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Residential and Business Broadband Prices
Part 1: An Empirical Analysis of Metering and Other Price Determinants

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Abstract

For this project, we assemble a new dataset consisting of more than 25,000 residential and business broadband plans from all OECD countries from 2007–2009. We explore three issues: the relationship between plan components—such as metering—and consumer prices, price changes over time, and how broadband prices vary across countries.

This paper, part 1 of the project, discusses pricing for broadband plans and, specifically, the relationship between plan components and pricing. We find that residential broadband plans with data caps—plans in which consumers pay a base price for a set amount of data—cost less than plans with unlimited data, other things being equal, for consumers who do not exceed the cap. The estimates suggest that a residential standalone plan with a 10 gigabyte (GB) cap, for example, would cost about 27 percent less than an otherwise identical, but unlimited plan. A residential triple play plan would cost about 14 percent less than an otherwise identical but unlimited plan. In the case of standalone broadband, each gigabyte of the cap is associated with an additional $1.67 per year; for triple play the premium is $1.85. In plans that include video packages, each channel is, on average, associated with a $2 price increase over the course of a year.

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Prologue

Most empirical analyses of broadband have focused on availability, adoption, and sometimes speeds.[1] A smaller literature examines household demand for Internet access,[2] and a few papers attempt to estimate the consumer benefits of broadband.[3] With few exceptions, analyses of prices have been relatively simplistic—and controversial—comparisons across countries, largely because broadband prices are complicated and little consistent data are available. In spite of these limitations, two aspects of broadband prices remain actively debated: (1) New pricing schemes, such as metered pricing and plans that include a base amount of data transfer and then impose usage charges or throttle speed beyond that base (i.e., data caps or bitcaps), and (2) Relative prices for broadband access in different countries.

We assemble a large dataset that allows us to address both of these issues. Part 1 of our project, this paper, examines the effect of pricing schemes on consumer prices. Part 2 of the project explores price levels and changes for different types of broadband service across countries. We will also publish a data appendix that will provide detailed data for each OECD country.

I. Introduction

This paper provides a unique analysis of how pricing schemes such as data caps affect the prices consumers pay for broadband. We construct and analyze an original dataset of about 25,000 residential and business broadband plans offered by 169 firms in 30 OECD countries between 2007 and 2009. Unlike prior studies, we identify components of each plan, including promotional rates, installation charges, activation charges, other hidden fees, contract lengths, bitcaps, bundled services, and components of bundled services such as the number of channels in video packages. This information allows us to examine how different components of broadband plans affect consumer prices and to compare price levels and changes across countries in ways that have not been possible previously. In addition, while most research has focused on residential broadband, we also study business broadband prices.

We find that, on average across OECD countries, broadband plans with bitcaps cost consumers less per year than do unlimited plans as long as data use stays below the cap, and that plans with contracts are typically less expensive than plans without contracts. The estimates suggest that a residential standalone plan with a 10 GB cap, for example, would cost about 27 percent less than an otherwise identical (by the variables for which we control) but unlimited data plan. A residential triple-play would cost about 14 percent less than an otherwise identical but unlimited plan. In the respective categories, prices increase by $1.67 and $1.85 annually for each gigabyte (GB) added to the cap. We also find that consumers pay about $2.01 per annum, on average, for each channel included in video bundles.

[1] See, for example, Agarwal, Animesh, and Prasad (2009); Aron and Burnstein (2003); Chaudhuri and Flamm (2005); Faulhaber (2002); Flamm (2005); Flamm and Chaudhuri (2007); Hausman and Sidak (2004); Horrigan (2009); Prieger and Hu (2007).
[2] In particular, see Rosston, Savage, and Waldman (2010) and Savage and Waldman (2004).
[3] See Greenstein and McDevitt (2009) and Dutz, et al (2009).

These results suggest that the unlimited data plans typically offered by most U.S. wireline broadband providers may not be optimal for many consumers. The details of capped plans matter, and how an individual user is affected depends on the base price, allowed data usage, and consequences for exceeding the cap. Nevertheless, because capped plans are—all else equal—cheaper than unlimited plans, many consumers, particularly the low-volume users, are likely to pay less for broadband with data caps than they would for plans offering unlimited data transfer.

The paper proceeds as follows. In Section II we introduce the questions we address regarding pricing and explain the data we use to investigate those questions. Section III evaluates the relationship between prices and attributes of broadband service contracts. Section IV concludes.

II. Data

Broadband prices are difficult to decipher and compare for several reasons. Broadband is not a homogeneous product. It is available with different download and upload speeds and other features, and frequently comes bundled with telephone and video services, each of which has its own set of features. Additionally, it is marketed in numerous ways—with contracts and promotions that vary considerably from plan to plan, even within a company. This complexity has contributed to, as the FCC's National Broadband Plan puts it, "a dearth of consistent, comprehensive, and detailed price data".[4]

To address this problem we follow and build upon the approach taken by Greenstein and McDevitt (2010). In particular, we construct a new dataset from information available from Point Topic, a UK-based consultancy that compiles data on plans from the "major broadband operators" in countries around the world.[5]

Point Topic records some of the data, such as company name and upload and download speeds, systematically, but unfortunately many of the details necessary to characterize plans accurately were included in written notes that had no consistent pattern. Quantifying details in the notes, which included factors such as contracts, bitcaps, promotions, and rebates, was a heavily labor-intensive process.[6] Often those details implied that one particular plan in the Point Topic data contained, in reality, multiple service options. For example, the notes for one plan might include statements like, "activation fee waived if user signs a 2-year contract, otherwise activation fee of $75." In that case, what Point Topic and probably even the Internet Service Provider (ISP) consider to be a single plan becomes two plans in our dataset: one with an activation fee and a one-year contract, and another with no activation fee and a two-year contract. These alterations become more complicated when factoring in notes on promotions and extra features.[7]

[4] Federal Communications Commission (2010b, 38).

