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## The Impact of Entry and Merger on the Price of Mobile Telecommunications Services

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# The Impact of Entry and Merger on the Price of Mobile Telecommunications Services\*

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10th May 2015

## Abstract

According to static models of industrial organization, a rise in competition decreases prices. In this paper, I test whether this conclusion can be reversed in the mobile telecommunications markets where dynamic efficiency effects might be significant. The empirical test relies on the change in the intensity of competition introduced by the entry of the fourth mobile operator in France and the merger between the third and the fourth mobile operators in Austria. Using a hedonic price model and a double-difference matching identification strategy, I find that the entry in the French market has raised the unit price of mobile data services by 4 dollars per Gigabyte; contrary to the merger in the Austrian market which lowers the unit price of mobile data by 6 dollars per Gigabyte. These results suggest that the dynamic efficiency effects actually outweigh the static ones in the mobile telecommunications industry. Therefore, a merger from four to three mobile operators may be welfare enhancing.

**Keywords:** Dynamic Efficiency Effects, Ex-post Merger Evaluation, Non-linear Pricing, Mobile Telecommunications.

**JEL Classification:** D43, L11, L13.

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# 1 Introduction

Mainstream static IO models predicts a fall in prices following an increase in competition irrespective of the price structure. However, in a dynamic framework where firms invest in cost-reducing technologies, a rise in competition may end up increasing price if the dynamic efficiency effects outweigh the static ones. In the mobile telecommunications industry, this question is at the center stage of the policy debate regarding whether mergers from four to three mobile operators should be accommodated.<sup>1</sup>

In this paper, I take advantage of the entry of the fourth mobile operator in France as well as the merger between the third and the fourth largest mobile operators in Austria to test whether the dynamic efficiency effects outweigh the static ones in the mobile telecommunications industry. The empirical test consists in assessing the effect of the entry and the merger on the prices of the mobile telecommunications services. The dynamic efficiency effects would dominate the static ones if, contrary to the predictions from the static models, entry induces higher prices and the merger leads to lower prices.

The empirical test relies on a detailed tariff dataset provided by Teligen (Strategy Analytics) over 7 quarters and 40 countries. It accounts for the nonlinear structure of the price and the provision of bundles of voice and data services by estimating a hedonic price model (Griliches, 1961). The design of the hedonic price model assumes that the nonlinear prices observed can be represented by a two-part tariff. Thus it allows us to identify the standalone access and unit prices, as well as their corresponding bundling discounts which are not directly observables from the mobile tariffs. The estimation of the hedonic price model shows a very good fit up to 80 percent.

The identification strategy of the impact of entry and merger relies on a double-difference approach. Given that the tariff of the mobile plans before the entry and the merger were not observed, we employ a nearest-neighbor matching estimation strategy, following Heckman, Smith, and Taber (1998). The nearest-neighboring markets were identified using a principal component analysis (PCA) based on the determinants of mobile price trend such as the mobile penetration rate, the Herfindhal-Hirschman Index, the number and the average age of the firms in each market before

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<sup>1</sup>On the one hand, OECD (2014) recommends that increasing the number of mobile network operators would lowers prices and raises investment. On the other hand, Bohlin, Caves, and Eisenach (2013) suggests the contrary.

the fourth quarter of 2011.

The PCA is implemented on 38 countries for which tariff data are available from the Teligen tariff database. It yields three factors that represent 80% of the total variance of the variables. Using the coordinates of each country on these three factors, we are able to compute the distance of each market with respect to France and Austria respectively. Based on the minimal distance, we find that Korea is the closest market to France, whereas Italy is the closest market to Austria.

The double-difference estimation is implemented on the sample of tariffs from each pair of markets (France; Korea) and (Austria; Italy). It turns out that neither the entry in France, nor the merger in Austria affects the access price of mobile voice or data plans. There is also no effect on the bundling discount on the access price. However, the entry in France has raised the unit price of mobile data by 4 dollars per Gigabyte ; contrary to the merger in Austria which significantly reduces the unit price by 6 dollars per Gigabyte. These findings are robust to changes in the counterfactual markets. They are driven by the bundling discount on the unit price of mobile data which is lower following the entry; but higher following the merger.

These results suggest that the dynamic efficiency effects outweigh the static ones in the mobile telecommunications industry; more precisely between markets with three and four mobile network operators. They provide an empirical contribution to the literature on the effect of competition in a dynamic environment. As in Schmutzler (2013), much of this literature dealt with the impact of competition on investment. In this paper, I go a step further by showing how a change in the market structure can affect prices through the channel of innovation.

The results of this paper also complement the findings from the literature on bundling and nonlinear pricing as in Armstrong (2010), by showing that the bundling discount on the unit price can fall following an increase in competition. The underlying rationale for this result is derived from the literature on the relationship between competition and investment which shows that investment in new technologies can fall following an increase in the number of firms (Vives, 2008). They are also related to the literature on the impact of competition on nonlinear pricing as in Seim and Viard (2011) which found, contrary this paper, an increase of the quantity discount for high-valuation consumers after the deregulation of entry into the mobile telephony market in the US.

The rest of the paper is organized as follow. Section 2 presents some background information about the entry, the merger and the specific feature of the mobile tele-

coms industry that could explain the findings of this paper. Section 3 presents the theoretical framework which highlights the tradeoff between the static and dynamic effects of increasing the number of firms in an innovative market. Section 4 lays out the empirical strategy, particularly the identification of the counterfactual markets for France and Austria, the dataset and the variables, the estimation of the hedonic pricing model and the formulation of the double-difference estimation strategy. Section 5 presents the results along with some robustness checks and the underlying mechanisms. Section 6 concludes.

## 2 Industry Background

### 2.1 Innovation and Nonlinear Pricing in the Mobile Telecommunications Industry

The mobile telecommunications industry is characterized by significant rate of technological progress. This feature makes it particularly suitable to test the dynamic efficiency effects. According to the study by (Koh and Magee, 2006), the annual rate of technological progress in the transmission of information was 35 percent between 1940 and 2006. This is far greater than the annual rate of technological progress in energy transportation (13.2 percent) (Koh and Magee, 2008). Every year, mobile communication equipment providers innovate and release new technologies of mobile telecommunications. The adoption of these new technologies by mobile operators reduces their marginal cost of production.

However, the tariff proposed by firms in this industry is rather complex. Historically, mobile telecommunications services mainly consist of the supply of voice services, including short or multimedia messages services. These services can be purchased as prepaid or postpaid contract. Under a prepaid contract, the consumer typically pays for an allowance of voice before consuming. The set of prepaid contracts proposed by a firm is equivalent to a menu of pairs of quantity and tariff, without any loyalty commitment required from the consumer. Under a postpaid contract, the consumer pays a tariff periodically (monthly in general) for a given allowance, with a minimum duration of commitment for loyalty. Some postpaid plans include unlimited voice or data allowance. For mobile plans with limited allowance, the consumer should pay a unit price to use the service in excess of the initial allowance. Because of these features, the tariff structure of a mobile plan is in general considered as a three-

part tariff (Lambrecht, Seim, and Skiera, 2007). The first part is an access charge meant to recover the fixed cost of investment or to extract consumer surplus. The second part corresponds to the usage allowance and the third part is a marginal price charged for every additional unit of the service consumed in excess of the allowance.

More recently, innovations in new generations of mobile networks, notably the third and the fourth generations (3G and 4G), have spurred the supply and demand for mobile data services. For instance, the share of mobile data in the revenue of Western European mobile network operators has tripled from 15% in 2007 to almost 45% in 2013. This emergence of mobile data services has been accompanied by the bundling of both mobile voice and data services (Ovum online database). As of the first quarter of 2014, half of the European Union mobile users purchase voice and data services in bundle (E-communications surveys N<sup>o</sup>414).

On top of these features, a postpaid mobile contract may also include several add-ons such as a subsidy for the handset, a premium quality services for business customers and an inter-temporal discount. This complexity makes it difficult to compare average price across firms or markets.

## 2.2 The Entry in France and the Merger in Austria

Entry in the mobile telecommunications market strongly depends on the allocation of radio frequency bands by the regulator. In the French market, three mobile network operators (MNO) were active in early 2000s. Then, the regulator proposed four packages of frequency bands dedicated to the provision of the third generation of mobile network (3G) in order to accommodate a fourth entrant. However, only the incumbent MNOs compete for the licenses, leaving one package unsold. As of December 2009, *Free*, a fixed broadband network operator, won the fourth license for the provision of mobile telecommunications services based on the third generation of mobile network technology (3G). Meanwhile, the other three MNOs also won additional frequency licenses for the provision of the second and the third generation of mobile network technology, conditional on providing access to their network to *Free*. Additional frequency licenses was granted to the four MNOs in September 2011 and in January 2012. The fourth MNO, *Free* began supplying its commercial services in January 2012.

Following its entry, *Free* offered two mobile plans with no handset subsidy (SIM-Only), one for 2 euros including 1 hour of voice calls, the other for 20 euros including

unlimited voice calls and 3 Gigabytes of data. The 2 euros plan was then the cheapest in the market, leading to a substantial switching of consumers from the incumbent operators. Some weeks prior to the entry, the incumbent MNOs released comparable mobile plans but their prices remain slightly higher than the cheapest plan of *Free*. Three years later, the voice allowance of the 2 euros mobile plan rises by 1 hour and includes 50 Megabytes of data. The 20 euros plan remains with the same allowance although the subscriber can now have access to the fourth generation network. The new entrant also offers bundling discounts for its fixed broadband customers.

In the Austrian market, Hutchison, the fourth operator in terms of market share, acquired Orange, the third operator, in December 2012 following a notification to the European Commission (EC) in May 2012. This notification underwent a thorough analysis by the EC, after which the clearing is made on the conditions that Hutchison divests its radio spectrum to a potential new entrant and provides wholesale access for mobile virtual network operators. In the aftermath of the merger, the newly formed operator *Hutchison Drei Austria* maintained the lowest tariff previously proposed by Orange. Two years later, it removes this cheapest plan from its offers.

