Bundling and Consumer Churn in Telecommunications Markets

Lukasz Grzybowski, Julienne Liang, Christine Zulehner

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Abstract

In this paper, we analyze how fixed-mobile (quadruple-play) bundling impacts the decision of consumers to churn telecommunications services. We use a database from an European operator of fixed and mobile telecommunications services which includes information about 9.6 million fixed broadband subscribers and 14.2 million mobile subscribers between March 2014 and February 2015. This data is combined with socio-demographic characteristics from each municipality in this country. We find that consumers who bundle fixed and mobile services from the same provider are less likely to churn. Without fixed-mobile bundling the annual churn of fixed broadband consumers would increase from 8.4% to 9.2%. Furthermore, the consumer churn in the mobile market would increase from 11.5% to 13.1%. We conclude that in the current competitive environment in the country considered, bundling has a moderate impact on consumer retention on both fixed and mobile networks.

Key Words: *Quadruple-play; Bundling; Consumer churn*

JEL Classification: L13, L50, L96

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1 Introduction

Bundling multiple communication services has become a widely used strategy in the telecommunications industry. Fixed telecommunications operators typically offer so called triple-play tariffs consisting of TV, fixed-line and high-speed Internet. In the last years, there has been also an increasing supply of quadruple-play offers in several countries including France, Spain, South Korea, and Japan. These type of offers include mobile services in addition to triple-play services. Consumers responded positively to these bundled offers with a fast-growing penetration. For instance, about 42% of fixed broadband households in France and 21% in Spain bundled their mobile services with fixed broadband service at the end of 2012. These numbers increased to respectively 71% and 82% by the end of 2019.[1]

In this paper, we analyze how fixed-mobile bundling impacts consumer churn using the whole customer database of one of the largest incumbent operators in Europe. In particular, we use data of about 9.6 million subscribers to fixed broadband services and about 14.2 million subscribers to mobile services from the same operator between March 2014 and February 2015. In this data, about 8.4% of subscribers to fixed broadband services and about 11.5% of mobile consumers churned during one year period between March 2014 and February 2015. We combine the consumer-level information with data from each municipality in this country. We then assess the impact of fixed-mobile bundling, competition with other providers of broadband services and demographics on consumers' decision to churn. We find that consumers who bundle fixed and mobile services from the same provider are less likely to churn. Without fixed-mobile bundling the churn of fixed broadband consumers would increase from 8.4% to 9.2%, while the consumer churn in the mobile market would increase from 11.5% to 13.1%. Thus, fixed-mobile bundling has a stronger impact on retaining consumers in the mobile market than in the fixed broadband market. But the impact of bundling on consumer retention, given the market conditions in the country under study, is smaller than expected.

Moreover, we find that competition with other DSL operators and with cable operators increases consumer churn in both fixed and mobile markets. We further find that consumer

[1] Source: 2021 S&P Global Market Intelligence.

churn due to competition with 4G mobile broadband is negligible for fixed broadband, which may indicate that substitution between fixed and mobile broadband services is still relatively small. Finally, the propensity to churn depends on differences in consumer characteristics across geographic areas.

Bundling of products and services has drawn a lot of attention in the theoretical and empirical literature in both economics and marketing. In particular, the theoretical economic literature focused mainly on the optimality of bundling for monopolists (see Whinston, 1990), equilibrium theories of bundling (see Matutes and Regibeau, 1992), and the welfare implications of bundling (see Salinger, 1995). On the other hand, the marketing literature studied mainly the question of optimality of bundling (see Bakos and Brynjolfsson, 1999; Hanson and Martin, 1990), consumer evaluation of bundles (see Johnson, Herrmann and Bauer, 1999), and firms' pricing and promoting of bundles (see e.g. Yadav and Monroe, 1993). In the case of telecommunications, the provision of fixed-mobile bundles may increase welfare if it brings more choices, higher quality, or lower prices to consumers.[2] Moreover, bundled offers may enable firms to create cost savings, launch more valuable products and create more choice for consumers (see Salinger, 1995). Bundling is also a tool for price discrimination. In a recent empirical paper, Crawford (2008) shows that bundling of cable channels within tiers rather than "a la carte" is an effective way of second degree price discrimination. In turn, bundles can be also used to limit competition when entrants are not able to replicate the essential products and services. In such a situation, bundling may foreclose entry of a single-product provider (see Whinston, 1990; Nalebuff, 2004). The possibility of foreclosure in markets with dominant players has drawn attention to bundling practices by policy makers, which resulted in major antitrust cases against Microsoft and Google in the United States and European Union in the last years. There may be also antitrust concerns related to fixed-mobile bundling in telecommunications industry, since there are few market players and incumbency advantage in fixed broadband market.