[5] Specifically, we used data from Point Topic's Operator Source dataset (combining individual spreadsheets kept for each quarter, downloaded in April 2010), which has information on broadband plans offered by a large number of providers around the world.

[6] One consequence of this exercise is that after months of reading the "fine print" on thousands of broadband plans, Riso has little sympathy for anyone who complains about reading the details for a single plan.

[7] The data are complicated in many ways. For example, many records indicate prices are not uniform throughout a provider's footprint. Over a third of Bell Canada plans in our dataset note "Tariffs mentioned for Ontario region. Different services and promotional offers for Quebec region." Other notes are less explicit; e.g. almost all Comcast plans mention that prices are applicable for Philadelphia but "may vary for other regions." Our data are

The final dataset yielded a total of 25,279 unique broadband plans from 169 companies in 12 quarters (2007Q1–2009Q4). Table 1 shows the breakdown of these plans by residential or business classification and other services with which they are bundled.

Table 1
Number of Broadband Plans in the Dataset by Type

Type of Broadband Plan:	Residential	Business
Standalone	8,422	8,855
Bundle with		
Fixed voice	2,800	1,299
Video, fixed voice (triple play)	2,087	55
Video	855	29
Fixed voice, mobile voice	328	170
Video, fixed voice, mobile voice	283	4
Video, mobile voice	45	15
Mobile voice	30	2
Total	14,850	10,429

The table shows that standalone plans are the most common in the dataset, followed by broadband bundled with fixed voice and broadband bundled with telephone and video—the so-called triple play. The table also shows a small number of plans bundled with mobile voice services.[8]

unfortunately unable to capture those regional differences within plans. In addition, some promotional prices are offered generally, whereas others are targeted specifically at existing customers or apply only to new customers. We ignore these distinctions and use the lowest available discounted price.

[8] ISPs now appear to be bundling mobile broadband service with fixed broadband services, though that type of bundle does not appear in our dataset. In the United States, Comcast and Time Warner Cable offer Clearwire's 4G service as an added feature in areas in which Clear offers service (http://www.comcast.com/About/PressRelease/PressReleaseDetail.ashx?PRID=887 http://news.cnet.com/8301-1035_3-10300017-94.html). Clearwire itself sells fixed and mobile wireless broadband service as a bundle (http://www.clear.com/shop/quickshop?id=975&market=71).

Table 2
Distribution of Plans by Country and Company

Country	Number of Companies	Number of Plans
Australia	4	1331
Austria	2	525
Belgium	6	577
Canada	11	2050
Czech Rep.	2	309
Denmark	7	1332
Finland	3	557
France	7	464
Germany	13	1233
Greece	3	396
Hungary	4	600
Iceland	1	106
Ireland	5	1221
Italy	3	477
Japan	8	978
Luxembourg	1	67
Mexico	4	336
Netherlands	8	945
New Zealand	2	484
Norway	8	1146
Poland	5	750
Portugal	3	590
Slovakia	1	319
South Korea	4	538
Spain	6	875
Sweden	7	1487
Switzerland	4	581
Turkey	2	75
UK	10	1188
USA	29	3869

Readers should take care when interpreting these tables. The distributions of plans by type and country are potentially misleading in two ways. First, the number of plans offered by a company is not necessarily related to a company's subscriber base. For example, in our dataset Cincinnati Bell offered 177 plans over the time period while Comcast offered only 86, even though Comcast is over 60 times larger than Cincinnati Bell.[9]

[9] At year-end 2009 Cincinnati Bell had 244,000 DSL and fiber subscribers, compared with Comcast's 15.93 million High-Speed Internet customers. See company releases at

Second, we do not know the number of subscribers to each plan. To our knowledge, those data are not available, and certainly not for the way we define plans. We therefore cannot say what a typical consumer would pay, but only what a consumer would pay if subscribing to a particular available plan. In this paper we deal, imperfectly, with these problems by including firm fixed-effects in the regressions.

Attributes of broadband plans

In addition to customer group (business or residential) and bundle type, our dataset also includes a number of variables relevant to decomposing prices and attributes. Table 3 highlights those variables.

Table 3
Relevant Variables in the Dataset

Description
Regular monthly service charge
Monthly service charge promotional rate that applies for a portion of customer lifetime
Number of months customer receives promotional rate for service charge.
Activation fee less any discounts noted
Installation fee less any discounts noted
Equipment fee less any discounts noted (generally distinct from on-going rental costs)
Misc. monthly fee required on top of those named above, if noted (usually line rental)
Monthly service charge named requires contract of at least length entered (in months)
Downstream speed
Upstream speed
Plan has a data cap (bitcap)
Amount of data transfer allowed under cap, in megabytes
Number of TV channels, excluding music/radio where possible
Price includes tax (indicator)
Annual purchasing power parity (for GDP) exchange rate as published by OECD

Table 4 shows selected summary statistics about the plans we observe. The table illustrates that bitcaps are common in many countries, with service providers in 24 of the 30 countries offering plans with bitcaps. Nine of the countries listed have bitcaps on over 50% of the plans offered. In three countries, Australia, New Zealand and Belgium, 75% or more of the plans offered contain bitcaps. While we are unaware of research explaining why caps are more common outside the United States, one possible reason is that because local landline phone calls were historically metered in countries other than the U.S., residents of those countries never experienced truly unlimited dialup service and were, therefore, less likely to expect unlimited broadband from ISPs.

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http://investor.cincinnatibell.com/phoenix.zhtml?c=111332&p=irol-newsArticle&ID=1387040&highlight and http://files.shareholder.com/downloads/CMCSA/845254023x0x348274/c7755491-8d6d-4027-b3ae-0a061f45fc5f/Comcast_Q4Trending_2.2.10.pdf

The table also shows that plans that bundled video packages include far more television channels in the U.S. than in other countries. The median number of channels included in a video package in the U.S. is 160, far above the amount of channels offered in most other countries. Plans in Canada offer the second-largest number at 116.

