Borradores de ECONOMÍA

Merger Effects with Product Complementarity: Evidence from Colombia's Telecommunications*

Juan Vélez[†]

Abstract

Mergers of firms producing complementary products have ambiguous effects on consumer welfare. Consumers benefit if the firm, motivated by the internalized profits created by the complementarity, lowers prices. Consumers are hurt if the firm uses bundles to exert price discrimination, making standalone products more expensive. To assess which effect dominates, I use an administrative dataset, which records prices, market shares, and plan attributes of the universe of Colombia's telecom carriers. I estimate a random coefficients discrete choice model of demand for bundled and standalone telecom products, in which the degree of substitutability or complementarity among products is an essential parameter of interest. I find that major telecom products display a mix of substitutability and complementarity, but in general hardwired and mobile services are complements. Counterfactual experiments using the estimated model indicate positive net effects of mergers with complements: despite a small increase in the price of standalone goods, consumer surplus increased by around 11 million dollars per quarter after the Claro merger. On the other hand I find evidence that mergers between ISPs and mobile carriers reduce the likelihood of poorer households adopting faster broadband.

Keywords: Market Structure, Imperfect Competition, Mergers, Telecommunications.

JEL codes: L22, L13, G34, L96.

Resumen

Los efectos de fusiones entre firmas que producen bienes complementarios son ambiguos. Por un lado, la firma fusionada tiene incentivos para bajar precios porque la fusión internaliza los beneficios creados por la complementariedad. Por otro, con la fusión, la firma gana la capacidad de usar paquetes para discriminar precios, incrementando el precio de los bienes individuales. En este artículo uso datos sobre suscripción a servicios de telecomunicación para averiguar cuál de las dos posibilidades prevalece. Estimo un modelo elección discreta en el que los consumidores pueden suscribirse a bienes individuales o empaquetados, que identifica los patrones de sustitución o complementariedad entre internet, celular, televisión e internet móvil. Los resultados sugieren que para los Colombianos los servicios de comunicación cableados e inalámbricos son complementarios. Experimentos contrafactuales usando las preferencias estimadas, muestran evidencia de efectos netos positivos de fusiones entre operadores de cable y operadores móviles: a pesar de un leve incremento en los precios de los servicios individuales, el excedente del consumidor aumenta aproximadamente en 11 millones de dólares cada trimestre a causa de la fusión de Claro. Por otro lado hay evidencia de que estas fusiones pueden reducir la probabilidad de que hogares de estratos 1,2 y 3 adopten internet de alta velocidad.

1 Introduction

In recent years, there has been a wave of mergers among firms producing differentiated and potentially complementary products. Take for instance the merger between Apple and Beats.[1] Although some consumers enjoy having simultaneously a smartphone and a pair of headphones, others are content having just one or the other. For consumers who enjoy having both, the utility of consuming them together is typically higher than the sum of their individual components. The products sold by Apple and Beats are textbook examples of complementary products, and the merger between these two firms is not a traditional horizontal or vertical merger. Mergers like this, in particular among the market leaders in their respective fields, often stir a policy debate fueled by concerns about anti-competitive effects. Consider Colombia's telecommunications industries as an example. The 2012 Claro merger involved Comcel, the largest mobile carrier, and Telmex, the largest Internet Service Provider (ISP) in the country. Consumers were understandably concerned not only due to the massive market power of the merging parties, but because of the cunning nature of the deal.[2]

The difficulty of predicting the effects of mergers of complementary goods has been recently highlighted in the antitrust literature (Masson et al., 2014). Choi (2008) shows that the merger may cause a decrease in prices that would increase consumer welfare. The price reduction occurs because the demands of firms producing complementary goods are decreasing in each other's prices. A reduction in the price of either firm, increases the revenue of the other. When acting independently a firm reducing the price does not reap the extra profits it generates, thus, the firms have no incentives to reduce prices prior to the merger. The merger internalizes those extra profits making it optimal to lower the price. However, the prices could also rise because besides the standard upward pricing pressure that comes with any merger, the merged firm may use bundling to exert price discrimination. The merged firm could find it optimal to decrease the price of bundles

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[1]Other examples around 2015 are: AT&T-DirecTV, Dell-EMC, IBM-Explorys.

[2]The merging firms dismissed the possibility of a merger in February 2012 (http://archive.is/KLvxs). By June the same year the companies announced the unification of their brands (http://archive.is/exIwu). By the end of that summer no one doubted they had effectively merged.

and increase it for standalone goods, and by doing so, it would harm consumers who prefer to build their own bundle (mix-and-match). If enough people prefer to mix-and-match, price discrimination may cause a net reduction in consumer welfare.

Two reasons make the telecommunications sector in Colombia a great setting for studying these mergers. First, the sector has been rocked by several momentous events during its recent past including a few mergers of companies delivering complementary services. [3] The second reason is the availability of detailed data because regulators have been very resolute in collecting information about the industry.

This article explores the dual effects of mergers with complementary goods using panel data from Colombia on market shares, prices, and product characteristics for the universe of telecommunications providers. I begin by estimating the demand for bundles of telecommunications services -Internet, cell phone, TV, landline phone and mobile Internet-, in a discrete choice framework that permits complementarities between the different products. Then, I use the estimated demand model together with an assumption of Bertrand competition to evaluate whether mergers between wired and wireless providers would be pro- or anti-competitive.

I employ a comprehensive administrative data set put together by the Comisión de Regulación de Comunicaciones (CRC).[4] The dataset contains information about the universe of firms and plans offered because every provider of telecom services in Colombia is obligated to file CRC's Form 5 quarterly. In Form 5, providers report bundled and standalone services provided in every market, the number of households subscribed to each service and the service's most relevant characteristics. The key feature of the data, besides the high detail of information about characteristics of the products, is the ability to observe market shares for standalone and bundled goods, as this is critical to identify whether the services are complements or substitutes.

The framework I use to obtain the substitution patterns builds on Gentzkow (2007). I estimate

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[3]For instance, early in 2012 Telefónica consolidated its control over Coltel and a few months later Telmex and Comcel merged under the Claro banner. 2013 was the year of the Mobile Virtual Network Operators (MVNO), with Éxito and Virgin entering the mobile market. In 2014 Tigo and Une-EPM merged and DirecTV started providing mobile Internet. Furthermore, there will be soon another merger, as the government of Bogotá decided to sell ETB.

[4]CRC is the Colombian analog to the Federal Communications Commission in the US.

a random coefficients discrete choice model for telecommunications services in which the utility is specified to allow consumption of standalone and bundled goods. The indirect utility function of bundles is adjusted to incorporate the additional utility of joint consumption, namely, it includes a parameter containing information about the substitution patterns between the goods in the bundle. An estimated negative (positive) sign means that the goods in the bundle are substitutes (complements).

The main challenge is to avoid confusing complementarity with correlated tastes or with the fact that the goods are just bad substitutes. Observing that subscribers to cable TV often subscribe to broadband as well, can be evidence that the two are complements. But it could also mean that the preferences for both are correlated, like when a household of cinephiles subscribes to cable TV and Internet because both are media for watching movies. Similarly, one usually observes joint purchases of goods that are bad substitutes, like when households purchase salt and detergent jointly because they are bad substitutes and not because they are complements.

With the appropriate data, the model can recover true complementarity. A good dataset to recover complementarities must have market shares for both bundled and standalone goods and variation of the characteristics of the goods is desirable, because it aids in the identification of the substitution patterns. Identification is further enhanced when characteristics that shift the utility of one good do not enter the utility of the other. All these traits are present in the data collected by the CRC.

I find that Colombian households, in general, derive extra utility from consuming hardwired and mobile services together. For instance, there is a strong complementarity between Internet and cell phone services. Every month, households get almost $3.13 worth of utility for their joint consumption. Households also perceive TV, mobile and hardwired Internet as complements. The extra utility they get from subscribing to all three is worth almost $1.45 a month. In contrast, mobile Internet and land-line phone are strong substitutes.