Our paper contributes to the literature on bundling by providing empirical evidence on how

[2]See also OECD (2015), "Triple and Quadruple Play Bundles of Communication Services."

it impacts consumer behaviour. This is the first paper which provides evidence on the impact of bundling on consumer churn using data on millions of consumers of telecommunications services. The empirical literature on bundling is scarce due to limited data availability. In general, individual-level panel data is required with information on bundling and switching products over time. The existing empirical literature so far focused on bundling communications services and television on fixed networks. For instance, Prince and Greenstein (2014) analyze the impact of triple-play bundling of TV, telephone, and high-speed Internet and consumers' switching behavior using survey data of U.S. households. But since they lack time-series information from a firm, they need to rely on nearest-neighbor matching methods to construct a pseudo panel data. They find that households with triple-play bundles are less likely to switch service providers. The other two recent studies on bundling and churn rely on survey data for a single period and declarations about past behavior. Burnett (2014) uses a survey of UK households to analyze the impact of bundling of communication services on the probability that a household changes supplier. He finds that bundling reduces the probability to switch. Lee (2016) uses survey data of Korean consumers to analyze whether bundling of telecommunications services makes individuals less likely to switch their Internet service provider. His results show that subscribers who previously bundled are less likely to switch their service provider than are those who did not bundle. Pereira et al. (2013) use Portuguese consumer-level data of invoices to analyze whether bundles of subscriptions to television, fixed broadband and fixed voice are a relevant product market for competition policy. This paper, however, does not analyze the impact of bundling on switching service providers.

The papers mentioned above, with the exception of Pereira et al. (2013), do not use consumer panel data obtained from a firm. Moreover, since quadruple-play tariffs are a recent development in telecommunications, they focus on bundling of fixed-line products. To the best of our knowledge the only paper that studies demand for quadruple play tariffs is Grzybowski and Liang (2015), but it is focused on consumer valuation of fixed-mobile bundles and switching costs between tariffs, and not on consumer churn.

In this paper, we observe the decisions of subscribers to one of the largest telecommunications operators in Europe to churn fixed broadband or mobile services between March 2014 and February 2015. This allows us to assess the role of bundling on consumers' retention. However, since we have data from a single operator, we cannot study strategic decisions of firms to provide bundled offers. There are only a few empirical papers which focus on the strategic bundling decisions of firms in telecommunications markets. Macieira et al. (2013) use data on Portuguese consumers who choose from assortments of different types of telecommunications products to analyze incentives of firms to offer bundles. Crawford and Yurukoglu (2012) use firm-level data to estimate the welfare effects of unbundling in the retail cable television industry in the US. They find that unbundling channels would increase input costs and consequently prices paid by consumers, thus offsetting consumer surplus benefits from purchasing individual channels.

The remainder of the article is organized as follows. Section 2 presents the data which we use in the estimation. Section 3 introduces the econometric framework. Section 4 presents the estimation results. Finally, Section 5 concludes.

2 The Data

In this analysis, we combine four data sets from different sources: (i) customer data from one European operator of fixed and mobile telecommunications services, which includes individual-level information on the use of fixed-mobile bundles and subscribers' decision to churn from fixed broadband and mobile services within one year period; (ii) municipality-level information on the launching date and quality of fixed broadband copper network; (iii) municipality-level information on the number of competitors providing broadband services via local loop unbundling, coverage of cable network and share of population with access to 4G mobile services; (iv) municipality-level socio-economic statistics.

The first database includes information on 9,577,664 subscribers to fixed broadband services who were active in March 2014, which was provided to us by one of the largest telecommunications operators in Europe. Among these consumers, about 8.6% churned within 12 months

between March 2014 and February 2015. We have monthly information on the type of subscription used by each consumer which can be: (i) a 'naked' Internet access; (ii) 'double play' offer which includes Internet access and fixed telephony over IP (IP telephony); (iii) 'triple play' offer which includes Internet access with IP telephony and television over IP (IPTV); or (iv) 'quadruple play' offer which includes Internet access with IP telephony, IPTV and access to mobile services. We know whether in March 2014 a consumer had used a bundle of fixed and mobile services (quadruple-play tariff plan). The share of fixed broadband users with quadruple-play subscriptions was 39.2% in March 2014.

Moreover, for each consumer in this database we know whether in March 2014 he was eligible to have FttH (Fibre to the Home) access and, in case of eligibility, whether he subscribed to FttH services. In general, fixed broadband services can be accessed via FttH or DSL (Digital Subscriber Line) technology, where FttH offers connection speed of 100 Mbps and more, while the connection speed on DSL ranges between 1 and 30 Mbps. In our database, all households can use fixed broadband based on DSL technology but not all have access to FttH.[3] For consumers who used DSL broadband services in March 2014, we know whether they had an active fixed-line connection for voice calls (PSTN), in which case there is an additional charge for it.[4] We also have information on the number of years passed since the first subscription with our operator. But we do not know the length of consumers' contractual commitment. It is possible that subscribers to quadruple-play tariffs are in general committed for a longer period than subscribers to triple-play tariffs and thus have higher costs of breaking the contract. Finally, for each consumer we have information on the postal code, which can be uniquely linked to municipalities in the country considered.