Table 4
Characteristics of Residential Broadband Plans, 2007-2009

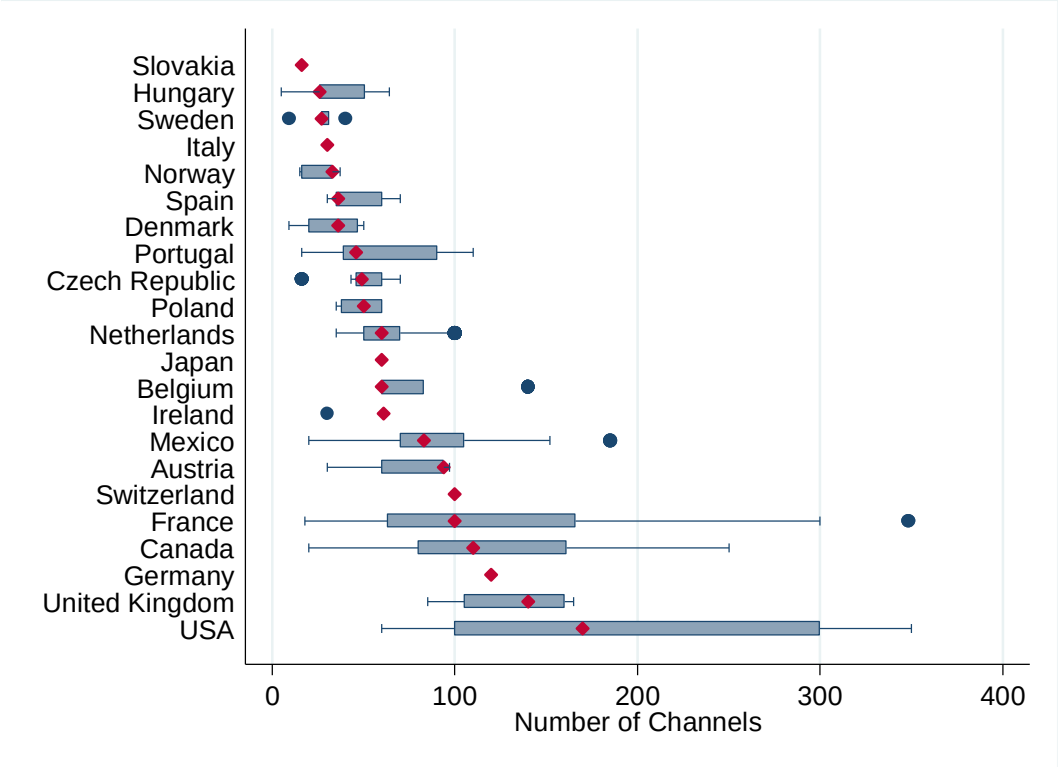
	Median Speed (kbps)		Bitcap[10]		Median number of video channels
	Download	Upload	Share with	Median size (GB)	
Australia	8000	256	99%	12	
Austria	8192	768	11%	5	94
Belgium	10000	256	75%	20	60
Canada	1500	640	52%	30	116
Czech Republic	3072	256	15%	20	49
Denmark	6144	1024	21%	0.05	36
Finland	2048	600	0%		
France	28000	800	0%	50	100
Germany	6144	608	1%	1.5	60
Greece	2048	256	10%	3	
Hungary	4096	480	14%	1	47
Iceland	8000		63%	6	60
Ireland	3000	256	46%	20	61
Italy	20000	1000	0%		30
Japan	26000	2000	0%		60
Luxembourg	8000	384	64%	15	
Mexico	1024	128	1%	4	83
Netherlands	8000	1024	2%	100	53
New Zealand	4000	2000	94%	20	
Norway	5000	1000	0%		33
Poland	1024	256	7%	17	40
Portugal	8192	256	61%	14	46
Slovakia	1536	256	53%	1	16
South Korea	20000	6000	0%		
Spain	6000	320	6%	1	36
Sweden	10000	3000	1%	0	27
Switzerland	5000	425	10%	0.02	100
Turkey	1024	256	27%	6	
UK	8000	448	42%	10	100
USA	5000	768	4%	250	160

Note: None of the 45 residential plans reported in Iceland (all offered by Siminn) named upload speed. Upload data is missing in over 2680 plans (vs. 184 missing download speed).

[10] Some of the bitcaps seem, at first glance, implausibly small, but appear to be legitimate. For example, the plans in Denmark with 50 MB monthly caps also capped additional usage charges at DKK 400 (approximately USD 75) per month.

Figure 1 provides detail on triple-play video packages by showing the range of the number of channels available in video packages in each country. The figure shows that the U.S. has the highest median number of channels (160) and also the widest range of number of channels. The UK has the second highest median number of channels (140), followed by Germany (120), Canada (100), and France and Switzerland (both with 100).

Figure 1
Number of Channels Included in Residential Triple Play Packages by Country, 2007-2009



Note: Box plot shows median (diamond), 25th to 75th percentiles or interquartile range (shaded box), values within 1.5 times the interquartile range (whiskers) and outliers (dots). Channel distributions differ from Table 4 because this figure isolates triple play plans.

The number of channels included in a video package is one important indicator of the value of a video bundle. After all, video distributors themselves frequently use that indicator in their advertising. Nevertheless, other factors also affect how consumers value the bundle and how costly the programming is to the video distributors. For example, consumers may care about the availability of high-definition (HD), premium, and sports channels. Meanwhile, programmers have differing abilities to bundle their own programming and to charge the distributor. Unfortunately, we do not have any such information across countries, meaning that our channel count, while the best available, is a highly imperfect indicator of the quality of video bundles.

Creating a comparable price variable

As mentioned above, comparing broadband prices is not straightforward. Factors like promotions and miscellaneous fees mean that simply examining advertised monthly prices is likely to yield inaccurate and potentially misleading comparisons. Instead, we require a variable that is comparable across plans, companies, and countries.[11] We create such a variable by calculating the total price a consumer would pay for a year of service for each plan, as shown in equation (1) below.