The figure below presents the evolution of the market concentration index in France and Austria. The HHI falls by 800 units within the three years following the entry of the fourth operator in France. This fall is rather significant compared to the overall decline by 66 units over 6 years before the entry. In Austria, the merger has led to a jump of the HHI by 500 units.

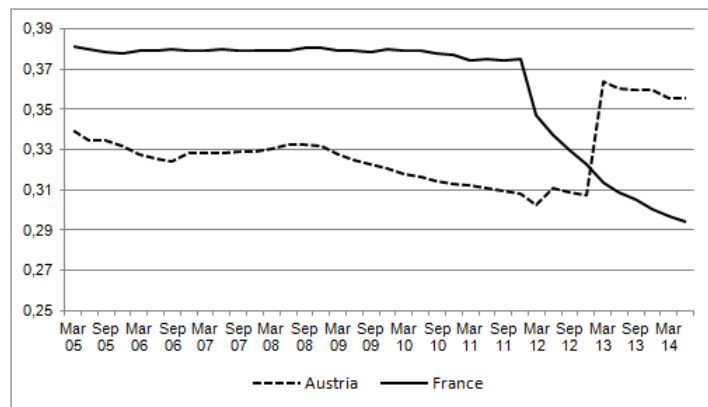


Figure 1: Herfindahl-Hirschman Index of market concentration

### 3 The Theoretical Framework

The theoretical model is drawn from the framework proposed by Saavedra (2011) where she uses a differential game approach to analyze the impact of the number of firms in an industry with significant technological progress. In this framework,  $n$  firms compete in price for the provision of a differentiated product whose demand can be expressed as in Shubik and Levitan (1980). The number of firms in the market is determined once and for all by a regulator. This is typically the case for the mobile telecommunications industry where network operators need to purchase a license from the regulator in order to supply their services.

The demand addressed to firm  $i$  writes:

$$q_i = \frac{1}{n} [1 - p_i - \gamma(p_i - \bar{p})] \quad (1)$$

Where  $\bar{p}$  is the standard average price in the market and  $\gamma$  is a parameter of product differentiation.

Firms are symmetric with constant marginal cost of production  $c$ .

■ In a static framework, firms simultaneously set their prices to maximize their static profit  $\pi_i = (p_i - c)q_i$ . The symmetric Nash equilibrium price and quantity write:

$$p^s = c + (1 - \phi)(1 - c) \quad (2)$$

And

$$q^s = \frac{1}{n} \phi(n, \gamma) * (1 - c) \quad (3)$$

Where  $\phi(n, \gamma) = \frac{n + \gamma(n-1)}{2n + \gamma(n-1)}$  characterizes the intensity of competition either through the degree of product differentiation  $\gamma$  or the number of firms  $n$ .  $\phi$  is actually an increasing function of its parameters.

In this static framework, the equilibrium price falls as the regulator increases the number of firms in the market. This is consistent with the standard static IO models.

■ In a dynamic framework, assume that firms simultaneously set their prices and



investment to maximize their discounted net profit:

$$\Pi_i = \int_0^{\infty} \pi_i(t) e^{-rt} dt \quad (4)$$

Where  $\pi_i(t) = [p_i(t) - c(t)]q_i(t) - y_i(t)$  is the instantaneous profit and  $y_i(t)$  is the investment of firm  $i$  at time  $t$ .

The law of motion of the marginal cost is described by the following equation:

$$\frac{dc(t)}{dt} = -\rho\psi(y_i(t))c(t) \quad (5)$$

This equation implies that investment in new technology reduces the marginal cost of production due to the size of innovation represented by  $\rho$  and the investment efficiency function  $\psi$ . This latter is positive, increasing and concave.

Given the settings of the model, it turns out that the open-loop Nash equilibrium is subgame perfect. In particular, the only steady state stable point is reached at the point where the investment is nil and the marginal cost is expressed as follows:

$$c_n^* = \frac{1}{2} - \sqrt{\frac{1}{4} - \frac{nr}{\rho\psi'(0)\phi(n, \gamma)}} \quad (6)$$

This steady state is reached under the condition that the size of innovation measured by  $\rho$  is large enough. This condition stems from the positivity of the expression under the radical.

The equilibrium price is the same as in the static game with the exception that the marginal cost now depends on the investment.

The effect of the number of firms on the equilibrium price writes:

$$\frac{\partial p_n^*}{\partial n} = \frac{\partial c_n^*}{\partial n} - \left[ \frac{\partial \phi}{\partial n} (1 - c_n^*) + (1 - \phi) \frac{\partial c_n^*}{\partial n} \right] \quad (7)$$

It can be shown that the dynamic efficiency effect  $\frac{\partial c_n^*}{\partial n}$  is positive while the static effect  $-\frac{\partial \phi}{\partial n} (1 - c_n^*) - (1 - \phi) \frac{\partial c_n^*}{\partial n}$  is negative, as long as there are two or more active firms in the market.

Therefore, an increase in the number of firms may end up increasing prices if the

dynamic efficiency effect dominates the static one. This is what the empirical section purports to test.

## 4 The Empirical Test of the Dynamic Efficiency Effects

The empirical test consists in assessing the impact of the entry in France and the merger in Austria on the price of the mobile telecommunications services. The identification strategy relies on a double-difference estimation. However, we first need to identify the best counterfactual market for France and Austria, for the price of the mobile plans were not observed before the entry/merger due to data limitation.

### 4.1 Finding the best counterfactual markets for France and Austria

Given the observables determinants of entry or merger, I would implement a propensity score matching in order to determine the best counterfactual markets. However, within the set of 38 markets for which tariff data is available, the entry of a new mobile operator occurs only in France and Israel in 2012; whereas the merger between two mobile network operator only happens in Austria in 2013. Therefore, there is not much variation in the "treatment" to implement a propensity score matching.

To overcome this limitation, I employ a principal component analysis (PCA) based on a set of variables that are deemed to determine the evolution of price in the market.<sup>2</sup> The PCA will transform these variables into an index that measures the distance between the potential counterfactual markets and France and Austria, respectively.

A best counterfactual market is a market where the prices of the mobile plans would have followed the same trend as in France or Austria, should an entry or merger occurs. We assume that the price trend is determined by demand factors such as the level and evolution of the mobile penetration, supply factors such as the number and the age of the MNOs, as well as by the level and evolution of the market structure measured by the Herfindahl-Hirschman Index (HHI). To avoid the endogeneity of

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<sup>2</sup>See (Jolliffe, 2002) for a presentation of the principal component analysis method.

these factors with respect to the entry/merger, these variables were measured before 2012.

The demand factors are measured by the mobile penetration rate as of the fourth quarter of 2011 just before the entry of Free in France, and by the change in the mobile penetration rate between the 2000 and 2011.<sup>3</sup> The supply factors have been measured by the number of MNOs in the market as of the fourth quarter of 2011, and their average and median age in years.<sup>4</sup> Finally, I use the HHI as of the fourth quarter of 2011 and its change between 2007 and 2011 to measure the change in the market structure. The HHI has been constructed using data on the number of subscribers of all the firms in the market provided by the WCIS. A counterfactual market is the one which is the closest to France/Austria with respect to all these variables.

The implementation of the PCA on these seven variables excludes the USA and Canada from the dataset as outliers. It is therefore run on 38 countries of which France and Austria. It yields three independent factors which represent 80% of the total variance of the data (See table 2 on eigen values in appendix). Each national market has its own coordinates on the three dimensional space formed by the three factors (see table 3). These coordinates have been used to compute the distance between each national market and France on the one hand, and Austria on the other hand. Formally, the euclidean distance between a potential counterfactual market  $x$  and the reference market  $r$  writes :

$$D(x, r) = \sqrt{(x_1 - r_1)^2 + (x_2 - r_2)^2 + (x_3 - r_3)^2} \quad (8)$$

Where  $x_i$  is the coordinate of the national market  $x$  on the  $i^{th}$  factor. Likewise,  $r_i$  is the coordinate of the reference market on the  $i^{th}$  factor. The reference markets are France and Austria respectively. The lower  $D(x, r)$ , the closer are the national markets  $x$  and  $r$ . The following graphs present the distance of each national market with respect to France and Austria respectively. The closest market can be identified from the x-axis. It turns out that Korea is the closest market to France; whereas Italy is the closest market to Austria.

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<sup>3</sup>The data on the mobile penetration have been retrieved from the World Cellular Information Services (WCIS) online database managed by Ovum.

<sup>4</sup>This information comes from the Wireless Intelligence database.

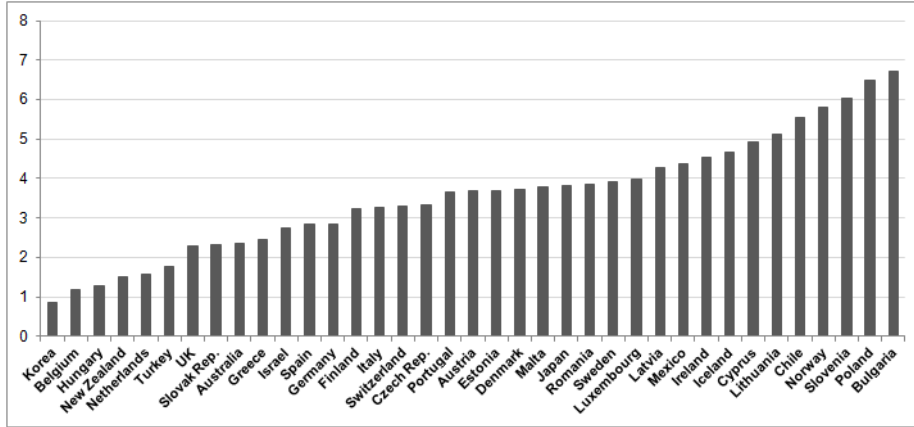


Figure 2: Euclidean distance with respect to the French mobile market

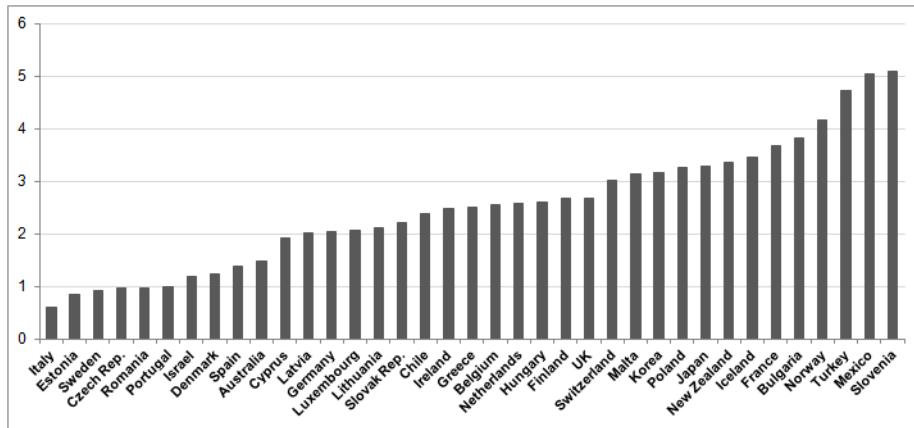


Figure 3: Euclidean distance with respect to the Austrian mobile market

## 4.2 Description of the tariff dataset

I build a new dataset on mobile plans using information from various sources including the Teligen price benchmarking and the Wireless Intelligence databases.<sup>5</sup> The Teligen database provides quarterly information about the characteristics of all the telecommunications plans proposed by the major operators in the OECD member States including 6 non-OECD countries, making a total of 40 countries covered. It covers the two or three largest operators that made up at least 50% of the market size in terms of subscribers. As a result of this selection, information on the new entrants are generally not present in the database. The estimation will only be valid for the incumbent operators.