Next, we have access to a similar database of 14,189,887 subscribers to mobile services from the same operator who were active in March 2014. Among these consumers, about 11.5% churned

[3]The household is eligible to have FttH access when the optical fibre reaches the customer's premises, i.e., there is a fibre box on the outside wall of the building.

[4]Consumers with FttH connection do not need PSTN service because they can make voice calls using Voice over IP (VoIP), which is included in the price of FttH.

within 12 months between March 2014 and February 2015. We also know whether mobile users had fixed-mobile bundle in March 2014 and whether their broadband connection was based on DSL or FttH technology. The share of mobile users with quadruple-play subscriptions was 26.0% in March 2014. But we do not have information on whether these consumers have a PSTN connection and whether they are eligible to have a FttH connection, which we know for fixed broadband subscribers, as discussed above. We have information on the number of years passed since the first subscription with our operator. This database includes consumers with postpaid contracts, but not consumers with prepaid contracts. The latter consumers may use two types of contracts: (i) similar to postpaid with a commitment of 12 or 24 months (usually linked to a handset subsidy); and (ii) without commitment in which case they can churn anytime without a contract breaking fee. Thus, churn among mobile users in our sample is certainly lower than in the full population of subscribers to our operator.

Our second data source includes municipal-level information on the number of years which passed since the installation of Internet broadband services (DSL) in each municipality, which approximates the economic attractiveness of a municipality.[5] Our third database includes municipal-level data which approximates competition in local markets in 2014. In general, fixed broadband may be provided on three different networks: copper, cable and optical fibre. There is only one copper network which belongs to the historical incumbent operator. But to allow entry and competition in the broadband market, the regulator mandated the incumbent to provide access to its MDFs and copper lines to potential competitors via so called local loop unbundling (LLU). Under LLU regulation, incumbents have to grant access to their physical local copper infrastructure at regulated prices to enable entrants the provision of DSL broadband services. An alternative to LLU is the so called bitstream access, where the incumbent provides access to a high-speed ADSL data connection and not to the actual copper wire of the local loop.

[5]Technically, the start of broadband Internet in a municipality is marked by the installation of the first broadband equipment (DSLAM) in the main distribution frame (MDF), to which the copper network in the municipality is connected. The asymmetric version of the DSL technology ('ADSL') and the very-high-bit-rate digital subscriber line (VDSL) are technologies that allow faster data transmission.

To provide DSL services to consumers, an operator wishing to use LLU has to build a backhaul network to the MDFs, and then install its DSL equipment in the MDFs to deliver broadband over copper lines. The LLU regulation led to a wave of entry of operators in municipalities across the country. Furthermore, there is also only one cable operator in the country considered, which covers about 30% of the population, mainly in urban areas.[6] Finally, there are competing fibre networks which can provide speeds that exceed by far those achievable with the DSL or cable modem technologies.[7] For each municipality we know the number of competitors providing DSL broadband services via LLU and whether there was cable operator present. The coverage of fibre networks in general coincides with our information on FttH eligibility because other FttH operators tend to co-invest with our incumbent operator or enter independently in the same municipalities. We also have information on the percentage of the population covered with a 4G mobile network of our and other operators at the end of 2014. The data on competitors and coverage was extracted from different sources including the websites of broadband providers and the website of the regulator of telecommunications industry.

Finally, we collected municipal-level socio-economic information for the year 2014 (or for the year 2013 when information for 2014 was not available) from the website of the statistical office which includes: (i) the number of households; (ii) density of the population (number of households divided by the municipality area); (iii) number of kids per population; (iv) number of students per population; (v) number of deaths per population; (vi) median income (in 2013); and (vii) unemployment rate. The last variable is reported for 322 employment areas and it is assumed to be the same for all municipalities belonging to the same area. We use these variables to control for socio-economic factors, which may affect consumers' decision to churn and which are not available at the individual-level in the operator's database.

[6]The cable network, which was originally developed to carry television signals, had to be upgraded to the DOCSIS 3.0 standard, which permits high-bandwidth data transfers substantially exceeding those of DSL connections.

[7]Optical fiber is a technology that converts electrical signals carrying data into light, and transmits it over fibers.

The consumer-level data was merged with municipal-level data using unique postal codes. Table 1 shows summary statistics for municipalities. The number of individuals used in the regressions is a bit smaller than the initial number, which is due to data cleaning and loss when merging the individual- and municipal-level data sets. Figure 1 shows a histogram of the percentage of churning consumers by municipality and Figure 2 shows a histogram of the percentage of consumers with fixed-mobile bundles by municipality. On both figures there is a large variation in these variables across municipalities.