Knowing that wireless and wired services are complementary goods, allows me to simulate several scenarios of interest. I start by studying alternatives ways in which to the Claro merger

could have unfolded. Namely, I simulate a counterfactual in which the regulators block the merger altogether, and another in which the merger is allowed but the merged firm cannot sell bundles. In these simulated equilibria, I re-optimize the prices of all firms in a market assuming that Telmex and Comcel decide prices independently if the merger is blocked, and to maximize joint profits when the merger is allowed. I use the fact that the data contains information about services provided by the merging firms prior to the 2012 to get an insight into the kind of services that the firms would have provided in each scenario. Finally I simulate a merger between ETB and Avantel which provide wired and wireless services respectively. The interest in this simulation is twofold as it contributes to the understanding of the effects of mergers with complements and to an ongoing debate around the sale of ETB.

In the simulations, I assume that the firms engage in Bertrand-Nash competition every period. This solution concept assumes that the firms strategically decide prices conditional on their rivals' characteristics. I use the First Order Conditions (FOC) of the game to simulate the alternative scenarios and solve for the new equilibrium prices. The resulting distributions of prices confirm the predictions from the theory.

The findings presented here have important implications for regulatory agencies as they often prescribe divestiture and proscribe bundling when allowing mergers. Given the potential for pro-competitive effects, the acquisition of firms producing complements could be an alternative remedy to divestiture. If the merger under scrutiny is a merger with complements and consumers have strong preferences for bundles, the regulatory agencies can be more lenient toward bundling. For the particular case of selling ETB, those deciding whether to sell it or not need also decide to whom. The relation between ETB's products and those of its eventual buyer matters. The insights gained here imply that it is more desirable to sell the company to a mobile carrier because consumer surplus increases and because, potentially, a mobile carrier would be willing to pay a higher price for it.

Studying the effect of mergers with complements empirically is very important for two separate reasons. First, there is an important economic theory question of what occurs with these mergers.

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It is well understood that mergers between complements can solve double-marginalization problems and hence are pro-competitive. When the levels of complementarities are large enough, they can be pro-competitive even in the absence of cost synergies. But do products in different sectors have enough complementarities to overcome the standard upward pricing pressure effects from mergers? Economic theory alone cannot resolve this question and hence empirical research can add valuable evidence.

Second, in both the U.S. and Colombia, there have been some proposed mergers between providers of complementary services, in the telecommunications and other sectors. For instance, in the U.S., AT&T and Comcast recently announced their intentions to merge. Exactly as in the Claro case, AT&T focuses on wireless services while Comcast focuses on wired services. To evaluate the price impact of any of these mergers, one would need to understand the level of complementarity between these providers and how this translates into changes in welfare following the merger.

The structure of the rest of the paper is the following. The next two sections more details about mergers with complements and describe how my work relates to the literature. Next I introduce the data and the main features of Colombia's telecommunications sector. The next section presents the empirical model of demand used to estimate substitution patterns. Finally, I present and discuss the results of estimating the model and the counterfactuals.

2   Relation to the Literature

The literature on the effects of mergers of firms producing complementary goods is sparse. In particular, it pales in comparison with the literature studying vertical and horizontal mergers. A handful of theory articles examine the behavior of firms that engage in mixed-bundling after the merger. For instance, Choi (2008) provides an analytical framework to study how a merger affects prices when the merged firm can bundle, and derives the welfare implications for such mergers under different sets of assumptions. Besides, he examines how the mergers impact the incentives

for R&D in the long run. A similar model is presented by Anderson et al. (2010) in which it is shown under which circumstances the merger is profitable for the merging parties and under which conditions it may lead to competitive harm. Both models assume that there are no cost synergies and instead, the incentives for the merger arise from the internalization of profits.

To the best of my knowledge, not many empirical studies have tested the predictions of the theoretical models described above. This article aims at filling that void. To do so, I draw from Gentzkow (2007) which devises a method for estimating complementarity between goods. In short, he proposes to write the utility of a bundle as the sum of two parts. One part is the sum of the utilities of the standalone goods included in the bundle and the other is a term that varies by bundle and whose sign defines a substitution pattern. A negative estimate for the term means that the goods are substitutes whereas a positive estimate means that they are complements. My results suggest that Colombian households, perceive wired and wireless telecom services as complements. The relation between mobile and fixed telecom services, however, is likely to vary around the world (Banerjee and Ros, 2004). For instance, in a similar exercise to the one presented here, Ribeiro and Vareda (2010) found that in the UK phone and cell phone are complementary goods. Wulf et al. (2013) find that complementarity between fixed and mobile services is common among OECD members. This article is similar to Grzybowski and Pereira (2007) in that they assess the unilateral effects on prices of a merger in the Portuguese mobile telephony market but they find that the Portuguese merger caused anti-competitive effects. Several other articles attempt to estimate substitution patterns in the telecom industries. Srinuan et al. (2012) try to estimate substitution patterns between Mobile and Fixed broadband for Sweden, using a multinomial logit. They find that Mobile and Fixed broadband are independent. Their results, though, are probably due to the fact that substitution between goods in the multinomial logit depend exclusively on the goods market shares. Andersson et al. (2009) estimate a demand model for text messages and voice with data from Norway. Their results are inconclusive as they find that voice is a substitute for text messages for small network sizes, and a complement for large network sizes. More recently, Grzybowski et al. (2014) investigate whether mobile and fixed telecom are part

of the same market using data from Slovakia. They conclude that antitrust scrutinies should consider mobile broadband and fixed broadband as belonging to the same market. In energy markets, Granier and Podesta (2010) find that mergers of firms that bundle after the merger have detrimental effects to social welfare.

3   Data

To estimate the model described in the next section, I use data from two sources. The first source is data from CRC's Form 5 which contain market shares and product characteristics. The second source of information is the Gran Encuesta Integrada de Hogares (GEIH) which is a household survey in the style of the Current Population Survey. From the GEIH I get demographics describing households that subscribe to telecom services.

3.1   The CRC's Form 5 data

Firms providing any telecommunications services, be it mobile or hardwired, fill out Form 5 every quarter. The firms report information about the number of subscriptions to individual and bundled services in each city. There are 5 basic services reported by the firms: Internet, cable TV, phone, cell phone and mobile Internet. Firms must also report detailed information about the products attributes.

For instance, when a bundle includes TV, the firms report if at least one channel is High Definition (HD). They also report whether the subscription includes at least one premium channel, as well as the technology used to deliver the service.[5] I do not observe, however, how many or which channels are in the bundle. This raises some concerns for the estimation, as it is likely that more expensive bundles include more premium channels. I describe below how to address these concerns.

When the bundle includes broadband, firms report the download and upload speeds advertised.

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[5]Premium channels are channels like HBO, AMC or Sundance. TV can be delivered through 3 means: IPTV, cable and satellite

Table 1: Bundle characteristics: means and standard deviations

	2015Q1	2015Q2	2015Q3	2015Q4
Price[a]	26.39	29.72	28.31	27.55
	(31.13)	(38.27)	(31.88)	(32.10)
Download speed[b]	2.85	3.12	3.43	3.40
	(1.92)	(2.81)	(3.11)	(3.26)
Premium channel[c]	0.31	0.33	0.34	0.39
	(0.30)	(0.32)	(0.32)	(0.34)
HD channels	0.26	0.24	0.27	0.23
	(0.19)	(0.18)	(0.17)	(0.15)
Data[d] (Mobile)	3.42	3.68	3.76	3.52
	(2.90)	(2.87)	(2.89)	(3.11)
Minutes[e] (Cell)	301.01	409.12	410.36	452.31
	(100.08)	(102.89)	(132.38)	(137.55)
Data[d] (Cell)	2.68	2.89	3.17	3.20
	(4.14)	(5.17)	(5.28)	(4.18)
Minutes (Phone)	435.22	482.337	473.21	461.46
	(212.17)	(283.47)	(473.21)	(258.81)
Observations	28,934	28,965	28,919	28,727

(a) price in 2015 dollars; (b) advertised download speed of bundles with Internet; (c) for bundles with TV (channels like HBO, Sundance, etc.); (d) usage allowance for the plan; (e) number of minutes included with the plan.