<sup>5</sup>The Teligen database is compiled by Strategy-Analytics and the Wireless Intelligence database is compiled by the GSMA. These are proprietary data purchased by Orange Group. I am grateful to Orange for having provided access to these databases.

The Teligen database provides information about both fixed and mobile telecommunications plans but the estimation will be done on the mobile telecommunications plans as the change in the market structure only occurs on the mobile market.<sup>6</sup> The information provided by the Teligen database allows distinguishing three types of mobile plans, namely postpaid, prepaid and pay-as-you-go. The pay-as-you-go plans do not provide any information about the voice or data allowance. They cannot be used in the estimation. Regarding the prepaid plans, they are not representative of the pricing and consumption of a given consumer as they can be purchased several times within a given period or consumed later after the purchase. In addition, they are always supplied in standalone. For these reasons, the estimation will rely on postpaid plans, as they provide information on the monthly price of voice and data in standalone or bundled.

On top of the price information and the bundling status of a mobile plan, the dataset also contains information about the monthly allowances, namely the number of minutes, the volume of data along with the download speed. Additional information on the characteristics of the mobile plan are the contract duration (in months), whether the plan is targeted to business or residential consumers and whether it is bundled with a mobile terminal subsidy. The Wireless Intelligence database provides the information on the mobile network operators in each national market. In particular, their date of entry, merger or exit, if applicable. Given the data availability constraint, the dataset contains information over 7 quarters; from the first quarter of 2013 to the third quarter of 2014.

This analysis uses the prices of the mobile plans and their voice and data allowance as the main variables. The price is converted into the constant Q1-2013 dollars purchasing power parity (PPP) to ensure comparability across markets and quarters. The limited voice and data allowances have been converted into hours and Gigabytes respectively. The unlimited voice and data plans have been converted into limited plans by imputing the following allowances for simplicity: 20 hours for unlimited standalone or bundled voice plan, 50 Gb for unlimited standalone data plan and 15 Gb for unlimited bundled plan. We check that our results are not sensitive to these choices.<sup>7</sup>

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<sup>6</sup>The change in the market structure of the mobile market may also affect the pricing of the fixed telecommunications plans. A robustness check that includes the fixed telecommunications plans into the dataset finds no effect of the change in the mobile market structure on their pricing.

<sup>7</sup>These sensitivity analyzes are available upon request.

### 4.3 Descriptive Statistics

The closeness between France and Korea as well as between Austria and Italy in terms of their mobile markets is confirmed by the following descriptive statistics. First, as show in the figure 4, the rate of mobile penetration in Korea is similar to the one observed in France. The same conclusion stands out when comparing the mobile penetration rate between Austria and Italy. Before, the entry of Free Mobile, there were three MNOs in both France and Korea with similar dates of entry (figure 5). Likewise, there were four MNOs in both Austria and Italy and they enter in approximately the same years. The entry in France raises the number of MNOs from 3 to 4; whereas the merger in Austria reduces the number of MNOs from 4 to 3. This is an interesting feature for the policy debate about the number of MNOs that is the most likely to maximize social welfare. Meanwhile, the evaluation of the dynamic efficiency effect will be only valid for a change in the market structure from 4 to 3 firms or inversely.

In addition, as shown in figures 6 and 7, the level and evolution of the HHI were alike in France and Korea, as well as in Austria and Italy before the change in the market structure. In all the markets, there is a general downward sloping trend in the HHI. However, the entry in France, has accelerated this trend; driving the HHI down from 3750 in Q4-2011 to 2940 in Q2-2014. In the meantime, the HHI merely falls from 3860 to 3800 in Korea. Regarding the merger in Austria, it significantly raises the HHI from 3080 in Q4-2012 to 3560 in Q2-2014; while in the meantime, the HHI slightly falls from 3000 to 2870 in Italy.

Figure 8 presents the evolution of the average price of the mobile plans irrespective of whether they include voice or data, and whether they are provided in standalone or bundle. It shows that on average, the price of mobile plans is higher; but falling in France, compared to Austria where it is lower; but rising. These price statistics do not account for the nonlinear structure of the tariff, the bundling discounts, as well as the price attached to the add-ons services. The hedonic price model presented in the new section addresses this issue.

### 4.4 The Hedonic Price Model

I overcome the shortcomings of the descriptive statistics by estimating a hedonic price model following Griliches (1961). The hedonic price model is based on the intuition that any product can be viewed as a bundle of attributes such that firms

and consumers trade to determine the price attached to each attribute. Rosen (1974) provides a formal presentation of this model in a perfectly competitive framework and Karamti and Grzybowski (2010) applies it to study the evolution of the prices of mobile telephony services in France.

As discussed in the background section, the price of a mobile plan is typically a three-part tariff. However, I assume for simplicity that the pair of tariff and allowance that characterizes a mobile plan can be represented by a two-part tariff. The fixed part corresponds to the access charge and the variable part corresponds to the unit price. On top of these components, I also add a bundling discount for the tariffs of those plans that are proposed in bundles.

The design of the hedonic price model is meant to recover the access and unit prices of voice and data; as well as the corresponding bundling discounts. The access and unit prices have been identified under the hypothesis of a constant unit price. Regarding the bundling discounts, their identification relies on the observation of the prices of the standalone products that made up the bundles. The hedonic price model writes:

$$T_i = \lambda_v + \lambda_d D_i + \delta B_i + \alpha_s S V_i + \alpha_b B V_i + \beta_s S D_i + \beta_b B D_i + \gamma X_i + F e_i + \varepsilon_i \quad (9)$$

Where  $T_i$  is the monthly price of the mobile plan  $i$ , in constant 2013 US dollars PPP.  $D_i$  is the download speed of plan  $i$  in Gigabits per second.  $D_i = 0$  for mobile voice plans so that the coefficients  $\lambda_v$  and  $\lambda_d$  measure the access price to mobile voice and data respectively.  $B_i$  is a dummy variable for bundle plans. Its coefficient  $\delta$  measures the bundle discount on the access price. Its sign should be negative.  $S V_i$  and  $B V_i$  are respectively the number of hours of voice calls included in standalone and bundled plans. Their coefficients  $\alpha_s$  and  $\alpha_b$  measure respectively the unit price of standalone voice and its bundling discount or premium. Similarly,  $S D_i$  and  $B D_i$  are respectively the number of Gigabytes of data included in standalone and bundled plans. Their corresponding coefficients  $\beta_s$  and  $\beta_b$  measure respectively the unit price of standalone data and its and bundling discount or premium.  $X_i$  includes the characteristics of the plans such as the duration of the contract in months, the market segment addressed (business or residential) and a dummy for SIM-only plans. The hedonic price model also includes country, operator and quarter fixed effects represented by the variable  $F e_i$ .

This equation is estimated by OLS correcting for arbitrary heteroscedasticity. The quality of the hedonic price model is evaluated by the goodness of fit indicator, R-squared. The hedonic price model is generally deemed satisfactory when the R-squared is large enough, typically above 80%. Table 4 in appendix shows the estimated results for Austria with an R-squared of 80%.<sup>8</sup>

## 4.5 Econometric Model

I employ a double-difference estimation strategy using the counterfactual market as the control group. The corresponding econometric model interacts the main variables of the hedonic price model with a dummy for the market in which entry or merger occurs and a dummy for each quarter. For instance, in the case of the entry in France, I interact a dummy for France and a set of dummies for the quarters with the variables  $D_i$ ,  $B_i$ ,  $SV_i$ ,  $BV_i$ ,  $SD_i$  and  $BD_i$  of the hedonic price model. The double-difference estimator of the impact of entry/merger on a component  $\theta$  of the price at the date  $t$  thus writes:

$$\hat{\theta}_t = [E(T/\theta, M = 1, t) - E(T/\theta, M = 1, t = t_0)] - [E(T/\theta, M = 0, t) - E(T/\theta, M = 0, t = t_0)] \quad (10)$$

Where  $\hat{\theta}_t$  denotes the estimator of the impact of entry/merger on the component  $\theta$  of the price at the date  $t$ . This component may be the standalone access or unit price of voice or data, or their corresponding bundling discounts.  $T$  represents the tariff of the mobile plan.  $M$  denotes a dummy variable for the market in which entry/merger occurs. Due to data limitation, the reference date  $t_0$  is set to the first quarter of 2013 for both entry and merger. This choice corresponds to the date of the merger in Austria. However, it is rather a later date with respect to the date of entry of Free in France (January 2012).

An OLS estimation of the hedonic price model with the interaction terms provides the estimates of  $\hat{\theta}_t$ . This estimation is made on each pair of markets: (France, Korea) for the entry, and (Austria, Italy) for the merger.