(1) *Net price for one year = (promotional price * number of months promotion lasts) + (standard price * (12 – number of months promotion lasts)) + installation fee + activation fee + equipment charges + other and hidden fees – rebates*

The implicit assumption behind this variable is that consumers consider their total expected payments over a year when choosing a broadband plan. Certainly, not all consumers think that way. More practically, this variable overstates payments for consumers whose plans have contracts of less than one year or no contract and who aim to shop for a new service as soon as possible. Similarly, it understates payments for consumers whose contracts exceed one year. Nevertheless, we believe the variable is appropriate because it allows for a consistent and comparable measurement of prices that takes into account many of the factors included in the price a consumer pays.

Table 5 shows some basic descriptive statistics for this variable. Specifically, the table shows the median unweighted prices of the different residential and business bundle types in the data. Because they are unweighted, they do not necessarily reflect the price a typical OECD consumer would pay, but they do give a sense of some the differences across plans. The table shows, for example, that business plans tend to be more expensive than residential plans, with the unweighted price for business more than double that for residential. Note that while the table shows the median for bundles that include mobile voice, the sample sizes for those plans are quite small, so those figures may not be especially meaningful and we do not explore them further in the analysis.

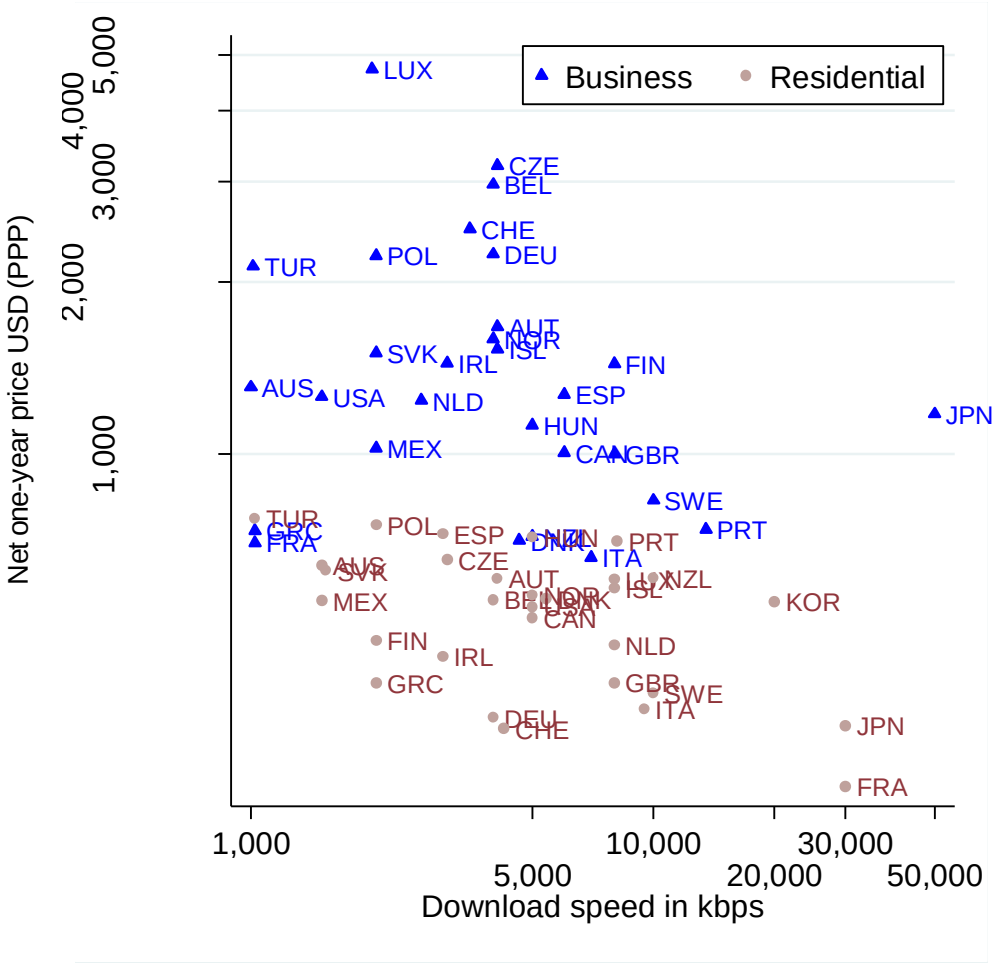
Table 5
Median Unweighted Broadband Bundle Prices Across all Countries, 2007-2009

Bundle type	Residential	Business
Standalone broadband (no bundle)	$499	$1,190
Bundle with		
Fixed voice	544	904
Video	674	-
Fixed voice, video ("triple play")	904	-
Fixed voice, mobile voice, video	974	-
Fixed voice, mobile voice	672	963

[11] Note that all currency values are converted to U.S. dollars at annual purchasing power parity (PPP). All discussion and figures are presented in dollars by PPP. Rates available from the OECD at http://stats.oecd.org/Index.aspx?datasetcode=SNA_TABLE4.

Figure 2 provides additional information on the residential-business price difference. The figure shows that business plans are consistently more expensive than residential plans even where, as is the case in many countries, residential plans tend to be faster.

Figure 2
Median Net One-Year Price and Download Speed for Business and Residential Standalone Broadband Plans, 2007-2009[12]



Upcoming papers in this series will use the data to examine price comparisons over time and across countries. Section III of this paper uses this dataset and the variables we constructed to evaluate how the different components of broadband plans are correlated with price.