The information about Internet service also describes the technology used for its delivery.[6] Form 5 does not account for rented modems. That means that I do not know whether a household is renting a modem or using its own. This should not be a problem giving the high prevalence of modem rentals around the world. In spite of the fact that I do not have data about how often Colombians rent modems, I do know that Americans do it more than 90% of the time.[7] Given that Colombians are, in general, less tech savvy than Americans, it is not a wild assumption to say that Colombians cannot be bothered setting up their own modems and over 90% of them prefer to rent them. [8]

For cell phone and mobile Internet I observe the data allowance of the plans. Cell phone plans

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[6]The last mile connection can be done via ADSL, DSL, coaxial, fiber, wimax, etc.

[7]http://archive.is/qdoVR

[8]In the data there is a small number of residential Internet plans with less than 4 subscribers and with prices well over 6 standard deviations above the mean . The technology used for the delivery of those plans was clear channel (fiber). All other Internet plans delivered via that technology are business plans. I believe there was a mistake when reporting those plans and they ended up coded as residential when they were in fact business. Therefore, I drop them from the dataset. In any case their market shares were infinitesimal.

Table 2: Price and market share of bundles					
	Mean	Median	Std	Min	Max
Price[a]	26.39	25.72	38.31	2.75	619.33
Share[b]	1.03	0.96	3.21	0.01	8.59

(a) price in 2015 dollars; (b) percent of market; 115,545 observations.

specify the number of minutes and messages that consumers can use. Form 5 also records the price of additional messages and minutes, but actual consumption is not observed nor is the overage. Finally, I observe which units are used to determine charges.[9] Providers also report the market in which they offer the bundle and for each market they indicate the bundle's price and the number of households subscribed to it.[10] Figure 2 in the appendix shows all the details included in Form 5.

Table 1 shows summary statistics for the characteristics of bundles included in the data. Notwithstanding the short period of time, there is variation from quarter to quarter. For instance, download speeds are always higher in the last quarter and that increase in speed is caused by firms retiring old plans with low speeds in fringe markets.

Table 2 provides basic summary statistics about prices and market shares and table 3 does so for firms. There is a huge deal of heterogeneity in the data, originating from two sources. First, the firms providing the services are quite different. Some of the firms are giants that operate in almost every market offering numerous plans. For instance, the largest mobile carrier in the data reports over 20 million subscribers every quarter. In contrast, there are small local firms with a reduced number of subscribers that provide a single plan. The other source of heterogeneity are the plans themselves. Landline standalone plans, for instance, are very cheap. On the contrary, bundles including high-speed Internet and premium channels tend to be expensive.

Figure 1 shows the correlation between the presence of standalone goods in bundles.[11] Blue indicates a positive correlation whereas a red indicates a negative correlation. For instance, mobile Internet and cell phone exhibit a strong positive correlation, meaning that households tend to buy

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[9]In some plans charges are calculated by the minute, whereas in others the unit used to compute the charge are seconds.

[10]They also report the price of the individual components in the bundle when there are more than one

[11]Table **??** in the appendix shows the numbers behind the heat map.

Table 3: Summary statistics for firms: means and standard deviations

	2015Q1	2015Q2	2015Q3	2015Q4
Firm level				
Subscribers	2,214,828	2,211,547	2,211,441	2,213,830
	(6,791,197)	(6,673,909)	(6,543,127)	(6,346,187)
# plans	123.84	128.35	124.22	118.38
	(387.35)	(418.88)	(347.85)	(393.41)
Observations	82	82	81	80
Firm-market level				
Subscribers	649,018	654,520	641,785	674,676
	(3,423,785)	(3,367,082)	(3,040,004)	(3,040,004)
# plans	54.28	59.61	44.89	57.61
	(126.48)	(144.84)	(109.28)	(156.59)
Price	15.59	16.00	15.34	17.39
	(20.40)	(26.24)	(24.30)	(22.63)
Observations	3,521	3,405	3,186	3,402

bundles that include both. Analogously, Cable TV and Internet, and land-line phone and mobile Internet show negative correlations.

3.1.1 Cities, strata and markets

Colombian cities are divided into smaller areas and each area is labeled with a number from 1 to 6 called stratum. In the beginning, policy makers created strata to cross-subsidize public utilities (water, electricity and sewage). The idea is straightforward. Higher strata (typically 5 and 6) pay higher prices than they would without stratification whereas lower strata (typically 1 and 2) pay lower prices. The extra revenue generated by the higher strata covers the losses of revenue from lower strata. Consequently, the strata were designed to be highly correlated with income.[12]

Providers of hardwired services realized that they could use strata for price discrimination. Since the stratum number is tied to the dwelling, households cannot arbitrate prices. A person living in a stratum 3 house cannot buy cheaper cable TV to resell it to a stratum 6 household for

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[12]Formally strata are not supposed to be a measure of income. They are supposed to be a measure of the surrounding amenities. Despite that, strata are an aggregated measure of income as rich people live in areas with better amenities. The summary statistics presented below show that strata increases with income.
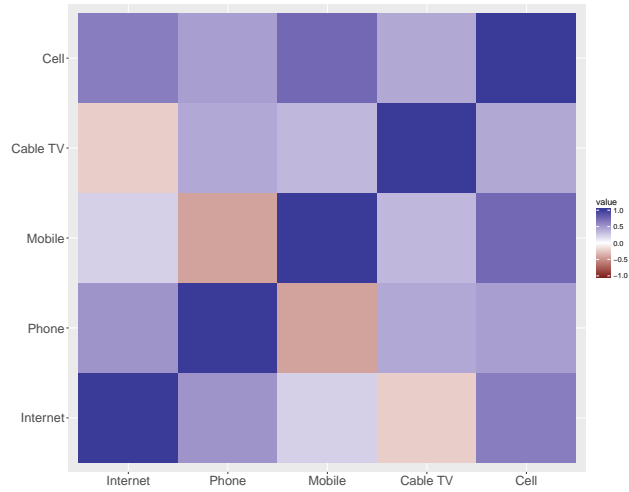
Figure 1: Correlations between standalone goods

a profit. The strata system is perfect for third-degree price discrimination, firms know it and act accordingly. For that reason, the relevant markets are the strata and not the cities. Firms treat each strata within a city as an independent market. Form 5 reflects that and requires firms to report the number of subscribers for each stratum within a city.

3.2 The GEIH data

The other source of data, is the Gran Encuesta Integrada de Hogares (GEIH). The GEIH is a household survey similar to the CPS conducted by the Census Bureau and the Bureau of Labor Statistics in the US. It samples households from 24 populated geographical regions.[13] Households report information about their labor force and living standards. From each one of the 24 geographic areas I get a sub-sample of households and their characteristics. Moreover, I take sub-samples from each stratum in each city. As mentioned earlier, stratification divides Colombian cities into smaller areas. These areas are heterogeneous in many dimensions. By sampling from each stratum in each city I get a more precise distribution of household characteristics. This enhances the precision of the estimates on preferences.

Table 4 shows descriptive statistics for the sample of households. All 24 geographic areas (MSA

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[13]The 24 areas are 13 metropolitan statistical areas and 11 cities. Well over 80% of the country's population live in those 24 areas.