3 Econometric Model

We analyze consumers' decision to churn fixed broadband and mobile services. Fixed broadband subscribers have three options: (i) to switch to another fixed broadband operator, if available at a consumer's location; (ii) switch to mobile broadband operator, if there is 3G or 4G network coverage at a consumer's location; (iii) give up using broadband Internet. It is rather rare that a consumer gives up Internet access completely but this may happen when moving household for instance. Mobile subscribers have two options: (i) to switch to another mobile operator; (ii) give up using mobile services. Again, it is rather rare that mobile consumers give up using mobile services or switch to fixed-line.

We model the decision to churn using a logit model, where the consumer makes a zero-one decision to leave our fixed broadband operator or to stay. The decision to leave the mobile services of our operator is modelled in an analogous way. When we discuss the empirical model below, we focus on the decision to churn fixed broadband services. In both cases, we specify the following utility function for a consumer i living in municipality m_i:

$$U_i = \alpha B_i + X_i\beta + C_{m_i}\gamma + Z_{m_i}\delta + \epsilon_i = V_i + \epsilon_i \tag{1}$$

where the variable B_i is a dummy variable which is equal to one if a consumer has a fixed-mobile bundle in March 2014 and zero otherwise. We expect a negative coefficient α, which is estimated relative to the utility from churning without fixed-mobile bundle. Consumers with

a fixed-mobile bundle may have higher switching costs, but they may also value their current fixed-mobile bundle more than other tariff plans on the market. For both reasons, there should be lower churn among consumers who use fixed-mobile bundles.

The vector of variables X_i represents consumer characteristics which include: (i) number of years passed since the first subscription with our operator; (ii) having an active PSTN line; (iii) eligibility to use FttH broadband; (iv) having a FttH broadband connection instead of DSL. These characteristics are expected to influence the utility derived from a subscription with our operator relative to the outside alternative, and thus also the decision to churn. In particular, the time passed since the first subscription with our operator may indicate loyalty and should have a negative impact on churn. Also, people in households with a PSTN line are typically older and more attached to the incumbent operator. Moreover, there are additional switching costs to transfer or give up a PSTN line, which should have a negative impact on churn. Households that are eligible to have a FttH connection typically live in wealthier urban areas with more competition, and they may be more willing to churn. But they may be also less price sensitive and responsive to competitors' offers. Finally, consumers having a FttH connection already switched once from a DSL connection which they used before FttH. They are familiar with the process and it may be easier for them to switch again.

The vector C_{m_i} includes a set of variables related to the presence of alternative fixed broadband operators and coverage by 4G mobile networks. These variables approximate local competition and prices of alternative operators to which consumers may switch. We anticipate that prices of alternative operators are lower than the price of our operator in municipalities in which they are present because new entrants typically charge less than the incumbent operator. We expect that the following variables have a positive impact on the utility which consumers derive when leaving: (i) the number of LLU operators in a municipality, (ii) presence of a cable operator in a municipality; (iii) percentage of the population covered by the 4G networks of the competitors. The impact of the percentage of the population covered by the 4G network of our operator may be ambiguous. On the one hand, consumers may be more willing to use fixed-

mobile bundles and keep a fixed broadband subscription with our operator when 4G coverage is better. On the other hand, they may be willing to give up fixed broadband and use mobile broadband services only.

The vector of variables Z_{m_i} represents socio-economic characteristics of the municipality in which consumer i resides, as listed in Section 2. These characteristics approximate missing consumer-specific characteristics, which influence the utility derived from our and alternative broadband operators. The vector also includes the average copper line loss and the number of years passed since the municipality was connected to broadband Internet.

We define $y_i = 1$, if the consumer i decides to churn by the end of our period, and $y_i = 0$ otherwise. Assuming that ϵ_i follows a double exponential distribution, the probability that consumer i decides to churn is given by:

$$P_i(Y_i = 1) = \frac{\exp(V_i)}{1 + \exp(V_i)} \tag{2}$$

and the probability of not churning is given by $P_i(y_i = 0) = 1 - P_i(y_i = 1)$. Further assuming that the decisions of individuals $i = 1, ..., N$ are independent, we can write the following log-likelihood function:

$$\mathcal{L}(\alpha, \beta, \gamma, \delta) = \sum_{i=1}^{N} [y_i \log(P_i) + (1 - y_i) \log(1 - P_i)]. \tag{3}$$

The maximum likelihood estimator is the vector of parameter estimates which maximizes the log-likelihood function $\mathcal{L}$.