III. Metering, Contracts, and Video

Americans have become accustomed to paying for flat-rate unlimited Internet connections ever since AOL introduced such a plan for its dial-up Internet service in December 1996.[13] Recently,

[12] ISO abbreviations per http://unstats.un.org/unsd/methods/m49/m49alpha.htm

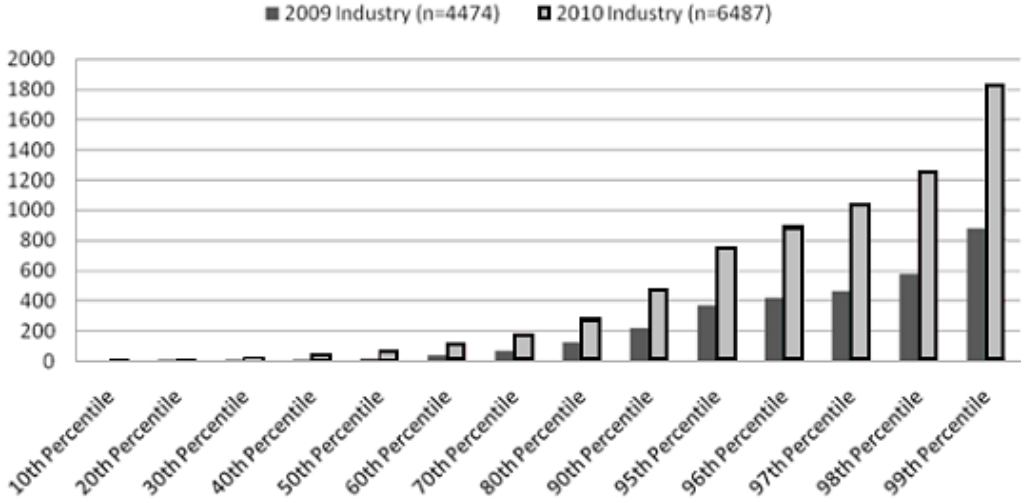
[13] Though AOL is the most recognizable, Microsoft and small ISPs were actually first to introduce a flat-rate. See Bourreau (2002, footnote 3).

though, increasing bandwidth demand has prompted ISPs to begin to explore implementing various types of metered pricing.

Some wireless providers already sell plans that allow a certain amount of data to be exchanged each month for a base price, with additional charges for additional data.[14] Such plans could become more common with the growing popularity of "smart phones" and other wireless devices. Reaction to these plans has been mixed.

By one calculation, most consumers would probably pay less for data under AT&T's new wireless plans with data caps than they would under its older, unlimited, plans. Figure 3, from Nielsen, shows that in 2010 99 percent of smartphone users consumed less than two gigabytes, the cap for AT&T's more expensive plan, in a typical month.[15]

Figure 3
"Industry MB Usage by Percentile – Smartphone Only"



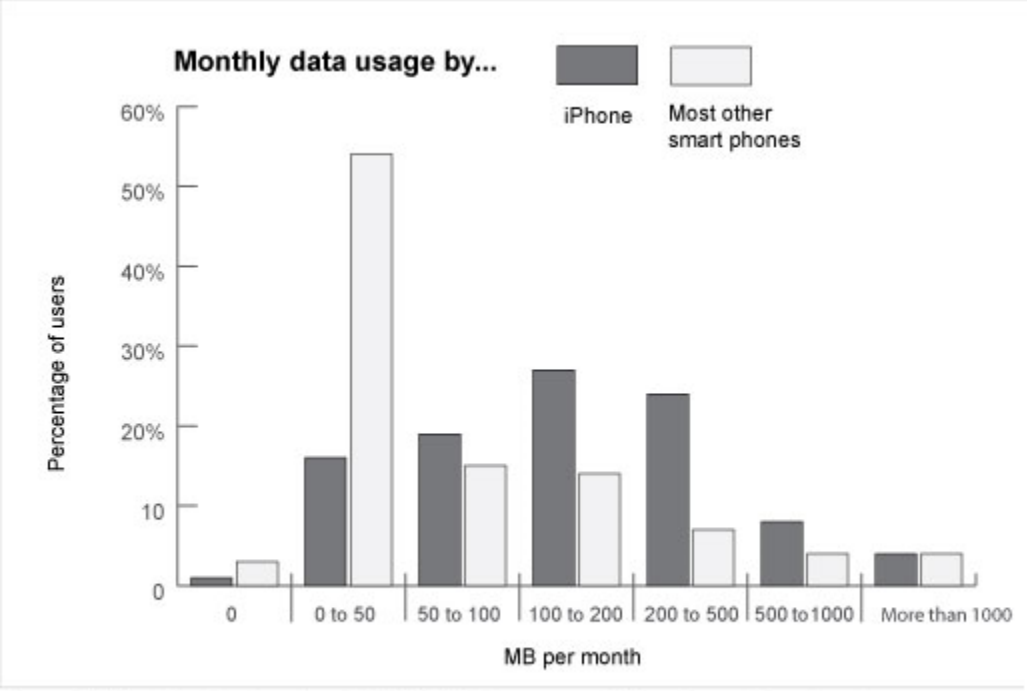
Source: The Nielsen Company

Consumer Reports cites a study by Validas confirming Nielsen's analysis (Blyskal 2010). Figure 4 shows that close to 70 percent of iPhone users consume less than 200 MB per month, which is the cap for AT&T's cheaper data plan.

[14] AT&T, in particular, eliminated its flat-rate unlimited pricing for new owners of iPhones and iPads, instead offering two plans: $15 for 250 MB of data per month, with $15 for an additional 200 MB; and $25 for 2 GB of data per month, with $10 for each additional 1 GB. See June 2, 2010 press release at http://www.att.com/gen/press-room?pid=4800&cdvn=news&newsarticleid=30854

[15] http://blog.nielsen.com/nielsenwire/online_mobile/quantifying-the-mobile-data-tsunami-and-its-implications/

Figure 4
Distribution of Wireless Data Usage According to Validas



Source: Validas. Based on data about 1,012 individual consumer cell phone lines collected from January through November, 2009. "Other smartphones" does not include Blackberries, which were analyzed separately.