Table 4: Household characteristics by stratum: means and standard deviations

	1	2	3	4	5	6
Schooling[a]	6.94	8.28	9.72	11.75	11.85	13.86
	(2.45)	(2.49)	(2.96)	(3.42)	(3.27)	(3.42)
HH age[b]	0.68	0.61	0.62	0.59	0.56	0.65
	(0.47)	(0.49)	(0.49)	(0.49)	(0.50)	(0.48)
Family size	5.34	4.76	3.65	3.86	3.59	3.37
	(3.45)	(2.27)	(1.48)	(1.62)	(1.53)	(1.52)
Income[c]	386.26	534.17	556.37	933.36	1084.72	1957.3
	(366.42)	(363.72)	(523.72)	(997.25)	(1549.46)	(2277.01)
Observations	720	720	720	720	390	390

(a) average number of years of schooling for members within the household; (b) head of the household is between 25 and 45 year old; (c) monthly income in 2015 dollars.

and cities) have at least 4 strata. Strata 5 and 6 are only present in the main 13 Metropolitan Areas. I sample 30 households from every strata in each area. The simulation step uses those to compute the inner integral in (6). A noteworthy feature of the table is how correlated income (and schooling and family size) and strata are. That is why strata are so useful to exert price discrimination.

4   Empirical model

The effect of a merger with complements on consumer welfare depends on the distribution of tastes for bundled and standalone goods. The merged firm can use mixed bundling to price-discriminate, increasing the price of individual goods and reducing the price of the bundles. If many consumers like individual goods, price discrimination can reduce welfare. To be able to understand a merger with complements, it is necessary, first, to know whether the products in question are complements or substitutes. I draw from the framework devised by Gentzkow (2007) to get estimates of the consumer's willingness to pay for joint consumption. On the demand side, I estimate a random coefficient discrete choice model for telecommunication services. I write a random utility function that captures the extra utility of joint consumption. For the supply side, I assume that, conditional on characteristics, the firms engage in price competition in a Bertrand-Nash fashion and that the costs of the merging firms do not change with the merger. Assuming no cost synergy, helps me

concentrate exclusively on the strategic aspect of the merger.

4.1 Empirical demand

Suppose that in a given market there are $\mathscr{F}$ firms indexed by $f \in \{1, 2, 3, ..., \mathscr{F}\}$. Let $g \in \{1, 2, 3, ..., G_f\}$ index the standalone goods provided by a firm. With those goods, the firm can sell bundles indexed by $b \in \{1, 2, 3, ..., \mathscr{B}(G_f)\}$. Let any combination of the same basic goods be a type of bundle.[14] Let $j \in \{0, 1, 2, 3, ..., 2^{max\{G_1, G_2, ..., G_{\mathscr{F}}\}}\}$ denote those types, with zero indexing the outside option.[15]

4.1.1 Utility

The utility that a consumer i derives from subscribing to a service g is given by

$$\bar{u}_{ig} = (p_g + \nabla p_g)\,\bar{\alpha}_i + \sum_k x_{gk}\bar{\beta}_{igk} + \xi_g \tag{1}$$

where p_g is the price, ∇p_g is a discount when the good is bundled with other goods (by definition $\nabla p_g = 0$ for singleton bundles), $x_{g1}, ..., x_{gK}$ are the observed non-price characteristics and ξ_g is the preference for the unobserved attributes of the good. The $\bar{\alpha}_i$ and $\bar{\beta}_{igk}$ are the consumer's preferences for price and characteristic k respectively. I allow these preferences to vary by consumer. In particular, I specify them as follows:

$$
\begin{aligned}
\bar{\alpha}_i &= \quad \alpha + \sum_r z_{ir}\alpha_r^o + \nu_{ip}\alpha^u \\
\bar{\beta}_{igk} &= \quad \beta_{gk} + \sum_r z_{ir}\beta_{gkr}^o + \nu_{igk}\beta_{gk}^u
\end{aligned}
\tag{2}
$$

I decompose a consumer's preference for attribute x_{gk} into a mean that is constant to all consumers, and a deviation from that mean that depends on the individual's observed (z_{ir}) and unobserved (ν_{igk}) characteristics.

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[14]For simplicity I use the term bundle to denote singleton bundles and the outside option as well as bundles with more goods.

[15]For instance, in the application below, there will be 5 standalone services: phone, Internet, cable TV, cell phone and mobile Internet. Suppose two bundles containing TV and Phone but differentiated as one has HD channels. The type of the two bundles is the same.

We can now write the utility of any given bundle b which is of type j as the sum of the utilities of the standalone services g in the bundle, plus a term Γ_j that is the same for all bundles of type j:

$$
u_{ib} = \begin{cases} \varepsilon_{ib} & \textbf{if } b = 0 \\[2mm] \sum_{g \in b} \bar{u}_{ig} + \Gamma_{j(b)} + \varepsilon_{ib} & \textbf{if } b > 0 \end{cases} \tag{3}
$$

where ε_{ib} are residual terms assumed to follow a type 1 extreme distribution. By assumption $\Gamma_{j(b)} = 0$ for singleton bundles. Putting together equations (1), (2) and (3) we get the utility for bundles

$$
u_{ib} = \delta_b + \sum_{g \in b, r} (p_g + \nabla p_g)_g z_{ir} \alpha_r^o + \sum_{g \in b, k, r} x_{gk} z_{ir} \beta_{gkr}^o + \sum_{g \in b} (p_g + \nabla p_g) \nu_{ip} \alpha^u + \sum_{g \in b, k} x_{gk} \nu_{igk} \beta_{gk}^u + \varepsilon_{ib} \tag{4}
$$

where

$$
\delta_b = \sum_{g \in b} (p_g + \nabla p_g) \alpha + \sum_{g \in b, k} x_{gk} \beta_{gk} + \Gamma_{j(b)} + \sum \xi_g \tag{5}
$$

As is evident from (4) and (5), every individual's utility for bundle b has three components. A component that is common across households consuming the bundle (δ_b); a term ($\sum_{g \in b, r} (p_g + \nabla p_g) z_{ir} \alpha_r^o + \sum_{g \in b, k, r} x_{gk} z_{ir} \beta_{gkr}^o$) that allows households with different observed characteristics to value characteristics differently; and a term not observed by the econometrician that helps to rationalize why households with the same observed characteristics would substitute more strongly between certain bundles ($\sum_{g \in b} (p_g + \nabla p_g) \nu_{ip} \alpha^u + \sum_{g \in b, k} x_{gk} \nu_{igk} \beta_{gk}^u$). Given the distributional assumption on ε_{ib}, the market share of households choosing bundle b is given by

$$
s_b = \int_\nu \int_z \frac{\exp \left[\sum_{g \in b} \bar{u}_{ig} + \Gamma_{j(b)} \right]}{1 + \sum_{f=1}^{\mathscr{F}} \sum_{l=1}^{\mathscr{B}(G_f)} \exp \left[\sum_{g \in l} \bar{u}_{ig} + \Gamma_{l(b)} \right]} dF_z dF_\nu \tag{6}
$$

where F_z and F_ν are the distributions of observed and unobserved characteristics of households, $\mathscr{F}$ is the number of firms in the market and $\mathscr{B}(G_f)$ is the number of bundles offered by firm f.

The estimation consists of finding the parameters that match the predicted shares in (6) to those in the data. The task is challenging in no less than two ways that are worth specifying. The first challenge comes from the choice of distribution for the errors. Under logit errors, there is no analytical closed form solution to the integrals in (6). Second, the goods have attributes that are not included in the data. Those unobserved characteristics could allow the firm to charge higher prices. Not accounting for unobservables may lead to underestimating the effect of price. I tackle the first challenge by computing the integrals by simulation.

4.1.2 Instruments

The second challenge is tackled by using instrumental variables. In particular, I construct a GMM estimator, as suggested in Berry (1994). Formally, I need instruments that are orthogonal to the unobserved characteristics of the bundles. In particular, let H be a matrix with the instruments and $\omega(\theta*)$ be the error term, written as an implicit function of the parameters. Then, the moment conditions are given by

$$E[H\omega(\theta^*)] = 0 \tag{7}$$

For the instruments to be valid, there must be a correlation between them and the prices. Also, after controlling for observables, the instruments have to be uncorrelated with the value consumers assign to a bundle. For instance, the prices of the same bundle in two different markets are correlated via their marginal costs. If one is willing to assume that the demand shocks are uncorrelated across markets, then, the price of a bundle in a market is a good instrument for the price of the same bundle in a different market. This is the idea behind the so called Hausman instruments used, among others, by Nevo (2000).