On top of the postpaid plans, the econometric model is also estimated on a sample which includes the prepaid plans; even though these latter typically do not reflect

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<sup>8</sup>For the other markets, the R-squared is between 50% and 70%. This is primarily due to time variant unobservable differences across firms within the same market. Otherwise, the R-squared is larger than 80% percent when the hedonic model is estimated for each firm, at the expense of lower precision due to fewer observations.



the actual consumption of the consumers. Otherwise, the estimates on the postpaid plans may be biased if prepaid plans represent a significant share of the consumers' purchase. This is the case in Italy where the revenue from prepaid plans represents more than half of the mobile market total revenue (Ovum, online database).

In order to reflect the actual change in price borne by the consumers, I also account for the consumption pattern observed in the market. Indeed, a simple OLS estimation implicitly assumes that all the plans have been equally chosen by the consumers. This assumption is likely to overestimate the impact of entry/merger; particularly if the change in price occurs for the plans that are farther away from the actual average consumption pattern of the consumers. To overcome this issue, I collect quarterly information on the monthly average consumptions of mobile voice and data in France, Korea, Austria and Italy, covering the period of estimation (Q1-2013 to Q3-2014). Thus I compute the normalized distance  $d_{ij}$  of each plan with respect to the average consumption of voice on the one hand and the average consumption of data on the other hand. Formally, this distance writes:

$$d_{ij} = \frac{|Y_{ij} - \bar{Y}_j|}{\max_i |Y_{ij} - \bar{Y}_j|} \quad (11)$$

Where  $Y_{ij}$  represents the allowance of voice ( $j=1$ ) or data ( $j=2$ ) in the plan  $i$  and  $\bar{Y}_j$  is the average consumption of voice or data observed at the market level.

I assign to each plan a weight that is inversely proportional to its distance with respect to the average consumption of voice and data. The weight is computed for each operator at a given quarter as follow:

$$W_i = \frac{1}{\sqrt{d_{i1}^2 + d_{i2}^2}} \quad (12)$$

Then I implement a weighted least square estimation using the normalized weights, clustered at the operator and quarter level. The intuition behind this weighting is that the plans that are farther away from the average consumption pattern are given lower weight in the estimation of the impact of entry/merger.

## 5 Results

### 5.1 Main Estimation Results

Tables 5 to 14 in appendix presents the detailed results of the estimation of the impact of entry in France and merger in Austria on the access and unit prices of voice and data, as well as on the bundling discounts. The variable *shock* is a dummy for the country in which entry/merger occurs. *packmob* is a dummy for a bundle of mobile voice and data. The first three columns present the result of the impact of a change in the market structure using respectively the monthly price of the postpaid plan, the consumption weights, and including the prepaid plans. This section comments the results of these columns. The remaining columns present the robustness check results using up to the fifth closest markets to France and Austria.

The table 1 below presents a synthesis of the estimation results.

		Standalone Price		Bundling discount	
		Entry	Merger	Entry	Merger
Voice	Access	0	0	0	0
	Usage	0	0	0	0
Data	Access	0	0	0	0
	Usage	+*	0	-	+

No effect (0); Increasing (+) Decreasing (-). (\*) This effect is nil when the tariffs are weighted by the actual consumption.

Table 1: A synthesis of the estimation results

It turns out that on the one hand the entry of the fourth mobile operator in France has raised the unit price of mobile data, due to a fall in the bundling discount on the mobile data. On the other hand the merger in Austria has led to fall in the unit price of mobile data, due to a larger bundling discount on mobile data. The details of these results are presented in the subsequent paragraphs.

The first four variables in the regression output tables 5 and 10 present the estimation of the price of the add-ons services. The coefficient associated with the dummy variable *business* is positive and significant at 1 percent; suggesting that the mobile plans targeted at business customers entails a premium for better quality. Likewise, the mobile plans with commitment are more expensive; as corroborated by the negative and significant coefficient associated with the price of SIM-Only plans. The price of these plans typically includes a monthly payment for the subsidized handset. Some mobile data plans are tied with fixed broadband plans. The negative and significant coefficient associated with the dummy *tiedplans* measures the tying

discount.

Given these add-ons hedonic prices, I now turn to the estimated impact of entry/merger on the access and unit price of mobile voice and data, as well as on their corresponding bundling discounts. The reference quarter for the interpretation of the results is the first quarter of 2013.

### **The impact of the entry of Free in the french mobile market**

The access to standalone mobile voice or data plans was cheaper in France compared to Korea. None of them has changed significantly both in France and Korea; implying that the entry in the French mobile market does not affect the access prices of standalone mobile voice or data. Their bundling discount is however smaller in France than in Korea. This bundling discount remains constant both in France and Korea, meaning that it was not affected by the entry in the French market.

Regarding the unit price of standalone mobile voice, it was higher in France than in Korea; but the corresponding bundling discount is larger in France. It is not affected by the entry, for it does not change significant either in France or in Korea. Its bundling discount is downward sloping; providing an evidence of a fall in the unit price of mobile voice in bundle in both markets. No specifically significant trend is observed for France, implying that even though the unit price of mobile voice package is falling in France, the same trend is observed in Korea as well. For this reason, the entry of the fourth mobile operator in France has no effect on the unit price of mobile voice in bundle.

For the standalone mobile data, the unit price in France was not statistically different from the one observed in the Korean market. However, this difference turns out to be large and significant when the sample is weighted, meaning that many mobile plans with greater unit price of data are closer to the average consumption of data in France or farther away from the average consumption in Korea. In terms of trend, there is no significant change in the unit price of mobile data in Korea. However, the unweighted unit price of mobile data rises in France, suggesting that the entry raises the unit price of standalone mobile data. Yet, this impact is no longer significant when the sample is weighted. Therefore the rise in the unit price mostly affects mobile data plans that are farther away from the average data consumption in France. Put differently, standalone mobile data plans become more expensive in France following the entry but they are chosen by very few consumers.

The bundling discount on the unit price of mobile data was greater in France than in

Korea; but this difference is no longer significant when we account for the consumption weights attached to each plan, which implies that the mobile plans with the larger discount are farther away from the average consumption of data in France. There is no significant change in the bundling discount on the unit price of mobile data in Korea. However, It turns out that this discount is falling in France irrespective of the specification. As a consequence, the entry in France has increased the unit price of mobile bundled plans, particularly because of the rise in the unit price of the included mobile data. The magnitude of this rise is about 4 dollars per Gigabyte of mobile data.

### **The impact of the acquisition of Orange Austria by Hutchison**

The access to standalone mobile voice or data was more expensive in Austria than in Italy. They remain constant in both markets; meaning that the merger does not affect the access price of standalone mobile voice and data plans. Their bundling discounts were similar across the market and also remain constant over the quarters. Therefore, the merger in Austria does not affect the discount on the access price of the mobile bundle.

With respect to the unit price of standalone mobile voice plan, it is not statistically different from the unit price observed in Austria. Moreover, it does not change either in Italy or in Austria; implying that the merger in Austria does not affect the unit price of standalone mobile voice plans. The only change is a rise in the unit price of prepaid mobile voice plans in Italy; but they are farther away from the average consumption of voice in this market such that the weighted sample estimation shows no significant change in the unit price of standalone mobile voice. Similar results are obtained for the bundling discount on the unit price of mobile voice.

Regarding the standalone mobile data plans, they have the same unit price in Italy and Austria. However, the weighted average unit price is significantly lower in Austria; suggesting that the cheaper standalone mobile data plans are closer to the average consumption in Austria. There is a rise in the unit price of standalone mobile data plans in both Austria and Italy. The unweighted regressions show no specific significant change in the unit price in Austria. However, we find a significant rise in this unit price in the second quarter when the sample is weighted, though there is a falling trend afterward. As a result, the merger does not affect the unit price of standalone mobile data plans. The rising trend is common to Austria and its counterfactual market.

The bundling discount on the unit price of mobile data is not statistically different

between Austria and Italy. Still, it turns out to be positive and very significant when the consumption weights are applied. This result suggests that the bundle discount on the unit price of mobile data is lower for mobile bundle plans that are closer to the average consumption of data in Austria. The bundling discount is falling in both Austria and Italy. However, it falls less in Austria, and even turns out to be upward trending. Therefore, the merger in Austria has led to lower unit price of mobile data in bundle. The magnitude of this fall is about 6 dollars per Gigabyte of mobile data.

## 5.2 Robustness Checks

In this section, I check the robustness of the main estimation results with respect to two features of the estimation strategy: the choice of the counterfactual markets and the underlying parallel trend assumption of the double-difference identification strategy.

### **The choice of the counterfactual markets**

The last three columns of tables 5 to 14 provide the point estimates of the impact of a change in the market structure using the next best counterfactual markets. Based on the principal component analysis presented in figures 2 and 3, I select the next three closest markets to France and Austria. It turns out that Belgium, Hungary and The Netherlands are the next best counterfactual markets for France; while Estonia, Sweden and Czech Republic are the ones for Austria. Interestingly, the main results still hold with these counterfactual markets. The bundling discount on the unit price of mobile data has been falling in France, but rising in Austria. Some point estimates for Austria are not statistically due to the lower number of mobile bundles tariffs in the counterfactual markets.

### **Testing the parallel trend assumption**

The identification of the double-difference strategy relies on the assumption that the price trend is similar between the treated market (the one in which entry or merger occurs) and its counterfactual before the change in the market structure. This assumption could not be tested directly in the main estimation as the Teligen tariff dataset does not provide the relevant price information before the change in the market structure. The most relevant information is available from the first quarter of 2013. However, the broadband internet access cost dataset (BIAC) constructed by the European Commission can be used as an alternative for this test.

The BIAC dataset provides information about the tariff of **fixed broadband plans** in France, Korea, Austria and Italy for the first quarters of 2011 and 2012; a year before the entry of Free in France and two years before the acquisition of Orange by Hutchison in Austria. It was not designed for collecting tariff data about mobile plans; but still provides information about mobile voice and data services bundled with fixed broadband.