Some analysts, however, remain concerned that these plans make video streaming impractical given the bandwidth it consumes, could eventually cost consumers more as they use their wireless devices more intensively, and generally make it less likely for wireless to become a viable substitute for wireline broadband.[16] To be sure, while Figure 3 shows that the vast majority of users consume small amounts of data today, it also shows per user mobile data consumption growing quickly, so the number of people who exceed the caps could increase significantly in a relatively short period of time.

Major U.S. wireline providers have not yet introduced metered pricing successfully, though, as shown above, it is common in other countries.[17] An experimental metered pricing plan by Time Warner Cable garnered strong reaction, prompting one group to demand that Congress "investigate ongoing metered pricing practices to determine the impact on consumers."[18] Some in Congress did, in fact, hold hearings on the plans.[19] In response to this backlash, Time Warner Cable canceled its experiment.

[16] See, for example, Burstein (2010) and Higginbotham (2010).
[17] Comcast, with its 250 GB monthly cap introduced in October 2008, is an exception, but the monthly bandwidth allowance is so high that, for today's broadband uses, it affects only a tiny number of consumers (according to Comcast, "about one tenth of 1%") See "Frequently Asked Questions about Excessive Use," http://customer.comcast.com/Pages/FAQViewer.aspx?seoid=Frequently-Asked-Questions-about-Excessive-Use Last accessed November 17, 2010.
[18] Free Press letter to the Committee on Energy and Commerce, April 22, 2009, available at http://www.freepress.net/files/FP_metering_letter.pdf
[19] Former Representative Eric Massa (resigned March 2010), even introduced a "Broadband Internet Fairness Act"

Despite the political reaction, all consumers are not inherently worse off or better off with metered pricing. Low-volume users are likely to be better off under metered plans and high-volume users worse off. The net effect on any given consumer depends on his data use, the base price, how much data the base price allows, the price of data when exceeding the cap, and how much he would have paid for an unlimited plan.

In addition, data caps and metering do not necessarily require charging by the bit for data use that exceeds the cap. Virgin Media in the UK, for example, has time-of-day data caps. When a user exceeds his allotted usage for the time period Virgin Media reduces his bandwidth until the time period expires.[20]

Metering is one of a potentially large number of attributes of broadband plans that consumers may value differently depending on their preferences. Consumers already choose a combination of plan components when they sign up for broadband. In addition to choosing whether to bundle their connection with phone and/or video, they choose upload and download speeds, contract length, and outside of the U.S., often data transfer caps. Different consumers value each of those attributes differently, and balance the net price against the components of their plan. To date, however, no analysis has attempted to disaggregate the price of different plan components.

Our dataset, introduced above, allows us to quantify the different components of broadband plans and estimate a hedonic model to determine how much each component of the plan contributes to the price.

Empirical Analysis

We use a simple hedonic approach to disaggregate the price components of each plan in our dataset. Specifically, we estimate equation (2) below:

$$(2)\text{price}_{it} = \begin{pmatrix} \text{download speed}_{it}, \text{bitcap}_{it}, (\text{size of bitcap} \mid \text{bitcap})_{it}, \text{tax included}_{it}, \\ \text{contract}_{it}, (\text{length of contract} \mid \text{contract})_{it}, \text{technology type}_{it}, \\ (\text{number of video channels} \mid \text{video bundle})_{it}, \gamma_i \phi_t \end{pmatrix}$$

In this equation, $f(\bullet)$ is a linear function, *i* indicates the plan and *t* indicates the quarter-year in which the plan was advertised. γ_i are firm fixed effects to control for firm-specific factors that may affect price levels, and ϕ_t indicates time fixed effects to control for general trends and time-specific shocks. Table 6 defines the variables in the equation.

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in June 2009 to make illegal "volume usage service plans imposing rates, terms and conditions that are unjust, unreasonable, or unreasonably discriminatory."

[20] http://shop.virginmedia.com/help/traffic-management/traffic-management-policy.html. In principle, by reducing peak demand on the network and thus the need to be able to handle large peaks, this approach to traffic management can allow a provider to build out more quickly and offer lower prices. We are not aware, however, of any empirical studies on this question.

Table 6
Variables Included in Equation

Variable	Definition
Download speed	Download speed, in Mbps, as advertised by the provider
Bitcap	Does the plan have a usage cap that, when exceeded, results in additional charges or throttling?
Size of bitcap | bitcap	Size of the cap, in GB, if the plan has a cap
Contract	Does the plan have a contract?
Length of contract | contract	Length of the contract, in months, if the plan has a contract
Video	Does the plan include a video package?
Fixed phone	Does the plan include a fixed phone line?
Mobile phone	Does the plan include a mobile phone?
Number of video channels | video bundle	Number of video channels included in the plan if video is included in the plan
Technology type	Indicator variables for whether the plan is cable, DSL, VDSL, FTTX, or other
Tax included	Indicator of whether the recorded price includes taxes

Given the very different prices for different bundles we consider them to be different products, and therefore estimate the equation separately for residential standalone broadband, residential triple play packages, and business standalone broadband.

Table 7 shows the results of this regression. The first column shows the results for residential standalone broadband, the second for residential triple-play packages, and the third for business broadband.