Similarly, the price of a bundle is correlated with the characteristics of competing bundles. The

reason is that rational firms decide their pricing strategies based on their competitors' attributes. Hence, when pricing a given bundle the firm considers the characteristics of competing bundles. For the characteristics of other bundles to be valid instruments, one needs to assume that the are predetermined as in Berry et al. (1995).

4.1.3 Identification of the complementarity

Suppose, for simplicity, that there are only 2 goods: A and B. The goal is to know whether the goods are complements or substitutes. For that, we need to estimate Γ_{AB}, the parameter describing the substitution pattern. Moreover, $\Gamma_{AB} > 0$ means that the goods are complements whereas $\Gamma_{AB} < 0$ means that the goods are substitutes. The idea behind the identification of the parameter is the following: the estimation should rationalize large shares of the bundled goods (s_{AB}) relative to the shares of standalone goods (s_A and s_B) with a positive estimate for Γ_{AB}. However, as mentioned before, that is not enough since the preferences for A and B could be correlated.

To separate correlated preferences from real complementarity it is necessary to have exclusion restrictions. An example of such exclusion restrictions would be any variable x entering the utility of, say, good A but not the utility of B nor Γ_{AB}. If there is such a variable, observing two values of it (x, x') adds three new pieces of information ($s_A(x')$, $s_B(x')$ and $s_{AB}(x')$) to help identify Γ_{AB}. For instance, suppose that often people subscribe to both goods (s_{AB} is high relative to s_A and s_B). If a high value of Γ_{AB} is the reason for it, the goods are complements, and increasing the utility of good A by altering the value of x should also increase the share of good B. If instead, Γ_{AB} is zero and the observed high share of the bundle is the result of mere correlation, the share of good B should not change with different values of x.

For a more concrete example, in light of the application below, suppose A is TV and B is mobile Internet. A large proportion of households subscribe to both goods. There could be two reasons for that. One reason is that the preferences for both services are correlated. This could, for instance, be due to people wanting to follow sports. They watch soccer matches at home using

cable TV but when they are away from home they keep track of the score using mobile Internet. If that is the case, the true Γ is zero and correlated preferences explain the relatively high share of bundled TV and mobile Internet. In this case the presence of HD channels should increase the share of TV and bundles with TV, leaving the share of mobile Internet unchanged. High Definition channels, alter the utility of subscribing to TV but have no effect on the utility of using mobile Internet. Thus, the presence of HD channels aids the identification of complementarity between TV and mobile Internet.

4.2 Pricing

On the supply side, I assume that the firms decide prices as in a multiproduct static Bertrand game. Before the game starts, the firms decide the attributes of their many products and contingent on its rivals' attributes, each firm decides a vector of prices that maximizes its profits. I do not impose any restrictions on the marginal costs.

The FOC for this model of competition are well known and given by

$$\mathbf{p} = \mathbf{mc} + \mathbf{\Omega}(\mathbf{p})^{-1}\mathbf{s}(\mathbf{p}) \tag{8}$$

where $\mathbf{p}$ and $\mathbf{mc}$ are vectors containing the prices and marginal costs and $\mathbf{s}(\mathbf{p})$ is a vector of market shares. The dimension of these three vectors is equal to the number of products in the market, say $\mathscr{I}$. The $\mathbf{\Omega}$ matrix is the product of two matrices. First a matrix $\mathbf{O}$ (known as the ownership structure matrix) of dimensions $\mathscr{I} \times \mathscr{I}$, whose (m,n) element is 1 only if the same firm produces bundles m and n and zeros otherwise. Second a matrix $\nabla\mathbf{s}(\mathbf{p})$ with the price derivatives of the shares. The Bertrand-Nash equilibrium is described by the vector $\mathbf{p}$ that solves the non-linear system of equations described in (8).

4.3 Counterfactuals

After obtaining the estimated preferences it is possible to carry out counterfactual simulations that help understand the price effect of mergers with complements. As described before, the firms decide their pricing strategies as (static) multi-product Bertrand competitors. The solution concept is Bertrand-Nash and the FOC in equation (8) describe the equilibrium.

In this setting, simulating a merger is equivalent to changing zeros into ones and ones into zeros in the ownership matrix. As an example, suppose that we want to simulate the merger of the firms producing bundles m and n. To achieve that, all that is necessary is to change the zero in (m,n) into a one. Note that the first order conditions depend on the marginal costs. Although the marginal costs are not observed I can get estimates for them. After obtaining estimates for the preferences, the only unknowns in (8) are the marginal costs. Plugging the baseline prices, and the estimated shares allows us to retrieve the estimated marginal costs $\widehat{\mathbf{mc}}$. Under the assumption that the marginal costs do not change after the merger, a simulated equilibrium can be obtained by solving the system of non-linear equations

$$\mathbf{p^{post}} = \widehat{\mathbf{mc}} + \left[\mathbf{O^{post}}\nabla\mathbf{s}(\mathbf{p^{post}})\right]^{-1}\mathbf{s}(\mathbf{p^{post}}) \tag{9}$$

where $\mathbf{p^{post}}$ is the vector containing the post-merger prices and $\mathbf{O^{post}}$ is the new ownership structure matrix. With the simulated prices, the effect that the new prices have on a consumer by calculating the compensating valuation conditional on characteristics

$$CV_i = \frac{1}{\bar{\alpha}_i}\ln\left(\frac{\sum_{b=0}^{B}\exp\sum_{g\in b}\bar{u}_{ig}(\mathbf{p^{post}}) + \Gamma_{j(b)}}{\sum_{b=0}^{B}\exp\sum_{g\in b}\bar{u}_{ig}(\mathbf{p^{pre}}) + \Gamma_{j(b)}}\right) \tag{10}$$

where $b = 0$ is the outside option and $b = B$ is the number of bundles available in consumer i´s market. For each market I calculate the total compensating valuation as market size times average compensating valuation. The average compensating variation is given by $\bar{CV} = (1/ns)\sum_{i=1}^{ns}CV_i$.

The assumptions outlined above imply stronger assumptions regarding the firms' product choice. Firms are likely to be playing a more complex game in which their strategies include

not only prices but the decision about which plans to offer (speed of broadband, number of HD channels, number of SMS, etc.). Moreover the game is likely to be a dynamic one. However, modeling a dynamic game of firms choosing prices and quality simultaneously is well beyond the scope of this article. To have a sense of which kinds of plans will the firms offer I follow a more heuristic approach. For the Claro break up simulation I use the menus observed right before the merger to infer what would Telmex and Comcel provide today should they operate as independent firms. In the ETB-Avantel merger simulation, I used their standalone products to create an arrangement of bundles that resemble those provided by their rivals and choose the ones that yield higher profits to the merged firm.

5   Results

In this section I present the results of the estimation in two parts. First, I show the estimates for tastes on bundle characteristics. Second, I report and discuss the estimates for substitution patterns.

5.1   Bundle characteristics

Table 5 reports the mean preference coefficients on bundle characteristics. Column 1 assumes that consumers have homogeneous taste coefficients so the only difference between households is their individual shock, ε_{ib}. The specification in Column 2 is a normal logit as well but this time it accounts for endogeneity using the characteristics of competing products as instruments for the price. Similarly, column 3 estimates an IV logit, but this time, the instruments are the prices of similar products produced by the same firm in other markets. Finally, the last column contains the result for the full model in which households differ in their tastes for characteristics.