The test basically compares the evolution of the prices of mobile voice and data services between each treated market and its counterfactual before the change in the market structure. As mobile telecommunications services are bundled with fixed broadband, their prices have been derived from a hedonic price model using the following equation:

$$T = \alpha + \beta_1 FV + \beta_2 MV + \beta_3 MBB + \beta_4 TV + \delta M + \gamma X + \varepsilon \quad (13)$$

Where  $T$  is the monthly tariff of the fixed broadband plan,  $FV$  is a dummy variable when fixed voice service is included,  $MV$  is a dummy variable when mobile voice is included,  $MBB$  is a dummy variable when mobile broadband is included,  $M$  is a dummy variable for the market which experience a change in its market structure (France or Austria) and  $X$  is a set of characteristics of the fixed broadband plans including the download speed, the technology used and whether fixed voice is required for the purchase of the fixed broadband plan. This equation is estimated on each pair of markets (France, Korea) and (Austria, Italy) for each year. The coefficient  $\delta$  captures the price difference between the treated market and its counterfactual.

The OLS estimation of this equation yields the tariff structure of the fixed broadband and particularly the hedonic price of mobile voice and data in each market for each year. The results are presented in the table 15 in appendix. They show that the average price difference between the two markets is not significant in all of the regressions. However, there is some difference between the coefficients of the components of the fixed broadband plan.

The parallel trend assumption is equivalent to testing whether these coefficients are statistically equal across the years 2011 and 2012. More specifically, it consists in comparing the point estimates of each pair of markets across the two years. We implement a test using the seemingly unrelated estimation method (Zellner, 1962). The p-values associated with these tests are shown at the bottom of the table 15 in appendix. They imply that the coefficients are not statistically different across

the years. Therefore, there is some evidence of a parallel price trend between the treated markets and their counterfactuals.

## 6 Conclusion

This paper provides an empirical evidence about the dynamic efficiencies effects in the mobile telecommunications markets. It does so by estimating the impact of the entry of the fourth mobile operator in France and the merger between the third and fourth operators in Austria on the price of mobile telecommunications services. It finds that the entry of the fourth mobile operator in the French market has raised the unit price of mobile data plans by 4 dollars per Gigabyte; contrary to the merger from three to four operators in Austria which reduces the unit price by 6 dollars per Gigabyte.

These results are driven by the bundling discount on the unit price of mobile data which falls following the entry; but rises following the merger. They are consistent with the findings by Vives (2008) whereby an increase in the number of firms can reduce firm's investment in process innovation. Actually, mobile operators offers more bundles of voice and data following the change in the market structure. However, they come with lower download speed and data allowance following the entry, and with higher speed and data allowance in the aftermath of the merger.

Besides, there is indeed a fall in the unit price of mobile voice calls following the entry of Free in the french market, due to the development of unlimited mobile voice plans. However, this effect could not be ascribed to the entry, for a decrease of comparable magnitude is also observed in its counterfactual market, Korea. Furthermore, several surveys highlight the fall in the consumers' expenditures in mobile telecommunications following the entry of Free in France. The result of this paper suggest that this fall is mainly due to the development of SIM-only plans, which the hedonic pricing model nets out as an add-on component, different from the price of the actual communications services.

Overall, the results of this paper show that the dynamic efficiency effects outweigh the static ones in the mobile telecommunications industry, at least when merging from four to three firms. They suggest that the investment in new technologies is a mean to increase the allowance of a mobile plan without changing its tariff. As in (Jeanjean, forthcoming), this is the force driving down the unit price of mobile data services. In addition, this paper highlights the importance of taking into account the nonlinear price structure and the adds-on services when assessing the price of mobile telecommunications services. This is because a change in the market structure affects allowances as well as the included adds-on services such as the mobile devices and the length of the contractual commitment.



Finally, this paper tests the dynamic efficiency effect when merging from four to three firms. A further step would be to evaluate whether this result is still valid for a merger from three to two or five to four, as the impact of the number of firms on investment might not be monotonous.

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# A Appendix

## A.1 Identifying the counterfactual markets: PCA results

Factor n°	Eigen value	Percentage of variance	Cumulated percentage of variance
1	2.35	33.63	33.63
2	1.71	24.45	58.08
3	1.53	21.94	80.03
4	0.71	10.14	90.16
5	0.34	4.85	95.02
6	0.27	3.88	98.90
7	0.07	1.09	100

The PCA yields 7 factors using the seven determinants of the price trend.

Table 2: Share of the total variance explained by each factor

Countries	Factor 1	Factor 2	Factor 3
Australia	-1.32	0.76	0.45
<b>Austria</b>	<b>0.05</b>	<b>1.31</b>	<b>0.38</b>
Belgium	-1.78	-0.33	-0.27
Bulgaria	3.29	1.60	-1.65
Chile	2.39	0.94	0.12
Cyprus	1.81	0.81	-0.23
Czech Rep.	0.23	0.44	0.02
Denmark	0.10	0.63	1.41
Estonia	0.42	0.87	-0.23
Finland	-2.06	2.21	-1.00
<b>France</b>	<b>-2.83</b>	<b>-0.86</b>	<b>-0.34</b>
Germany	-1.76	1.19	1.34
Greece	-1.48	0.83	-1.53
Hungary	-1.85	-0.09	-0.69
Iceland	1.57	-1.74	0.90
Ireland	1.25	-0.47	1.63
Israel	-0.70	0.47	0.74
<b>Italy</b>	<b>-0.38</b>	<b>1.03</b>	<b>0.70</b>
Japan	-0.34	-1.13	2.54
<b>Korea</b>	<b>-2.01</b>	<b>-0.90</b>	<b>-0.56</b>
Latvia	1.38	-0.03	-0.35
Lithuania	1.00	2.44	-1.14
Luxembourg	0.98	0.11	-1.02
Malta	0.68	-0.90	-1.75
Mexico	0.56	-3.62	-0.57
Netherlands	-1.37	-0.50	-0.76
New Zealand	-1.56	-1.61	-0.01
Norway	2.73	-1.83	0.99
Poland	3.15	0.98	1.33
Portugal	-0.16	1.64	-0.52
Romania	0.69	0.59	0.34
Slovak Rep.	-0.69	-0.25	-1.01
Slovenia	2.87	-2.65	-1.12
Spain	-0.33	0.01	0.67
Sweden	0.35	0.90	1.15
Switzerland	0.35	-1.30	-1.10
Turkey	-2.67	-2.54	0.17
UK	-2.55	1.00	0.98

Table 3: Coordinates of the countries on the three factors

## A.2 Descriptive Statistics: Comparing the markets

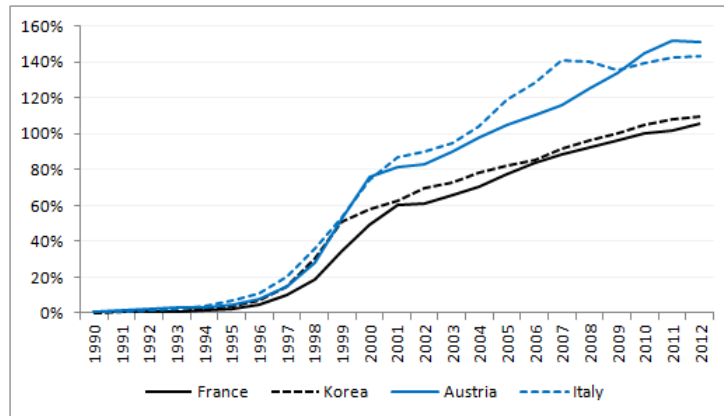


Figure 4: Mobile penetration rate (WCIS, Ovum)

Similarity between France and Korea and between Austria and Italy.

Country	Operator	Year of entry
France	SFR	1989
France	Orange	1992
France	Bouygues	1996
Korea	SK Telecom	1988
Korea	KT	1996
Korea	LG U+	1997
Austria	A1 Telekom	1990
Austria	T-Mobile	1996
Austria	Orange	1998
Austria	Hutchison	2003
Italy	TIM	1990
Italy	WIND	1995
Italy	Vodafone	1999
Italy	Hutchison	2003
Source : Wireless Intelligence, GSMA		

Figure 5: Year of entry of the incumbent/non-merging firms (Wireless Intelligence, GSMA)

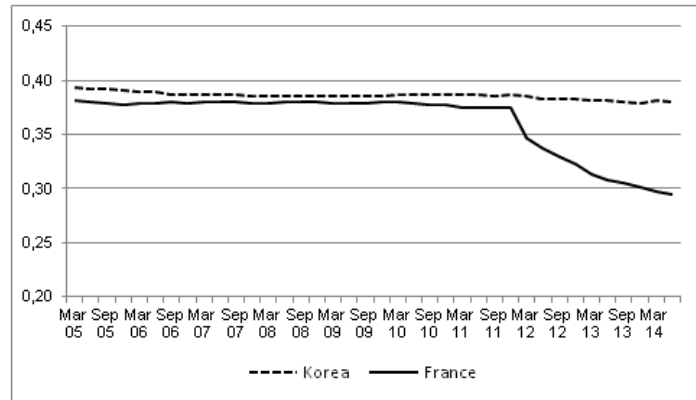


Figure 6: Herfindahl-Hirschman Index for France and Korea (Based on subscriptions data from WCIS, Ovum)

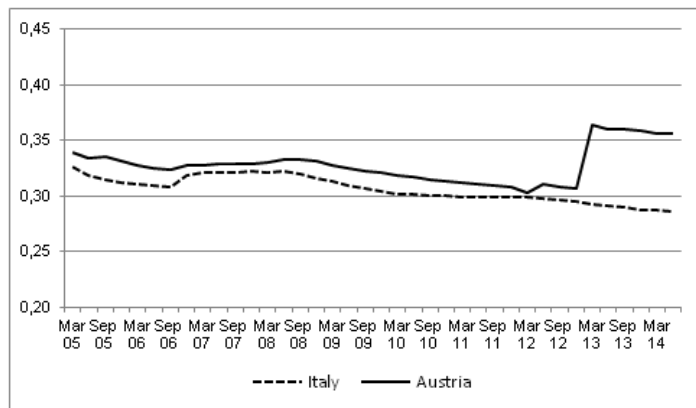


Figure 7: Herfindahl-Hirschman Index for Austria and Italy (Based on subscriptions data from WCIS, Ovum)