Table 7
Hedonic Regression Results for Broadband Plans

	Residential		Business
	Standalone	Triple play	Standalone
Mean of dependent variable (net one-year price in USD)	553.96	929.87	2097.71
Downstream speed in Mbps	2.97	8.92	3.81
	(22.61)**	(12.19)**	(5.45)**
Plan includes a data limit (bitcap)	-163.74	-152.06	-1,063.41
	(14.05)**	(3.61)**	(10.51)**
Size of bitcap in GB	1.67	1.85	3.90
	(15.26)**	(4.59)**	(4.30)**
Number video channels		2.01	
		(11.31)**	
Plan has a contract	-22.04	-11.31	-863.44
	(1.42)	(0.22)	(8.18)**

Contract length in months		-5.64	-5.04	23.94
		(7.04)**	(1.37)	(5.31)**
Price includes tax		-21.90	34.87	611.25
		(1.03)	(0.24)	(5.39)**
Broadband technology (relative to cable, which is the excluded technology)	DSL	-53.77	154.49	-1,649.75
		(6.22)**	(3.82)**	(26.44)**
	VDSL	7.02	86.03	971.47
		(0.40)	(0.59)	(6.63)**
	FTTX	-92.02	-341.44	205.25
		(7.57)**	(6.14)**	(1.35)
	Other	21.23	0.00	3,857.17
		(1.24)		(30.93)**
Date (relative to 2007Q1, which is the excluded period)	2007Q2	-16.05	130.11	-163.22
		(1.42)	(2.99)**	(1.63)
	2007Q3	-17.211	186.88	-50.72
		(1.49)	(4.38)**	(0.48)
	2007Q4	-24.562	211.705	-252.83
		(2.11)*	(5.01)**	(2.41)*
	2008Q1	-27.682	147.820	-393.94
		(2.38)*	(3.32)**	(3.80)**
	2008Q2	-42.710	188.634	-115.83
		(3.73)**	(4.26)**	(1.11)
	2008Q3	-33.899	157.616	-104.48
		(2.91)**	(3.56)**	(1.01)
	2008Q4	-35.860	145.658	-167.35
		(3.07)**	(3.31)**	(1.60)
	2009Q1	-30.599	155.166	-163.48
		(2.57)*	(3.49)**	(1.58)
	2009Q2	-16.787	166.905	-1.59
		(1.40)	(3.82)**	(0.02)
	2009Q3	-7.998	158.546	-31.47
		(0.66)	(3.63)**	(0.30)
	2009Q4	8.673	165.725	-72.70
		(0.72)	(3.82)**	(0.69)
Constant		788.29	284.11	4,103.95
		(21.64)**	(1.19)	(3.11)**
Observations		8262	1020	8563
R-squared		0.45	0.74	0.47

Absolute value of t-statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%
ISP (firm) fixed effects included, but not shown.

Discussion of Results

Overall, the results suggest that plans with data caps are cheaper than unlimited plans, plans with faster speeds cost more than those with slower speeds, and residential plans with contracts are cheaper than residential plans without contracts. Business plans with contracts are more costly than plans without contracts. We discuss these results in more detail below.

Residential Broadband Plans

The coefficient estimates presented above suggest that the net one-year price for plans with bitcaps is less than for similar plans with unlimited data transfer. Residential standalone plans with bitcaps are, on average, about $164 less per year than similar but unlimited plans. The price of the plan increases by about $1.68 per year for each gigabyte the bitcap increases (i.e., as it approaches unlimited from zero). Residential triple play plans with bitcaps are about $152 less per year than unlimited but otherwise similar plans, with the price increasing by about $1.85 for each gigabyte increase in the cap.

The coefficients on the contract variables suggest that longer contracts are generally associated with lower residential prices, though the coefficient estimates are not all statistically significant. The dummy variable for plans that have a contract is negative, but is statistically insignificant and small in magnitude ($22 less over the course of a year for standalone, $11 for triple play). The continuous variable representing the length of a contract, however, shows that for residential standalone plans each additional month of a contract is associated with a $5.64 decrease in the one-year price. The result is similar for triple play, but is not statistically significant at conventional levels.[21]

Residential plans offering voice, video and data are, on average, significantly more costly than standalone plans. The analysis suggests that each channel in a video package is associated with a $2.01 increase in the plan one-year price. Recall, however, that the data do not distinguish between *types* of channels, so these estimates are averages across all channels, from the least-watched public-access channels to the premium sports channels that command the highest fees.[22] Moreover, channels are rarely, if ever, sold a la carte either to the distributor by the programmers or to customers by the distributors. It is therefore probably not especially meaningful to think of a per-channel price. Thinking in terms of channel bundle sizes is more natural; for example, the analysis suggests that a 100-channel package would cost about $180 more than a 10-channel package.

The dummy variable indicating whether the price includes tax is not statistically significant for either standalone or triple play residential broadband. Curiously, though, the coefficient is negative for standalone plans and closer to statistical significance than for triple plays. One would think *a priori* that prices including tax would be higher than those that do not yet have tax added on. Though we cannot reject the hypothesis that the tax dummy is simply uncorrelated with the one-year price, the coefficient suggests that plans that include tax may, all else equal, be cheaper than those that do not. Let's assume for the moment that standalone broadband plans that advertise a price including tax are, in fact, cheaper than plans that do not, all else equal. A possible explanation could be that plans including tax in their advertised prices are targeted at more price-sensitive consumers, meaning that cheaper plans are more likely to include tax in their advertisements than are more expensive plans.

[21] P-value of 0.17.

[22] Other factors in addition to the wide variation in consumer willingness to pay for different channels also make the per-channel coefficient difficult to interpret. For example, if programmers sell content to video distributors in bundles of channels and the distributors, in turn, sell bundles of channels to consumers, then the average per-channel fee may not be especially meaningful.

Business Broadband Plans

Business broadband shows similar results for data caps. Plans with bitcaps are about $1,063 less than plans without, with the price increasing by about $3.90 for each gigabyte increase in the cap.

Other coefficients are somewhat more difficult to interpret. In this case, the dummy variable for business plans with contracts indicates they are about $863 less than plans without contracts. Each month of the contract, however, is associated with an increase of about $24. That is, the longer the contract (other things being equal) the more a business user would pay. On its face this increasing relationship is nonsensical—it implies that otherwise identical plans would cost more with a longer commitment, which runs counter to common sense and consumer expectations.[23] One possible explanation is that we cannot incorporate certain crucial elements of business contracts into our model. For example, while residential contracts simply obligate a subscriber to remain a customer for some length of time or pay a fee—presumably in exchange for a discount or additional services—business contracts are probably more likely to include additional obligations on the ISP. Longer contracts may require the ISP to maintain certain levels of quality, for example, or a guaranteed response time to fix problems. Such obligations could increase the price of a plan but would be worthwhile to the business customer.