4 Estimation Results

Table 2 shows the estimation results for churning fixed broadband and mobile services between March 2014 and February 2015. For comparison, we first show the estimation results with consumer-level information which is available in both data sets: (i) a dummy variable for a fixed-mobile bundle; (ii) a dummy variable for the current subscription to FttH broadband services (with the other option being subscription to DSL broadband services); (iii) number of

years as a subscriber with our operator. In the second regression conducted for fixed broadband only, we further include: (iv) a dummy variable for having a PSTN connection; (v) a dummy variable for the eligibility of FttH broadband services. These variables are not available in the database of mobile subscribers. Next, we show the estimation results adding municipality-level variables related to competition with other broadband providers and technologies. In addition, we include in these regressions the number of years since DSL broadband was available in the municipality. Finally, we include socio-economic characteristics of municipalities. Below, we first interpret the estimation results for fixed broadband and then for mobile services.

4.1 Fixed Broadband

Our estimation results show that consumers having fixed-mobile bundles are less likely to churn. This effect is significantly different from zero and remains unchanged after the inclusion of additional control variables. Our finding is in line with the results from previous empirical studies (see Prince and Greenstein, 2014). This result may be due to two effects with opposite impact on welfare which we cannot separate. On the one hand, consumers may benefit from having fixed-mobile bundles through lower transaction costs and they may end up paying a lower price than when buying fixed and mobile services separately. On the other hand, they may have higher switching costs when using a bundle. Lower transaction costs and prices increase welfare, while higher switching costs have the opposite effect.

Table 3 shows predicted churn in the population of consumers for different scenarios, as compared to the base case. We find that in the absence of quadruple-play tariffs, holding everything else equal, annual consumer churn would increase from 8.4% to 9.2%, which represents an increase of 9.5%.

The other results confirm our intuition. We find that churn is lower for consumers who keep a PSTN connection. The share of such consumers is about 27% at the start of our period. We observe that the share of households with a PSTN connection declines over time which thus results in a higher churn. The model predicts that when PSTN lines were not available and used

by consumers, churn would increase from 8.4% to 9.3%, which is an increase of 10.7%.

Furthermore, consumers who are eligible to use FttH broadband services are less likely to churn but, once they adopt a FttH connection, their likelihood to churn increases. This might be because consumers eligible to use fibre are targeted by marketing actions which try to convince them to make a switch from a DSL to a FttH connection. They may decide to change their triple-play or quadruple-play tariff from DSL to FttH but stay with our operator. But, once they use FttH it may be easier for them to switch to other fibre providers because the fibre network is typically deployed in co-investment. Finally, consumers who are longer with our operator are less likely to churn. Typically, these are older consumers whose loyalty can be explained by different factors including satisfaction with their current services, lack of information or higher switching costs.

The number of DSL competitors providing broadband services via LLU and the presence of cable operator in a municipality increases the likelihood to churn. Moreover, the propensity to churn is higher in municipalities, in which DSL broadband had been available for a longer period of time. These are typically more attractive municipalities with intense competition and with consumers who are better informed about available offers. The likelihood to churn is higher in municipalities in which a greater share of population is covered by the 4G network of the competitors. But it should be noted that the 4G coverage by different networks is correlated.

Our results confirm that there is a positive impact of competition with cable and other DSL operators on churn. We predict how competition impacts churn based on the following scenarios. First, we consider that cable has not been deployed at all, in which case consumer churn drops to 8.0% (by 4.8%). In the second case, we assume that cable is fully deployed which increases churn to 10.0% (by 19.0%). Furthermore, we consider that there are no LLU entrants at all, in which case consumer churn drops to 6.2% (by 26.2%). In alternative scenario, we assume that there are three LLU entrants in every municipality in the country, in which case churn increases to 10.0% (by 19.0%). Finally, we consider the impact of 4G mobile broadband, where in the first scenario there is no coverage at all, and in the second case 4G has full country coverage.

The impact of 4G coverage on churn is rather small, which suggests that, at this point of time, the substitution between fixed and mobile broadband was limited.

The inclusion of municipal-level control variables does not impact the estimates discussed above. We find that churn is lower in municipalities with a higher median income. There is also more churn in municipalities with a higher unemployment rate. Consumers churn more in densely populated municipalities. In municipalities with more kids churn is lower and in municipalities with a greater number of students churn is higher. The estimation results are overall intuitive and show that the likelihood to churn depends on characteristics of individual consumers, which are approximated by municipality-level statistics.

4.2 Mobile Services

In the case of mobile services, consumers having fixed-mobile bundles are also less likely to churn. Table 3 shows that in the absence of quadruple-play tariffs, annual churn of mobile subscribers would increase from 11.5% to 13.1%, which represents a change of 13.9%. Thus, the magnitude by which bundling reduces churn is greater for mobile subscribers than for fixed broadband subscribers.