### A.3 Descriptive Statistics: Mobile Plans

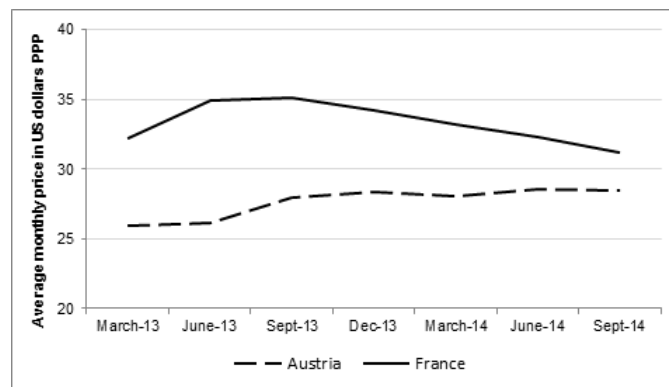


Figure 8: Monthly Price of Mobile Plans (voice/data, standalone/bundled)

## A.4 Econometric estimation results

Plan's Tariff component	Regression variables	Monthly price
Access to mobile voice	Constant	5.33*** (1.23)
	Download speed (Mbps)	0.22*** (0.01)
Access to mobile data	Fixed + Mobile broadband	-16.73*** (1.80)
	Mobile voice and data bundle (Bundlem2p)	-8.03* (4.77)
Discounts on bundles	Hours of mobile voice calls	1.06*** (0.07)
	Bundlem2p*Hours of voice calls	-0.38 (0.28)
Price per hour for mobile in standalone	Gigabytes of Mobile broadband	0.14*** (0.03)
	Bundlem2p*Gigabytes of mobile broadband	2.41*** (0.30)
Price per hour for mobile bundle	Business	2.49** (1.17)
	Mobile SIM-Only plan (voice or bundled with data)	-4.60*** (0.62)
Price per Gigabytes for mobile in standalone	Contract duration (months)	0.12*** (0.03)
	Operator (Orange Austria as reference)	√
Price per Gigabytes for mobile bundle	Quarter (Q1-2013 as reference)	√
	Observations	614
R-squared		<b>0.803</b>

Hedonic regression of the monthly subscription price on the characteristics of the mobile plans in Austria. Significant at 1%(\*\*\*) , 5%(\*\*) and 10%(\*). Robust standard errors in parentheses.

Table 4: Hedonic Price Model estimation for Austria

Dependant variable	Mobile price plan						
	Counterfactual market	Korea	Korea	Korea	Belgium	Hungary	Netherlands
	Estimation	OLS	Weighted OLS by consumption	Including prepaid plan	OLS	OLS	OLS
business	9.22***	9.46***	8.81***	8.32***	13.02***	11.39***	
	(1.23)	(1.35)	(1.23)	(0.87)	(1.10)	(0.76)	
nohandset	-9.93***	-3.58***	-9.53***	-8.88***	-7.76***	-8.24***	
	(0.81)	(0.72)	(0.75)	(0.89)	(0.89)	(0.86)	
contract	0.22***	0.01	0.22***	0.17***	0.00	0.11***	
	(0.03)	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)	
tiedplans	-29.92***	-48.24***	-29.22***	-14.75***	-29.27***	-29.28***	
	(8.69)	(9.67)	(7.49)	(4.19)	(8.80)	(8.75)	
prepaid			-24.77***				
			(1.74)				
1.shock	-9.49***	5.19	-9.55***	12.44**	0.95	11.61***	
	(2.70)	(4.48)	(2.63)	(5.53)	(3.86)	(2.90)	
2.quarter	-0.00	0.62	0.00	-0.76	2.21	14.72***	
	(2.51)	(2.79)	(2.36)	(8.80)	(3.88)	(3.64)	
3.quarter	-0.00	5.21*	0.00	-7.42	2.57	4.39*	
	(2.51)	(2.97)	(2.36)	(9.66)	(4.33)	(2.43)	
4.quarter	4.09	0.75	11.63***	3.92	-4.63	2.79	
	(2.63)	(2.76)	(2.54)	(6.63)	(3.57)	(2.86)	
5.quarter	-3.88	0.47	-3.47	8.92	-4.68	1.93	
	(2.55)	(2.48)	(2.35)	(5.57)	(3.67)	(2.86)	
6.quarter	-3.88	-0.87	-3.47	9.03	-8.11**	2.35	
	(2.55)	(2.16)	(2.35)	(5.59)	(4.03)	(2.85)	
7.quarter	-3.87	0.13	-3.18	13.81**	-4.94	2.92	
	(2.63)	(2.58)	(2.46)	(6.30)	(3.66)	(2.75)	
1.shock#2.quarter	1.27	-6.22	1.40	2.40	-1.01	-13.51***	
	(3.64)	(5.03)	(3.52)	(9.22)	(4.69)	(4.51)	
1.shock#3.quarter	1.52	-15.16***	1.77	9.48	-1.44	-3.11	
	(3.73)	(5.15)	(3.62)	(10.08)	(5.13)	(3.68)	
1.shock#4.quarter	-3.27	-2.36	-10.85***	-2.63	5.05	-2.25	
	(3.87)	(5.83)	(3.80)	(7.27)	(4.54)	(4.03)	
1.shock#5.quarter	0.57	-12.11**	0.92	-12.99**	0.49	-5.86	
	(3.78)	(5.14)	(3.64)	(6.26)	(4.55)	(3.97)	
1.shock#6.quarter	-0.34	-8.08	0.04	-13.92**	2.89	-7.23*	
	(3.73)	(5.24)	(3.59)	(6.26)	(4.78)	(3.92)	
1.shock#7.quarter	-1.15	-12.88***	-0.94	-19.28***	-0.90	-8.65**	
	(3.97)	(4.80)	(3.86)	(7.02)	(4.70)	(4.05)	

Table 5: The impact of the entry in France (1/5)



Dependant variable	Mobile price plan					
	<i>Korea</i>	<i>Korea</i>	<i>Korea</i>	<i>Belgium</i>	<i>Hungary</i>	<i>Netherlands</i>
<i>Counterfactual market</i>	<i>OLS</i>	<i>Weighted OLS</i>	<i>Including prepaid</i>	<i>OLS</i>	<i>OLS</i>	<i>OLS</i>
<i>Estimation</i>	<i>OLS</i>	<i>by consumption</i>	<i>plan</i>	<i>OLS</i>	<i>OLS</i>	<i>OLS</i>
downspeedb	0.29*** (0.05)	0.14 (0.09)	0.27*** (0.05)	0.53** (0.22)	0.16 (0.10)	1.02*** (0.13)
1.shock#c.downspeedb	-0.24*** (0.05)	-0.17 (0.12)	-0.22*** (0.05)	-0.50** (0.22)	-0.11 (0.10)	-0.97*** (0.13)
2.quarter#c.downspeedb	-0.00 (0.06)	-0.00 (0.12)	-0.00 (0.06)	0.24 (0.43)	0.01 (0.14)	-1.31*** (0.26)
3.quarter#c.downspeedb	-0.00 (0.06)	-0.14 (0.10)	-0.00 (0.06)	0.45 (0.48)	0.00 (0.14)	-0.55*** (0.14)
4.quarter#c.downspeedb	-0.05 (0.07)	-0.11 (0.10)	-0.40*** (0.05)	-0.09 (0.30)	0.00 (0.11)	-0.92*** (0.15)
5.quarter#c.downspeedb	0.03 (0.06)	0.02 (0.14)	0.02 (0.06)	-0.50** (0.25)	-0.05 (0.14)	-0.89*** (0.15)
6.quarter#c.downspeedb	0.03 (0.06)	-0.13 (0.10)	0.02 (0.06)	-0.48* (0.25)	-0.19 (0.14)	-0.91*** (0.15)
7.quarter#c.downspeedb	0.03 (0.07)	-0.06 (0.11)	0.05 (0.05)	-0.53** (0.23)	-0.41*** (0.12)	-0.98*** (0.14)
1.shock#2.quarter#c.downspeedb	0.02 (0.07)	0.06 (0.14)	0.02 (0.07)	-0.22 (0.43)	0.01 (0.14)	1.33*** (0.26)
1.shock#3.quarter#c.downspeedb	0.01 (0.07)	0.23* (0.12)	0.01 (0.07)	-0.43 (0.48)	0.01 (0.14)	0.57*** (0.14)
1.shock#4.quarter#c.downspeedb	0.04 (0.07)	0.17 (0.13)	0.39*** (0.06)	0.07 (0.31)	-0.02 (0.11)	0.91*** (0.16)
1.shock#5.quarter#c.downspeedb	-0.09 (0.07)	0.04 (0.16)	-0.09 (0.07)	0.45* (0.25)	-0.00 (0.14)	0.83*** (0.16)
1.shock#6.quarter#c.downspeedb	-0.09 (0.07)	0.16 (0.12)	-0.10 (0.07)	0.42* (0.25)	0.13 (0.15)	0.85*** (0.15)
1.shock#7.quarter#c.downspeedb	-0.09 (0.07)	0.13 (0.13)	-0.12** (0.06)	0.49** (0.23)	0.36*** (0.13)	0.93*** (0.14)
1.packmob	-46.47*** (6.45)	-18.04 (13.37)	-44.05*** (6.45)	5.76 (5.80)	10.56*** (3.55)	2.21 (3.38)
1.shock#1.packmob	41.75*** (7.30)	14.97 (13.69)	39.09*** (7.29)	-12.25* (6.64)	14.81*** (4.96)	-6.87 (4.67)
2.quarter#1.packmob	0.00 (8.83)	-3.87 (16.65)	0.00 (8.83)	-6.04 (9.44)	-2.78 (4.73)	3.72 (5.71)
3.quarter#1.packmob	0.00 (8.83)	15.98 (14.77)	0.00 (8.83)	1.96 (10.27)	-3.12 (5.09)	1.04 (4.03)
4.quarter#1.packmob	2.27 (8.90)	14.53 (14.57)	50.03*** (7.04)	-8.25 (7.49)	-0.14 (4.34)	5.04 (3.94)
5.quarter#1.packmob	0.79 (8.79)	0.97 (20.90)	1.04 (8.76)	-13.17** (6.55)	0.14 (4.35)	4.94 (3.84)
6.quarter#1.packmob	0.79 (8.79)	23.30 (14.65)	1.04 (8.76)	-13.86** (6.56)	4.06 (5.08)	4.42 (3.89)
7.quarter#1.packmob	1.07 (8.79)	10.68 (15.94)	-2.70 (7.34)	-17.60** (7.14)	1.83 (4.43)	2.63 (4.04)

