few deciles of users, distributions of usage are quite similar across subscriber groups. Thus, allowances and overage prices are mostly effective at reining in heavy users. Since such users account for a disproportionate share of total usage, three-part tariffs save significant network costs for the ISP.

By linking payments to usage, three-part tariffs also reduce the amount of cross-subsidization between the low- and high-volume users. Among subscribers on unlimited plans, the average subscriber in the top ten percent of users consumes 21.5 times more data per month but pays just 1.1 times more than the average subscriber in the bottom half of the usage distribution. Among subscribers facing three-part tariffs, however, the average subscriber in the top ten percent of users consumes just 15 times more data per month than the average bottom-half-usage subscriber, but pays about 2.3 times more for service.

Three-part tariffs do not strongly affect how much subscribers favor downloading (e.g., streaming Netflix) versus uploading (e.g., moving a file from local storage to Dropbox). Subscribers facing three-part tariffs download an average of 90.3% of data per month. While this is statistically smaller than the 90.9% fraction for subscribers to unlimited plans, we do not view a 0.6 percentage point difference as economically significant.

Second, we more closely examine data aggregated up to daily peak hours and daily off-peak hours for a one-month billing cycle during May and June of 2012. We find that subscribers facing three-part tariffs change their usage throughout the month in ways consistent with forward-looking behavior. Subscribers on pace to exceed their allowance cut back on usage in statistically and economically significant ways. For example, subscribers with cumulative usage at between 80% and 100% of the allowance face high implicit overage prices and reduce usage by 28% over the last six days of the billing cycle. In contrast, those who have consumed under 40% of the usage allowance face low implicit overage prices and increase usage by 13% over the last six days of the month.

Most importantly, the percentage effects described above—indeed, all effects of cumulative usage and time of month on current usage—are *statistically the same during peak and off-peak hours*. Intuitively, the way that subscribers cut back does not depend on time of day. Hence, while three-part tariffs do curtail overall usage by heavy users, these users lower their peak usage by the same proportion as they lower their off-peak usage.

Because total off-peak usage is (by definition) below network capacity constraints, any reduction in overall usage that occurs during off-peak hours has no effect on ISP welfare but lowers welfare for both subscribers and content providers (e.g., Netflix), who lose value-creating transactions. This suggests service plans that differentially price peak and off-peak usage may improve upon the three-part tariff schedule's ability to enhance consumer welfare and increase ISP profitability. Such plans would also provide incentives for content providers to make content more portable across the day. For example, since Netflix offers no “live” content, much of this traffic (currently over 30% of peak traffic) could be downloaded during off-peak hours.

We also show that usage is highly persistent, in the sense that a subscriber's usage in one month almost perfectly predicts usage in the next month. In the monthly data, more than 90 percent of subscribers use an amount that places them within two deciles of their position in the prior month's usage distribution. In the intra-month data, over half of the variation in usage is explained by individual-specific fixed effects. Hence, heavy users in one period tend to be heavy users in the next period. This is important, because it makes it relatively easy for ISPs to target such users with three-part tariffs while limiting the impact to a small number of subscribers.

Our study contributes to the policy debate surrounding appropriate network management. Due to uncertainty about how government agencies such as the FCC will enforce net-neutrality, ISPs have been reluctant to negotiate contracts with content providers to pay for the costs of delivering their traffic to end users. However, usage-based pricing of subscriber service plans appears to be (for the moment) a safe harbor from such scrutiny. For example, the 2010 FCC Open Internet Report and Order states:

> “… prohibiting tiered or usage-based pricing and requiring all subscribers to pay the same amount for broadband service, regardless of the performance or usage of the service, would force lighter end users of the network to subsidize heavier end users. It would also foreclose practices that may appropriately align incentives to encourage efficient use of networks. The framework we adopt today does not prevent broadband providers from asking subscribers who use the network less to pay less, and subscribers who use the network more to pay more.” (FCC, 2010, Paragraph 72)

While three-part tariff pricing is common practice by U.S. cellular providers and foreign residential broadband companies, it and other forms of usage-based pricing are controversial in the United States. Numerous consumer groups argue usage-based pricing is unfair and an unnecessary use of market power,[4] and Senator Ron Wyden has proposed legislation restricting it.[5] To inform this debate, the Federal Communications Commission tasked its Open Internet Advisory Committee to study the economics of usage-based pricing. The committee's recent report (OIAC, 2013) includes information on the proliferation of usage-based pricing and sets up a useful framework for thinking about the efficiency of usage-based

[4] See, e.g., StopTheCap.com.

[5] Sen. Wyden's bill, the so-called Data Cap Integrity Bill, can be found at http://www.wyden.senate.gov/news/press-releases/wyden-data-cap-legislation-will-protect-consumers-and-promote-innovation.