Implications

This analysis shows that data caps do not necessarily increase consumer prices and could reduce prices for consumers moving from unlimited plans to plans with data caps. The net effect on a given consumer depends on whether his data use exceeds the cap and, if so, the amount of additional data used and its price. The effect on consumer welfare of exceeding the data cap on a plan that throttles speed (rather than charges by the bit in excess of the cap) would depend on how much the user values the incremental speed.

Consider the implications of the results for a hypothetical plan with a 10 GB cap relative to a similar, but unlimited data, plan. A residential standalone plan with the 10 GB cap would cost about $147 less per year than an unlimited plan—about 27 percent less relative to the mean price. A 10 GB capped residential triple play would cost about $134 less per year than an unlimited plan—about 14 percent less relative to the mean price.[24]

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[23] Note the price predicted for a plan with contract (which incorporates the effect of the coefficient on the contract indicator and that which is tied to the specific contract length) is less than an otherwise identical plan without a contract for any length under about three years.

[24] This aligns with at least one real-world example. Until June 2010, AT&T offered "unlimited" data plans for iPhones and iPads for $30 per month. At that time AT&T introduced two new plans: $25 for 2 GB of data and $15 for 200 MB of data. If we were to consider wireless data plans to be like residential standalone plans, then we would expect a price decrease of approximately 30 percent with caps of that size (slightly less for 2 GB, slightly more for 250 MB). In fact, we saw a 16 percent price decrease for users going to the 2 GB plan and a 50 percent decrease for users going to the 250 MB plan, assuming, critically, that the user does not exceed his data cap.

We recognize that comparing wireless to wireline plans is problematic in several ways. While wireless and wireline have the potential to become competitors, especially with new 4G technologies, today they are not interchangeable products for most consumers, meaning that demand and supply curves are not alike. Additionally, there has been controversy over whether "unlimited" wireless plans are truly unlimited (http://www.dslreports.com/shownews/TMobile-Sued-For-Offering-Limited-Unlimited-Service-109801). Nevertheless, it suggests that our estimates are not outrageous.

As mentioned above, however, these estimates by themselves do not tell us how a typical consumer might fare under a capped plan. The biggest factors for a given consumer will be his data consumption, the size of the cap, the base price for the data allowance, and the overage charges.[25] Our data on penalties for exceeding caps are too incomplete to determine the point at which a consumer becomes indifferent between capped and unlimited plans. Other information, however, sheds some light on how caps are likely to affect a typical consumer.

Table 8 shows the mean and median size of data caps for capped plans in our dataset by year. According to the FCC (2010a), in 2009 the "the *median* user consumed less than 2 GB/month on her home connection, while the *average* (mean) U.S. Internet user consumed more than 9 GB/month" (p 6, italics in original). While the FCC's data are for U.S. consumers and the median and mean cap sizes below are mostly for non-U.S. OECD countries, together the two suggest that such caps would not impose much of a constraint on the typical user. In addition, the table shows that the size of the caps has been increasing over the time period, suggesting that concerns about the effects of growing bandwidth use may be misplaced, assuming both trends (growing use and cap size) continue.

Table 8
Median and Mean Size of Bitcaps for Plans With Caps, in GB

	Median	Mean
2007 1st half	10	18.1
2007 2nd half	10	20.7
2008 1st half	10	20.8
2008 2nd half	10	23.7
2009 1st half	13.5	28.0
2009 2nd half	20	31.8

Note: We exclude caps in the data that meet or exceed 200 GB per month as they appear to be outliers relative to the rest of the data. Including those increases the mean cap sizes significantly.

These results do not imply that capped plans are always less expensive than unlimited plans. After all, many factors affect prices. As we will see in Part 2 of this project, France has among the least expensive broadband prices of all OECD countries, yet nearly all French broadband plans offer unlimited data transfer.

With triple play plans the price effect of the data cap is smaller relative to the total price of the bundle and relative to the effect of video. Broadband bundled with video is arguably a different—and more costly—product from standalone broadband. Additional video channels add substantially to the price, on average, of these bundles.

[25] The additional cost to a consumer becomes harder to estimate when the penalty is throttled speed.

IV. Conclusion

This paper decomposes broadband prices using a unique dataset of more than 25,000 residential and business broadband plans from all OECD countries in the period 2007-2009. Contrary to much speculation, broadband plans with data caps and contracts tend to cost less per year than do unlimited plans and plans without contracts. The net price to a user will depend, of course, on the size of the data cap, how much data the user consumes, and whether exceeding the cap results in additional charges or speed throttling. The estimates suggest that a residential standalone plan with a 10 gigabyte cap, for example, would cost about 27 percent less than an otherwise identical, but unlimited data plan. A similarly capped residential triple-play would cost about 14 percent less than an otherwise identical but unlimited plan.

The way we build this dataset in the face of a lack of data on prices help make this paper unique. However, those factors also create problems. While we have tried to be clear about those problems and their implications, we feel it is important to reiterate the most important of them here. Perhaps the biggest problem, as discussed above, is that we do not know how many subscribers a given plan has, especially as we define a plan. We use the best tools and data we can to mitigate this problem, including ISP-level fixed effects in the regressions. Even so, it is almost certainly true that in some cases some broadband plans will have bigger effects on the analysis than are justified by their true subscriber numbers.

The policy implications of the paper, however, are clear. Policymakers should not immediately conclude that data caps and other pricing schemes that differ from traditional unlimited plans are necessarily bad. Many consumers, especially users at the middle or low end of bandwidth use, are likely to benefit in the form of lower prices. A crucial question regarding capped plans is whether they become increasingly binding as data consumption grows. While nobody knows what the future will bring, our data suggest that, like usage, the size of data caps has been increasing over time. It will be important to track these trends and evaluate the effects of metering on prices, investment, and usage.

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