Table 6: The impact of the entry in France (2/5)

Dependant variable Counterfactual market	Mobile price plan					
	Korea OLS	Korea Weighted OLS by consumption	Korea Including prepaid plan	Belgium OLS	Hungary OLS	Netherlands OLS
1.shock#2.quarter#1.packmob	-4.73 (9.79)	6.93 (17.09)	-4.89 (9.78)	1.24 (10.40)	-1.83 (6.44)	-8.35 (7.10)
1.shock#3.quarter#1.packmob	-4.09 (9.65)	-12.04 (15.31)	-4.34 (9.64)	-5.85 (11.02)	-0.34 (6.42)	-4.77 (5.56)
1.shock#4.quarter#1.packmob	-5.10 (9.73)	-18.19 (15.33)	-53.06*** (8.07)	5.59 (8.48)	-2.17 (5.85)	-7.55 (5.51)
1.shock#5.quarter#1.packmob	2.82 (9.52)	5.26 (21.20)	1.90 (9.50)	18.14** (7.52)	3.89 (5.68)	-1.06 (5.25)
1.shock#6.quarter#1.packmob	3.38 (9.51)	-18.78 (15.13)	2.26 (9.49)	19.18** (7.53)	0.85 (6.22)	0.19 (5.28)
1.shock#7.quarter#1.packmob	2.91 (9.59)	-5.99 (16.28)	5.91 (8.30)	22.47*** (8.12)	2.80 (5.85)	1.92 (5.51)
nbhrmob	0.73*** (0.27)	0.16 (0.31)	0.68*** (0.23)	1.98*** (0.34)	1.18* (0.62)	3.74*** (0.80)
1.shock#c.nbhrmob	0.95* (0.54)	2.97*** (0.70)	0.97** (0.46)	-1.02** (0.45)	0.46 (0.41)	-2.09** (0.93)
2.quarter#c.nbhrmob	0.00 (0.38)	0.90* (0.53)	-0.00 (0.32)	0.37 (0.64)	-0.18 (0.61)	-1.71 (1.10)
3.quarter#c.nbhrmob	0.00 (0.38)	-0.33 (0.44)	-0.00 (0.32)	0.13 (0.64)	-0.33 (0.62)	-4.42*** (0.86)
4.quarter#c.nbhrmob	-0.04 (0.39)	1.99*** (0.42)	-0.54* (0.32)	-0.57 (0.47)	0.28 (0.62)	-4.00*** (0.82)
5.quarter#c.nbhrmob	0.49 (0.42)	0.92 (0.76)	0.39 (0.34)	-0.45 (0.36)	1.89 (1.36)	-3.58*** (0.84)
6.quarter#c.nbhrmob	0.49 (0.42)	1.58*** (0.44)	0.39 (0.34)	-0.45 (0.36)	2.96** (1.27)	-3.95*** (0.82)
7.quarter#c.nbhrmob	0.61 (0.43)	0.83 (0.54)	0.62* (0.37)	-0.75* (0.41)	4.69*** (1.22)	-3.81*** (0.84)
1.shock#2.quarter#c.nbhrmob	-0.11 (0.45)	-1.75** (0.68)	-0.10 (0.39)	-0.44 (0.68)	0.09 (0.56)	1.61 (1.12)
1.shock#3.quarter#c.nbhrmob	-0.07 (0.45)	-0.35 (0.66)	-0.06 (0.40)	-0.17 (0.68)	0.28 (0.58)	4.36*** (0.89)
1.shock#4.quarter#c.nbhrmob	0.19 (0.46)	-1.94*** (0.70)	0.71* (0.40)	0.76 (0.53)	-0.10 (0.57)	4.18*** (0.85)
1.shock#5.quarter#c.nbhrmob	-0.37 (1.06)	-1.39 (1.26)	-0.26 (1.00)	1.29 (0.99)	-1.70* (0.95)	3.75*** (1.29)
1.shock#6.quarter#c.nbhrmob	-0.59 (1.00)	-2.34 (1.47)	-0.49 (0.94)	1.06 (0.92)	-3.01*** (0.89)	3.89*** (1.23)
1.shock#7.quarter#c.nbhrmob	-0.67 (1.02)	-0.75 (1.16)	-0.68 (0.97)	1.39 (0.96)	-4.70*** (0.79)	3.80*** (1.26)

Table 7: The impact of the entry in France (3/5)

Dependant variable	Mobile price plan					
	Korea	Korea	Korea	Belgium	Hungary	Netherlands
Counterfactual market	OLS	Weighted OLS by consumption	Including prepaid plan	OLS	OLS	OLS
Estimation	OLS	Weighted OLS by consumption	Including prepaid plan	OLS	OLS	OLS
1.packmob#c.nbhrmob	1.16*** (0.36)	1.74*** (0.55)	1.22*** (0.33)	-1.18** (0.52)	-0.43 (0.52)	0.73 (1.04)
1.shock#1.packmob#c.nbhrmob	-1.65*** (0.62)	-4.25*** (0.88)	-1.65*** (0.55)	1.45** (0.64)		-1.17 (1.16)
2.quarter#1.packmob#c.nbhrmob	-0.00 (0.50)	0.65 (0.79)	0.00 (0.46)	-0.39 (0.91)	0.21 (0.38)	0.83 (1.50)
3.quarter#1.packmob#c.nbhrmob	-0.00 (0.50)	-0.27 (1.06)	0.00 (0.46)	-0.56 (0.89)	0.36 (0.41)	0.80 (1.09)
4.quarter#1.packmob#c.nbhrmob	-0.16 (0.48)	-1.59** (0.66)	0.21 (0.43)	0.14 (0.75)	-0.37 (0.47)	1.03 (1.08)
5.quarter#1.packmob#c.nbhrmob	-1.40*** (0.49)	-1.90** (0.89)	-1.30*** (0.42)	-0.58 (0.57)	-1.37 (1.01)	0.63 (1.10)
6.quarter#1.packmob#c.nbhrmob	-1.40*** (0.49)	-2.27*** (0.66)	-1.30*** (0.42)	-0.48 (0.57)	-1.27 (0.97)	0.91 (1.09)
7.quarter#1.packmob#c.nbhrmob	-1.05** (0.50)	-0.79 (0.73)	-1.06** (0.44)	-0.22 (0.60)	-1.26 (0.99)	0.86 (1.09)
1.shock#2.quarter#1.packmob#c.nbhrmob	0.23 (0.62)	0.83 (0.97)	0.23 (0.58)	0.58 (0.99)		-0.62 (1.54)
1.shock#3.quarter#1.packmob#c.nbhrmob	0.39 (0.64)	2.27* (1.36)	0.39 (0.60)	0.90 (0.98)		-0.43 (1.16)
1.shock#4.quarter#1.packmob#c.nbhrmob	-0.19 (0.66)	0.74 (0.96)	-0.44 (0.59)	-0.54 (0.89)		-1.40 (1.17)
1.shock#5.quarter#1.packmob#c.nbhrmob	0.16 (1.11)	1.87 (1.38)	0.39 (1.06)	-1.42 (1.11)		-1.95 (1.50)
1.shock#6.quarter#1.packmob#c.nbhrmob	0.27 (1.07)	2.07 (1.63)	0.52 (1.02)	-1.40 (1.06)		-2.12 (1.45)
1.shock#7.quarter#1.packmob#c.nbhrmob	-0.09 (1.09)	-0.33 (1.32)	0.27 (1.04)	-1.64 (1.10)		-2.08 (1.47)
gbmobdata	0.26* (0.14)	2.60*** (0.52)	0.25* (0.13)	0.67*** (0.14)	1.20*** (0.24)	0.44*** (0.10)
1.shock#c.gbmobdata	-0.05 (0.16)	-1.86*** (0.56)	-0.07 (0.15)	-0.46*** (0.16)	-1.02*** (0.26)	-0.24* (0.13)
2.quarter#c.gbmobdata	0.00 (0.19)	-1.04 (0.81)	-0.00 (0.19)	-0.28* (0.16)	-0.13 (0.34)	1.38*** (0.51)
3.quarter#c.gbmobdata	0.00 (0.19)	0.28 (0.58)	-0.00 (0.19)	-0.23 (0.14)	-0.20 (0.37)	0.85* (0.46)
4.quarter#c.gbmobdata	-0.08 (0.19)	0.49 (0.60)	0.30 (0.30)	-0.17 (0.15)	-0.02 (0.32)	2.34*** (0.38)
5.quarter#c.gbmobdata	0.11 (0.20)	-0.36 (0.88)	0.10 (0.19)	3.50*** (0.80)	0.15 (0.33)	2.45*** (0.35)
6.quarter#c.gbmobdata	0.11 (0.20)	0.59 (0.59)	0.10 (0.19)	3.00*** (0.75)	1.10*** (0.42)	2.56*** (0.33)
7.quarter#c.gbmobdata	0.11 (0.20)	0.40 (0.61)	0.04 (0.19)	1.62** (0.71)	1.37*** (0.40)	2.49*** (0.29)

Table 8: The impact of the entry in France (4/5)