The estimate for the price coefficient has the right sign across all specifications. However, a quick look at the price coefficients across columns confirms that the prices are endogenous. The difference in magnitude between column 1 and the others is evidence of unobserved characteristics

that drive the price up. Although the sign of the estimate is correct, the endogeneity dampens the estimated effect of price on utility. The inclusion of instruments in columns 2 through 4 more than doubles the magnitude of the estimate. Both types of instruments help curb the problem caused by the correlation between unobserved quality and price. Despite that, I use Hausman instruments when estimating the full model.[16]

The signs of all the estimates are as expected. An increase in prices reduces the utility of subscribing to a bundle. Besides, the price elasticities implied by these estimate correspond in magnitude to those estimated by Grzybowski et al. (2014). On the contrary, households value all the other attributes of the bundles. Higher speeds, more usage data and access to premium channels, all increase utility.

5.2 Substitution patterns

Table 6 reports the estimates for the substitution patterns, Γ_j, and their equivalent dollar amount.[17] A positive (negative) number means that the goods in question are complements (substitutes). The magnitude describes a consumer's willingness to pay (required compensation) for their joint consumption. For instance, consumers perceive Internet and cellphone as complements and the extra utility of having access to both is worth over \$3 per quarter. Land-line phone and cell phone are perceived as complements as well and a given household value a subscription to both services at about \$1 per quarter. Unsurprisingly, the goods included in the bundle marketed as Triply-Play (Phone, TV and Internet) are also complements.

The main takeaway from the estimated substitution patterns is that Colombian households, in general, perceive hardwired (Internet, cable TV, and phone) and wireless (mobile Internet and

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[16]There are two fundamental reasons for doing so. First, the magnitude of the estimate on price is larger with Hausman instruments than it is with BLP instruments. That indicates that the former does a better job at explaining prices. Second, my previous work suggests that download speed is a strategic decision for ISPs. They decide their prices and characteristics based on their rival's. Thus, the exogeneity assumption that makes the BLP instruments attractive is not likely to hold. Car manufacturers decide their products characteristics after a long period of research and development. That means that car's attributes can't be easily changed. As a result competitors take their rival's attributes as given. ISPs, on the contrary, can rapidly change download and upload speeds in response to their competitors.

[17]Table 10 in the appendix reports the estimates and standard errors for all the goods. Tables 11, 12 and 13 show the dollar amounts.

	OLS	BLP Instruments	Hausman Instruments	Random coefficients Mean	Random coefficients Std. Dev.
Price[a]	-0.16**	-0.38***	-0.41***	-0.48**	0.03***
	(0.08)	(0.15)	(0.18)	(0.22)	(0.01)
Download speed[b]	2.23**	1.57**	1.79**	2.01*	2.01***
	(1.05)	(0.65)	(0.84)	(1.09)	(0.15)
Premium channel[c]	-0.06	0.03	0.03	0.09*	1.74**
	(0.06)*	(0.04)	(0.03)	(0.05)	(0.96)
HD channels	0.79	1.32**	1.28**	1.25*	1.65
	(0.61)	(0.66)	(0.52)	(0.66)	(1.89)
Data[d](Mobile)	1.04**	1.05**	1.03**	1.04**	2.31**
	(0.48)	(0.51)	(0.46)	(0.50)	(1.69)
Minutes[e] (Cell)	0.04***	0.03**	0.03**	0.03**	1.04**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.64)
Data[d](Cell)	0.47***	0.40**	0.39**	0.67**	1.71*
	(0.11)	(0.02)	(0.197)	(0.28)	(1.62)
Minutes[e] (Phone)	-0.03	0.02	0.02	0.02	6.71**
	(0.24)	(0.09)	(90.08)	(0.45)	(5.73)
Observations	115,545	115,545	115,545	115,545	115,545

Table 5: Bundle characteristics

(a) price in 2015 dollars; (b) advertised download speed of bundles with Internet; (c) for bundles with TV (channels like HBO, Sundance, etc.); (d) usage allowance for the plan; (e) number of minutes included with the plan.

Table 6: Estimated substitution patterns for selected goods

	Γ_j		Dollar value
Internet/Phone	0.82	***	$0.92
	(0.13)		
Internet/TV	-1.78	*	-$2.00
	(1.60)		
Internet/Mobile	1.35	***	$1.51
	(0.27)		
Internet/Cell	2.79	**	$3.13
	(1.38)		
Phone/TV	0.92	***	$1.03
	(0.04)		
Phone/Mobile	-2.11	***	-$2.36
	(0.57)		
Phone/Cell	1.02	***	$1.15
	(0.02)		
TV/Mobile	0.02		$0.02
	(0.01)		
TV/Cell	1.73	***	$1.94
	(0.01)		
Mobile/Cell	2.57	*	$2.89
	(1.22)		
Internet/Phone/TV	1.17	***	$1.31
	(0.26)		

cell phone) services as complements. Except for the plan containing landline phone and mobile internet, all the bundles in table 6 yield higher utility than the sum of their components. Moreover, as can be seen in table 10, the only negative estimates for Γ are those for the Phone/TV/Cell and Internet/Phone/Mobile/Cell bundles. Albeit some households are engaging in *cord-cutting* practices by subscribing just to mobile services, the vast majority still subscribe to both types of services, revealing that they get extra utility from their joint consumption.

Complementarity between telecommunication services is an important piece of information for regulatory agencies around the world. When scrutinizing potential mergers regulators often rely only on estimated cross-price elasticities. Using such approach, for instance, the CRC has decided that mobile and hardwired services belong in different markets. As is clear from the results just described, the definition of relevant markets is far more complex when analyzing mergers of firms producing potentially complementary products. If the regulators can be certain about the goods produced by the merging firms being substitutes, information about cross price elasticities may suffice. But scrutinizing a deal based on the presumption that that the products sold by the merging firms are not related may bias the outcome of the scrutiny. In the case of an ISP and a mobile carrier, for instance, this approach understates the potential benefits of the merger.

Similarly, when governments subsidize access to hardwired services like phone or Internet, they need to take into account the spillovers created by the complementarity between them and other services like mobile internet or cell phone. A subsidy on telephone service, for instance, is expected to have some direct effects on consumer surplus via the adoption of new lines or by reducing the prices for current consumers, but also through the additional enjoyment of complements like mobile services. A proper evaluation of such programs has to take into account these complementarities.

5.3 Counterfactual scenarios

In the next two subsections I simulate three counterfactuals in a bid to understand the effects of mergers with complements. First, I tinker with Claro's original constituents -an ISP (Telmex, which is present in many countries in Latin America) and a mobile carrier (Comcel)- assuming

two alternative scenarios. In one scenario they decide prices as totally independent firms, that is, as if the CRC had blocked the merger back in 2012. In the other scenario, which simulates what would have happened had the CRC allowed the merger but banned bundling, the firms do not sell bundles but decide the prices of their standalone goods to maximize joint profits.

In a third simulation ETB[18], a wired services operator, is merged with Avantel, a mobile carrier, and the resulting firm sells bundles with wired and wireless products. In all scenarios, I assume that the costs of providing the services remain unchanged. Cost synergies are expected when merging telecom providers and were used to justify the Telmex-Comcel deal, however, assuming there are none allows me to focus on the welfare changes that can be attributed to complementarities.

A common difficulty when simulating these scenarios is that the menus offered by the firms are endogenous. The menus observed in the data are the result of a, potentially dynamic, game in which the firms decide the plans they offer in response to their rival's menus and thus quality and prices are being determined simultaneously. Luckily there are workarounds to bypass this problem. For the first two simulations, in which Telmex and Comcel operate independently, I assume that they offer the same plans observed in the data minus those plans bundling wire and wireless services. The menus resulting after the removal of wired-wireless bundles, closely match those observed in the quarter prior to the merger.[19] For the ETB-Avantel merger I start by creating potential bundles which are obtained as permutations of the services provided by both firms. To select the bundles that the merged firms would provide, I use bundles provided by other firms in all markets to non-parametrically estimate the likelihood of providing a certain bundle in a given market. The predicted probabilities are used to determine the services offered in the markets where ETB and Avantel are present.