The other results are also broadly similar and confirm our intuition. Consumers who have fixed-mobile bundles with FttH are less likely to churn. This may be because FttH connections are priced attractively to encourage consumers to switch from DSL connections, which makes the outside option less attractive. As in the case of fixed broadband, consumers who are longer with our operator are less likely to churn. Even though mobile services may compete to a lesser extent with fixed broadband, the number of DSL competitors providing broadband services via LLU increases the likelihood to churn. Also, the presence of cable operators in a municipality increases the likelihood to churn. Furthermore, the propensity to churn is higher in municipalities in which DSL broadband was available for a longer period of time. In municipalities in which a greater share of the population is covered by 4G networks of the incumbent and other operators, consumers tend to churn more.

We use the model to predict how competition impacts churn based on the same scenarios as before. First, we assume that cable has not been deployed at all, or that it is fully deployed. In the first case, consumer churn drops by 0.9% to 11.4%, and in the second case it increases by 3.5% to 11.9%. Next, we consider that there are no LLU entrants at all, or that there are three entrants in each municipality in the country. In the first case, consumer churn drops by 11.3% to 10.2% and in the second case it increase by 7.8% to 12.4%. Finally, we consider the impact of 4G mobile broadband, where in the first case there is no coverage at all, and in the second case 4G has full country coverage. Without 4G coverage churn drops by 6.1% to 10.8%, and with full 4G coverage increases by 3.5% to 11.9%. Overall, as these predictions illustrate, there is a significant impact of competition in the fixed broadband market on the mobile market and vice versa.

The municipal-level control variables have a similar impact as for fixed broadband. We find that churn is lower in municipalities with a higher median income. There is more churn in municipalities with a higher unemployment rate. Next, consumers churn more in densely populated municipalities. In municipalities with more kids churn is higher as well as in municipalities with a greater number of students. Higher death rate increases churn.

In both cases of fixed broadband and mobile services, fixed-mobile bundles may be taken up by consumers who have a lower propensity to churn. They may like the services of our operator more than subscribers who do not use bundles. Fixed broadband subscribers with fixed-mobile bundles were on average 6.93 years with our operator as compared to 6.15 years for subscribers without such bundles. The respective numbers for mobile subscribers were 6.43 versus 5.89 years. By including in the estimation the number of years passed since the first subscription with our operator, we control to some extent for consumer preferences to stay with our operator. Indeed, we find that consumers who are longer with our operator are less likely to churn both fixed and mobile services. But we may be still overestimating the impact of bundling on consumer churn, and our estimates should be considered as an upper bound.

5 Conclusion

Bundling has been extensively studied in the theoretical literature but there is little empirical evidence so far on how it impacts consumer behavior. Bundled offers allow firms to create cost savings, launch more valuable products and create more choices for consumers. But when entrants are not able to replicate the essential products and services of dominant incumbent, bundled offers can be used to limit competition. In the last years, bundling of fixed and mobile telecommunications services became a norm with the majority of consumers in many countries using such offers. Telecommunication markets are thus an interesting case to study the effects of bundling on consumer behavior. While there is some evidence on the effects of triple play offers, we do not know much about the effects of quadruple play tariffs on consumers' decision to churn.

Our paper is the first one which relies on a complete information on subscribers to one of the biggest telecommunications operator in Europe to study the impact of fixed-mobile bundling on consumers' decision to churn. We use a unique data on about 9.6 million subscribers to fixed broadband services and about 14.2 million subscribers to mobile services between March 2014 and February 2015 and find that consumers who bundle fixed and mobile services from the same provider are less likely to churn. Without fixed-mobile bundling the churn of fixed broadband consumers would increase by 9.5 percent from 8.4% to 9.2%. The consumer churn in the mobile market would increase by 14.2 percent from 11.5% to 13.1%.

We find that fixed-mobile bundling allows firms to reduce defections of consumers, where the impact is stronger for mobile than for fixed broadband services. This may have different explanations. First, as our data shows, churn rate is lower among fixed broadband consumers which may be due to higher switching costs. Thus, the marginal increase in switching costs due to bundling may be higher for mobile services than for fixed broadband services. At the same time, the marginal benefits from bundling may be also higher for fixed broadband users than for mobile subscribers.

We consider the reduction in consumer churn due to fixed-mobile bundling to be modest. In

the telecommunications market in the country under study, there are four major competitors which offer both mobile and fixed broadband services. They all compete with comparable quadruple-play offers. Our results are therefore valid for a market situation, in which consumers can switch from a bundle offered by our firm to a bundle offered by the competitors.