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[18] The government of Bogotá owns over 84% of ETB and the council of the city decided in May 2016, after debating for 12 hours, to sell their controlling share They are looking for a buyer.

[19]The counterfactual menus look like updated versions of the old ones. Since the merger, there hasn't been much change when it comes to fixed phone minutes allowance or the quality of Cable TV. Nevertheless, there has been significant change in broadband speeds and the new menus reflect that. For instance, the fastest triple play offered by Telmex in 2012 was 20 Mbps (Bogotá, stratum 3) whereas its counterpart in 2015 had a download speed of 50 Mbps. Mobile plans have increased data and minutes allowance.

5.3.1 Dismantling Claro

Table 7 shows the result of dismantling Claro into its original constituents. Column 1 describes the baseline scenario in which the firms maximize profits under the current (last quarter of 2015) market structure. In column 2, Telmex and Comcel set prices as independent firms whereas in column 3, they set prices to maximize joint profits, although they do not sell bundles. The main takeaway from the table is that consumers are better off under the current structure, that is, they benefited from the 2012 merger. Had the regulators blocked the merger, consumers would have enjoyed $4.1 million/month less surplus. If instead, the regulators had decided to allow the deal but banned bundling, the loss of consumer welfare would have been $3.2 million/month. Both numbers suggest that, overall, consumers benefited from the merger and, in particular, benefited greatly from the merged firm's ability to bundle. From the merged firm's standpoint, perhaps unsurprisingly, the deal seems to be beneficial as well. Operating as one firm and bundling, as they do currently, Telmex and Comcel earn monthly $20 million more than they would have, had the merger been blocked and over $7 million more had it been allowed without bundling. Regarding users of just standalone services, on average, they would have saved 5 cents per Mbps of download speed fixed on their broadband subscriptions without a merger, and 2 cents in the merger-without-bundling scenario. Users of mobiles internet are unambiguously better off under the baseline market structure. The average price for Gb of data on mobile internet plans is lower when the firms merge and sell bundles, as they currently do.

Because Colombia's government recently implemented several policies aimed at fostering the adoption of broadband by households in lower strata, it is worthwhile to see how average speeds in those strata behave under the different counterfactuals. Table 8 shows the average speeds households in strata 1, 2 and 3 subscribe to, weighted by the number of subscribers and conditional on the plans being bought as standalone or as part of a bundle. Download speeds for standalone plans are faster in both counterfactuals whereas there isn't much difference in the speeds of bundled internet between the baseline and the counterfactual worlds. These results suggest that the merger of Telmex and Comcel had a slightly negative impact in the adoption of faster plans. When defining

Table 7: Claro Break up

	Baseline (merged)	No merger	Merger (no bundling)
Welfare change (month)[a]	-	-4.10	-3.15
Joint revenue (month)[b]	482	462	475
Price standalone internet[c]	2.66	2.61	2.64
Price standalone mobile internet[d]	1.09	1.12	1.14

(a) Change in total consumer welfare: total compensating variation in millions of 2015 dollars relative to baseline scenario (prices optimized under current market structure). (b) Sum of monthly revenue from services provided by Claro's wired and wireless divisions in millions of 2015 dollars. (c) Average unit price standalone broadband: amount of 2015 dollars paid per Mbps of download speed in plans provided by Claro. (d) Average unit price standalone mobile internet: amount of 2015 dollars paid per Gb of mobile data allowance.

Table 8: Broadband speeds in strata 1,2 and 3

	Baseline	No merger	Merger, no bundling
Standalone internet[a]	3.72	3.81	3.86
Bundled internet[b]	4.11	4.12	4.12

(a) Standalone broadband average speed in Mbps: average download speed of subscriptions to standalone plans of wired internet in strata 1, 2 and 3, using number of subscribers as weights. (b) Bundled broadband average speed in Mbps: average download speed of subscriptions to bundled plans of wired internet in strata 1, 2 and 3, using number of subscribers as weights.

its policies and how to measure their success, the Ministerio of TIC defined broadband as 1 Mbps, so in either scenario the average speeds are well above that goal. However, in the near future, policy makers should consider the impact of these kind of mergers when designing new policies or updating the goals of existing ones, as the resulting prices seem to hinder adoption of faster internet for poorer households.

5.3.2 A merger with complements and bundling

Table 9 shows the results of simulating a merger between ETB and Avantel. The table suggests that consumer welfare would increase by around \$0.75 million a month if, after the merger, the firms can sell bundles of their products. If, on the other hand, the firms merged but bundling was proscribed, there would be virtually no gains for consumers. Similarly, the firms would not benefit much from operating jointly if they can't sell bundles, as their monthly revenue would increase

Table 9: ETB-Avantel Merger

	Baseline	Merger (no bundling)	Merger (bundling)
Welfare change (month)[a]	-	0.02	0.75
Joint revenue (month)[b]	44.9	45.1	45.9
Price standalone internet[c]	2.51	2.49	2.49
Price standalone mobile internet[d]	1.06	1.03	1.05

(a) Change in total consumer welfare (month): Total compensating variation in millions of 2015 dollars relative to baseline scenario (prices optimized under current market structure); (b) Sum of monthly revenue from services provided by ETB and Avantel in millions of 2015 dollars; (c) Average unit price standalone broadband: amount of 2015 dollars paid per Mbps of download speed; (d) Average unit price standalone mobile internet: amount of 2015 dollars paid per Gb of mobile data allowance.

only by $0.2 million.[20] If instead, they are allowed to sell bundles, their monthly revenue increases by $1 million. Unit prices of broadband plans sold as standalone services do not change much in either counterfactual, thus, consumers with strong preferences for mix-and-match should not experience significant changes in the prices they face. On the other hand, subscribers to standalone mobile internet plans, would benefit from a merger with no bundling, because the unit prices for those plans fall, on average, almost 3%.

6 Final Comments

I estimate demand for telecommunications services using quarterly data from Colombia's telecommunications sector on subscription and product characteristics. The demand model has two key features: it allows for the demand of bundled and standalone goods, and recovers substitution patterns that determine whether goods are complements or substitutes. I conduct several counterfactual experiments in a bid to understand the effect of mergers between firms producing complementary goods, like ISPs and mobile carriers.

The estimated substitution patterns identify mobile and hardwired services as complementary. To understand the effects of bundling after a merger with complements, I proceed retroactively. I

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[20]There might be gains that stem from cost synergies between the merging firms, but the simulations assume those away in order to focus on the effects of the complementarity.

start by splitting up Claro, a consolidated merger, into its original constituents: Comcel (mobile) and Telmex (ISP). The results suggest that the merger has been beneficial for consumers and the benefits arise from the merged ability to sell bundles. Breaking up Claro, thus removing its ability to bundle mobile and wired services, reduces consumers surplus by around $4 million per month and the monthly joint revenue of the merging firms by $7 million. Next, I simulate a merger between a mobile carrier (Avantel) and a large state-owned ISP that is soon to be sold (ETB). In general, the effects of merging Avantel and ETB are pro-competitive and consumer surplus rises as a result by about $0.75 million per month. The simulations confirm that mergers of firms that produce potentially complementary goods entail pro-competitive effects that are often overseen by regulators.

The main implication of my findings is the importance of completely understanding the nature of pre-merger rivalry, if any, among the firms and the preferences of consumers when scrutinizing potential mergers. This is particularly crucial because regulators are prone to recommend a ban on bundling, as a remedy for the possible anti-competitive pressures of a merger, but some of the pro-competitive effects in mergers with complements stem from the firms' ability to sell bundles. The simulations presented above confirm that the welfare-enhancing effects of mergers with complements, under strong enough complementarities, are magnified when the firms can sell bundles.

A better understanding of the relation between the goods sold by the merging firm may even make the regulators job easier. When the Claro merger was announced the public freaked out, understandably one could argue, because the firms involved in the deal had enormous market shares, but Colombian regulators could have easily defused the controversy surrounding the merger and appeased consumers by appealing to the complementary nature of the services they provided.

There are a few courses in which this work can be improved. First, the model does not account for cost synergies between the merging parties. Cost reductions are often cited as being the main motivation behind mergers and could further increase the welfare gains obtained here. Second, with the data used here it is only possible to observe bundles sold by the same firm. Consumers could be

doing mix-and-match themselves, and subscribing to, say, Internet and Cable TV from two different operators. As a result, the level of complementarity between hardwired and hardwired services is underscored by my estimates. A data set with information about mix-and-match bundling would improve the assessment of complementarity. Third, this article remains agnostic about the effect that the merger could have on quality and menus. A firm's decision about which kind of plans to offer is likely to be endogenous and as such will be affected by the merger. Consumers benefit from the merger for two reasons: from lower prices and a larger choice set that allows them to substitute more flexibly, as shown in Draganska et al. (2009) whereby a reduction in the number of competitors is at the same time profitable for the merging firm and beneficial for consumers due to an increase in product variety. Endogenizing quality will certainly make it more difficult both conceptually and computationally, but will enhance our understanding of these phenomena.

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Table 10: Estimated substitution patterns for bundled services

	Γ_j	Std. Error
Internet/Phone	0.82 ***	0.13
Internet/TV	-1.78*	1.60
Internet/Mobile	1.35 ***	0.27
Internet/Cell	2.79 **	1.38
Phone/TV	0.92 ***	0.04
Phone/Mobile	-2.11***	0.57
Phone/Cell	1.02 ***	0.02
TV/Mobile	0.02	0.01
TV/Cell	1.73 ***	0.01
Mobile/Cell	2.57 *	1.22
Internet/Phone/TV	1.17 ***	0.26
Internet/Phone/Mobile	0.95 ***	0.13
Internet/Phone/Cell	0.47 *	0.22
Internet/TV/Mobile	1.29 ***	0.32
Internet/TV/Cell	0.33 ***	0.01
Internet/Mobile/Cell	0.09 *	0.05
Phone/TV/Mobile	0.78	1.14
Phone/TV/Cell	-0.42*	0.26
Phone/Mobile/Cell	1.25	1.55
TV/Mobile/Cell	2.18	3.12
Internet/Phone/TV/Mobile	0.10 ***	0.02
Internet/Phone/TV/Cell	0.35 ***	0.12
Internet/Phone/Mobile/Cell	-0.13	0.25
Internet/TV/Mobile/Cell	0.01 ***	0.01
Phone/TV/Mobile/Cell	1.78	3.61
Internet/Phone/TV/Mobile/Cell	0.22 **	0.01

Appendix

Table 11: Substitution patterns (Bundles of 2)

	Phone	Cell	TV	Mobile
Internet	$0.92	$3.13	-$2.00	$1.51
Phone		$1.15	$1.03	$2.36
Cell			$1.94	$2.89
TV				$0.02

Table 12: Substitution patterns (Bundles of 3)

	Internet	Phone	TV
Phone/TV	$1.31		
Phone/Mobile	$1.07		
Phone/Cell	$0.53		
TV/Mobile	$1.45	$0.88	
TV/Cell	$0.37	-$0.47	
Mobile/Cell	$0.10	$1.40	$2.44

Table 13: Substitution patterns (Bundles of 4 and 5)

	Mobile/TV	Cell/TV	Mobile/Cell/TV	Mobile/Cell
Internet/Phone	$2.11	$2.39	$2.14	-$0.24
Internet/TV				$2.01
Phone/TV				$2.00

Table 14: Correlation between standalone services

	Internet	Phone	Mobile	Cable TV	Cell
Internet	1.00	0.51	0.22	-0.22	0.63
Phone	0.51	1.00	-0.41	0.41	0.46
Mobile	0.22	-0.41	1.00	0.34	0.74
Cable TV	-0.22	0.41	0.34	1.00	0.41
Cell	0.63	0.46	0.74	0.41	1.00

Figure 2: Form 5

Left table:

#	
34	Servicio de telefonía móvil incluido (SI/NO)
35	Nombre del plan individual de telefonía Móvil
36	Tarifa mensual telefonía móvil
37	Unidad de medida
38	Tipo de consumo en el plan
39	Cantidad de unidades para llamadas a usuarios del mismo proveedor
40	Cantidad unidades para llamadas a usuarios de otros proveedores móviles
41	Cantidad de unidades para llamadas a usuarios de redes fijas
42	Número de mensajes cortos de texto (SMS) incluidos – mismo proveedor
43	Número de mensajes cortos de texto (SMS) incluidos - otras proveedores móviles
44	Valor de unidad de medida - Llamada mismo proveedor
45	Valor de unidad de medida - Llamada otro proveedor móvil
46	Valor del unidad medida - llamada a redes fijas
47	Valor de la unidad medida adicional mismo proveedor
48	Valor de la unidad medida adicional a otro proveedor de servicio móvil
49	Valor de la unidad adicional a redes fijas
50	Valor mensaje corto de texto (SMS) - Mensaje a mismo proveedor
51	Valor mensaje corto de texto (SMS) - Mensaje a otro proveedor
52	Beneficios de tráfico al interior de la red(SI/NO)
53	Beneficios de tráfico con destino a otras redes (SI/NO)
54	Servicio de Internet móvil incluido (SI/NO)
55	Nombre del plan individual de Internet Móvil
56	Tarifa mensual Internet móvil
57	Capacidad Datos Móviles
58	Otras características
59	URL

Right table:

#	
1	Año
2	Periodo
3	Municipio
4	Segmento (estrato/corporativo)
5	Cantidad de suscriptores
6	Nombre del Plan
7	Estado del Plan (Activo /no activo)
8	Valor total del plan tarifario (incluye IVA e impuesto al consumo)
9	Valor total del plan tarifario (sin impuestos)
10	Modalidad de plan (prepago o pospago)
11	Fecha inicio
12	Fecha fin
13	Tipo Plan (abierto /cerrado/mixto)
14	Servicio de telefonía fija incluido (SI/NO)
15	Nombre del plan individual de telefonía fija
16	Tarifa mensual Telefonía fija
17	Cantidad de Minutos incluidos
18	Valor minuto voz fija incluido
19	Valor minuto voz fija adicional
20	Servicio de Internet dedicado fijo incluido (SI/NO)
21	Nombre del plan individual de Internet Fijo
22	Tarifa mensual Internet
23	Velocidad efectiva de bajada
24	Velocidad efectiva de subida
25	Tecnología de acceso Internet fijo
26	Servicio de televisión incluido (SI/NO)
27	Nombre del plan individual de T.V.
28	Tarifa mensual TV
29	Tecnología de acceso TV
30	Canales TV Premium(SI/NO)
31	Canales TV HD (SI/NO)
32	VoD (SI/NO)
33	Costo Decodificador Adicional

Se deberán registrar los planes tarifarios individuales y empaquetados de los diferentes servicios prestados por el proveedor y las comunidades organizadas, así como también la cantidad de suscriptores/abonados por cada plan tarifario, incluyendo tanto planes activos como no activos que estén vigentes para los suscriptores/abonados.

Todos los planes tarifarios deben ser reportados dentro de los tres (3) días hábiles después de hacer pública la oferta comercial.

Cada vez que culmine la vigencia de un plan tarifario el proveedor u operador deberá modificar a estado no activo el registro del plan.

RESUELVE

Year
Quarter
City
Stratum

Text messages included

Mobile internet characteristics

TV price and technology

Can you watch Game of Thrones?

Continuación de la Resolución No. **4763** de **28 JUL 2015**

En virtud de lo expuesto,