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Appendix

Table 1: Summary statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Churn - fixed	9,543,248	0.084	0.277	0	1
Quadruple-play - fixed	9,543,248	0.392	0.488	0	1
Having FttH - fixed	9,543,248	0.037	0.189	0	1
Year with the firm - fixed	9,543,248	5.805	4.045	0	18
FttH in bundle - fixed	9,543,248	0.015	0.121	0	1
PSTN - fixed	9,543,248	0.222	0.416	0	1
Churn - mobile	13,417,487	0.115	0.319	0	1
Quadruple-play - mobile	13,417,487	0.26	0.439	0	1
Having FttH - mobile	13,417,487	0.006	0.08	0	1
Year with the firm - mobile	13,417,487	6.292	4.997	0	22
Number of LLU operators	35,672	1.205	1.042	0	6
Presence of cable	35,672	0.028	0.165	0	1
4G coverage (%)	35,672	0.252	0.389	0	1
4G coverage by competitors (%)	35,672	0.271	0.399	0	1
Years since DSL in municipality	35,665	10.516	2.014	0	15
Households/surface (tsd/km2)	35,662	67.197	436.451	0.17	18.27
Kids/population	35,638	0.233	0.084	0	1.28
Students/population	35,662	0.064	0.024	0	0.39
Death/population	35,593	0.010	0.009	0	0.50
Median income (tsd Euros)	35,672	19.522	3.082	4.82	45.46
Unemployment (%)	35,647	10.291	4.695	0.00	75.00

Figure 1: Percentage of churning consumers by municipality

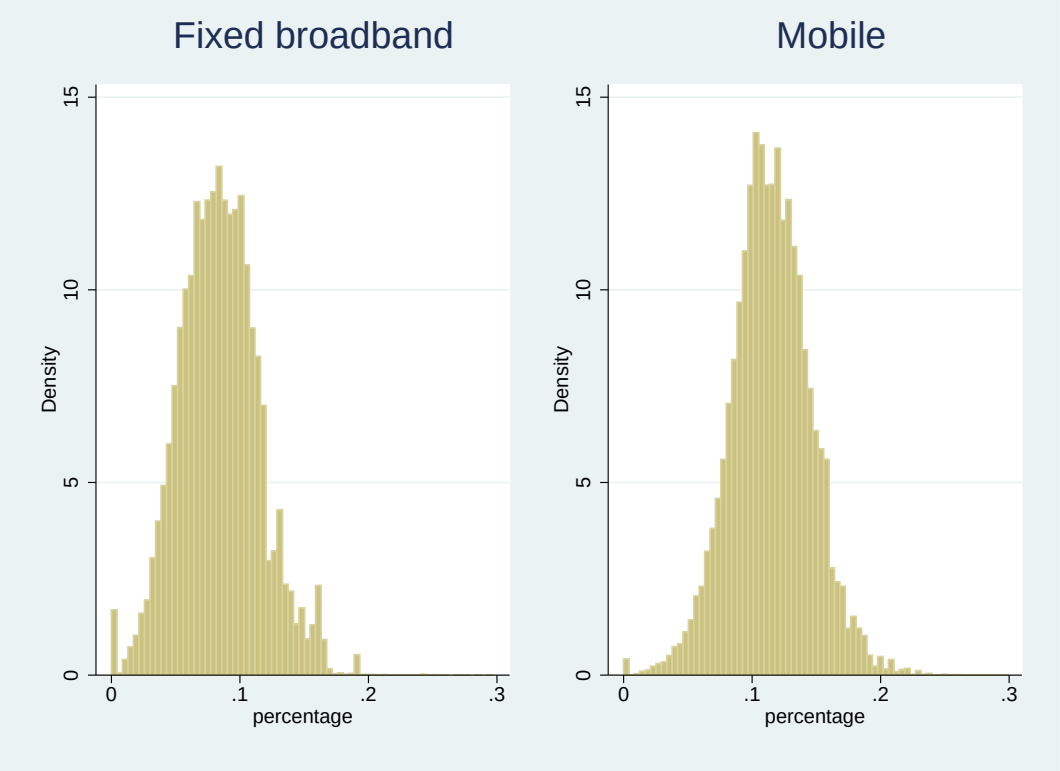

Figure 2: Percentage of consumers with quadruple-play bundles by municipality

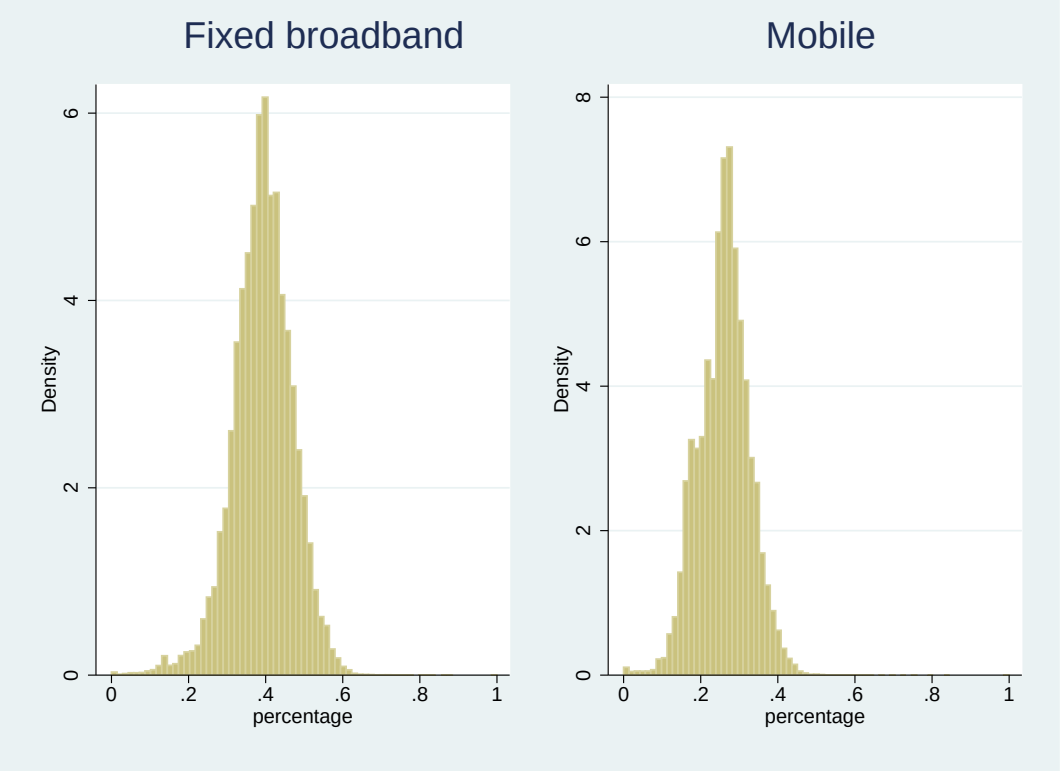

Table 2: Determinants of consumer churn for fixed and mobile markets

	Fixed				Mobile		
	I	II	III	IV	I	III	IV
Fixed-mobile bundle	-0.005***	-0.019***	-0.019***	-0.019***	-0.064***	-0.063***	-0.063***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
FttH in bundle	0.021***	0.101***	0.092***	0.087***	-0.001	-0.012***	-0.013***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Years with operator	-0.003***	-0.003***	-0.003***	-0.003***	-0.007***	-0.007***	-0.007***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PSTN		-0.041***	-0.042***	-0.041***			
		(0.000)	(0.000)	(0.000)			
FttH eligible		-0.153***	-0.177***	-0.182***			
		(0.000)	(0.000)	(0.000)			
LLU operators			0.011***	0.008***		0.006***	0.004***
			(0.000)	(0.000)		(0.000)	(0.000)
Cable presence			0.038***	0.020***		0.009***	0.005***
			(0.000)	(0.000)		(0.000)	(0.000)
4G coverage (operator)			0.001***	-0.000		0.003***	0.005***
			(0.000)	(0.000)		(0.000)	(0.000)
4G coverage (competitors)			0.002***	0.004***		0.004***	0.006***
			(0.000)	(0.000)		(0.000)	(0.000)
Years since DSL			0.001***	0.001***		0.000***	0.001***
			(0.000)	(0.000)		(0.000)	(0.000)
Density of pop				0.002***			1.023***
				(0.000)			(0.137)
Kids/population				-0.032***			0.003***
				(0.000)			(0.000)
Students/population				0.146***			0.015***
				(0.002)			(0.002)
Death/population				0.025			0.135***
				(0.020)			(0.019)
Income				-1.345***			-2.826***
				(0.027)			(0.028)
Unemployed				0.029***			0.120***
				(0.008)			(0.008)
Constant	0.105***	0.128***	0.080***	0.183***	0.173***	0.144***	0.169***
	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)	(0.001)	(0.002)
Observations	9,577,664	9,574,845	9,547,704	9,543,248	14,189,887	13,420,485	13,417,487

Standard errors are in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Model predictions

	churn fixed	%change	churn mobile	%change
Base	8,4%		11,5%	
No bundle	9,2%	9,5%	13,1%	13,9%
No PSTN	9,3%	10,7%		
Full cable coverage	10,0%	19,0%	11,9%	3,5%
No cable	8,0%	-4,8%	11,4%	-0,9%
Nb LLU= 3 coverage	10,0%	19,0%	12,4%	7,8%
Nb LLU= 0	6,2%	-26,2%	10,2%	-11,3%
Full 4G coverage	8,5%	1,2%	11,9%	3,5%
No 4G coverage	8,2%	-2,4%	10,8%	-6,1%