Dependant variable	Mobile price plan					
	Korea	Korea	Korea	Belgium	Hungary	Netherlands
Counterfactual market		Weighted OLS	Including			
Estimation	OLS	by consumption	prepaid plan	OLS	OLS	OLS
1.shock#2.quarter#c.gbmobdata	-0.06 (0.23)	2.50*** (0.87)	-0.07 (0.22)	0.21 (0.20)	0.07 (0.36)	-1.44*** (0.53)
1.shock#3.quarter#c.gbmobdata	-0.14 (0.22)	0.42 (0.68)	-0.14 (0.21)	0.08 (0.18)	0.07 (0.39)	-0.99** (0.47)
1.shock#4.quarter#c.gbmobdata	0.16 (0.23)	-0.70 (0.66)	-0.23 (0.32)	0.26 (0.19)	0.11 (0.34)	-2.25*** (0.40)
1.shock#5.quarter#c.gbmobdata	0.57*** (0.22)	0.68 (0.90)	0.61*** (0.21)	-2.81*** (0.81)	0.55 (0.34)	-1.75*** (0.36)
1.shock#6.quarter#c.gbmobdata	0.60*** (0.22)	-0.29 (0.62)	0.64*** (0.21)	-2.29*** (0.75)	-0.37 (0.43)	-1.84*** (0.34)
1.shock#7.quarter#c.gbmobdata	0.60*** (0.23)	-0.18 (0.65)	0.71*** (0.21)	-0.91 (0.72)	-0.65 (0.41)	-1.77*** (0.31)
0b.packmob#co.gbmobdata	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
1.packmob#c.gbmobdata	1.66*** (0.25)	-0.74 (0.65)	1.67*** (0.24)	6.14*** (1.57)	16.12*** (1.79)	2.33 (2.10)
1.shock#1.packmob#c.gbmobdata	-1.00*** (0.27)	0.72 (0.72)	-0.98*** (0.27)	-5.45*** (1.58)	-15.54*** (1.80)	-1.72 (2.10)
2.quarter#1.packmob#c.gbmobdata	0.00 (0.35)	0.82 (1.01)	0.00 (0.35)	0.27 (2.55)	0.39 (2.57)	-5.15* (3.07)
3.quarter#1.packmob#c.gbmobdata	0.00 (0.35)	0.91 (0.93)	0.00 (0.35)	1.42 (2.65)	0.48 (2.58)	-3.19 (2.18)
4.quarter#1.packmob#c.gbmobdata	0.34 (0.33)	-0.15 (0.78)	-0.06 (0.40)	2.40 (2.47)	2.46 (2.57)	-4.93** (2.18)
5.quarter#1.packmob#c.gbmobdata	0.39 (0.33)	0.98 (0.99)	0.39 (0.32)	2.47 (2.20)	0.84 (3.23)	-4.83** (2.18)
6.quarter#1.packmob#c.gbmobdata	0.39 (0.33)	-0.01 (0.74)	0.39 (0.32)	2.62 (2.14)	-4.54* (2.62)	-4.63** (2.19)
7.quarter#1.packmob#c.gbmobdata	0.13 (0.31)	0.00 (0.75)	0.17 (0.30)	3.55* (2.12)	-7.26*** (2.58)	-4.44** (2.22)
1.shock#2.quarter#1.packmob#c.gbmobdata	-0.02 (0.39)	-2.50** (1.10)	-0.02 (0.38)	-0.27 (2.56)	-0.39 (2.58)	5.14* (3.08)
1.shock#3.quarter#1.packmob#c.gbmobdata	-0.22 (0.39)	-1.85* (1.04)	-0.22 (0.38)	-1.62 (2.66)	-0.68 (2.59)	2.98 (2.18)
1.shock#4.quarter#1.packmob#c.gbmobdata	1.59 (2.07)	9.39*** (1.83)	1.67 (1.91)	-0.55 (3.25)	-0.60 (3.36)	6.82** (3.03)
1.shock#5.quarter#1.packmob#c.gbmobdata	3.62*** (0.77)	3.32*** (1.20)	2.90*** (0.84)	1.56 (2.32)	3.35 (3.31)	8.94*** (2.29)
1.shock#6.quarter#1.packmob#c.gbmobdata	4.11*** (0.89)	5.35*** (1.57)	3.35*** (0.94)	1.90 (2.30)	9.22*** (2.75)	9.24*** (2.35)
1.shock#7.quarter#1.packmob#c.gbmobdata	4.32*** (0.88)	6.97*** (0.87)	3.55*** (0.93)	0.93 (2.29)	11.91*** (2.72)	9.01*** (2.37)
Operator fixed effects	√	√	√	√	√	√
Constant	29.35*** (1.80)	20.95*** (2.00)	29.36*** (1.70)	9.39* (5.19)	20.68*** (3.46)	9.00*** (2.20)
Observations	4,710	4,710	4,905	2,194	2,718	3,147
R-squared	0.509	0.796	0.514	0.517	0.598	0.538

Significant at 1%(\*\*\*) , 5%(\*\*) and 10%(\*). Robust Standard errors in parentheses.

Table 9: The impact of the entry in France (5/5)

Dependant variable	Mobile price plan					
	<i>Italy</i>	<i>Italy</i>	<i>Italy</i>	<i>Estonia</i>	<i>Sweden</i>	<i>Czech Republic</i>
<i>Counterfactual market</i>	<i>OLS</i>	<i>Weighted OLS by consumption</i>	<i>Including prepaid plan</i>	<i>OLS</i>	<i>OLS</i>	<i>OLS</i>
<i>Estimation</i>	<i>OLS</i>	<i>Weighted OLS by consumption</i>	<i>Including prepaid plan</i>	<i>OLS</i>	<i>OLS</i>	<i>OLS</i>
business	7.45*** (0.61)	6.05*** (0.86)	7.36*** (0.60)	9.01*** (1.02)	4.92*** (0.70)	3.42* (1.93)
nohandset	-1.74*** (0.58)	-3.22*** (0.70)	-1.82*** (0.58)	-3.73*** (0.49)	-1.55*** (0.59)	-4.29*** (1.17)
contract	0.26*** (0.02)	0.11*** (0.03)	0.25*** (0.02)	0.24*** (0.04)	-0.01 (0.03)	0.19*** (0.05)
tiedplans	-9.63*** (1.04)	-10.64*** (1.93)	-9.71*** (1.03)			-6.75*** (1.06)
prepaid			-2.96*** (1.12)			
1.shock	8.07*** (2.08)	10.41*** (3.19)	8.14*** (2.08)	19.77*** (4.56)	0.55 (2.42)	-4.68 (3.03)
2.quarter	-0.88 (1.98)	5.08 (3.41)	-0.93 (1.98)	1.87 (3.67)	-2.21 (2.59)	-5.77** (2.82)
3.quarter	0.50 (2.18)	0.24 (3.12)	0.45 (2.18)	0.51 (3.34)	-1.70 (2.70)	-5.37** (2.62)
4.quarter	-3.70* (1.94)	-0.52 (3.05)	-3.75* (1.95)	0.76 (3.38)	-4.43* (2.51)	-5.97** (2.86)
5.quarter	-4.74** (1.86)	-3.08 (2.83)	-4.78** (1.87)	0.15 (3.45)	1.30 (2.42)	-4.31* (2.54)
6.quarter	-4.54*** (1.66)	-2.68 (2.43)	-4.49*** (1.66)	1.03 (3.51)	0.03 (4.71)	-5.43* (3.17)
7.quarter	-6.24** (2.73)	-4.61 (2.96)	-6.30** (2.74)	2.78 (3.37)	-3.30 (4.12)	-2.03 (2.63)
1.shock#2.quarter	-0.07 (2.80)	-11.37*** (4.13)	0.00 (2.76)	-3.46 (4.38)	0.10 (3.53)	4.05 (3.71)
1.shock#3.quarter	-2.47 (2.97)	-5.16 (4.07)	-2.39 (2.93)	-1.37 (4.03)	-0.15 (3.53)	4.57 (3.42)
1.shock#4.quarter	3.29 (2.66)	-3.14 (3.84)	3.58 (2.64)	-0.80 (4.03)	1.86 (3.25)	5.94* (3.55)
1.shock#5.quarter	2.40 (2.56)	1.28 (3.78)	3.05 (2.56)	-2.69 (4.03)	-6.15** (3.10)	2.00 (3.21)
1.shock#6.quarter	1.87 (2.40)	2.23 (3.80)	2.42 (2.41)	-3.80 (4.04)	-4.23 (5.10)	3.18 (3.73)
1.shock#7.quarter	1.41 (3.36)	-0.67 (3.81)	2.38 (3.36)	-8.60** (4.07)	-2.08 (4.57)	-1.04 (3.27)

Table 10: The impact of the merger in Austria (1/5)

Dependant variable	Mobile price plan						
	Counterfactual market	Italy	Italy	Italy	Estonia	Sweden	Czech Republic
	Estimation	OLS	Weighted OLS by consumption	Including prepaid plan	OLS	OLS	OLS
downspeedb	0.15*** (0.04)	0.31*** (0.05)	0.15*** (0.04)	0.42*** (0.11)	0.23*** (0.03)	-0.18 (0.23)	
1.shock#c.downsPEEDb	0.10** (0.04)	0.07 (0.08)	0.10** (0.04)	-0.15 (0.11)	0.05 (0.04)	0.44* (0.23)	
2.quarter#c.downsPEEDb	0.08 (0.05)	-0.04 (0.09)	0.08 (0.05)	-0.18 (0.12)	0.07 (0.06)	0.57** (0.24)	
3.quarter#c.downsPEEDb	0.04 (0.06)	0.01 (0.06)	0.04 (0.06)	-0.14 (0.12)	0.02 (0.05)	0.46** (0.23)	
4.quarter#c.downsPEEDb	0.08 (0.05)	0.03 (0.08)	0.08 (0.05)	-0.13 (0.12)	-0.12*** (0.04)	0.40* (0.24)	
5.quarter#c.downsPEEDb	0.09** (0.04)	0.02 (0.07)	0.09** (0.04)	-0.14 (0.11)	-0.13*** (0.04)	0.28 (0.23)	
6.quarter#c.downsPEEDb	0.03 (0.05)	-0.21*** (0.07)	0.02 (0.05)	-0.13 (0.12)	-0.24*** (0.06)	0.21 (0.23)	
7.quarter#c.downsPEEDb	-0.07 (0.06)	-0.09 (0.08)	-0.07 (0.05)	-0.25** (0.11)	-0.21*** (0.05)	0.17 (0.22)	
1.shock#2.quarter#c.downsPEEDb	-0.07 (0.06)	0.02 (0.11)	-0.07 (0.06)	0.20* (0.12)	-0.05 (0.07)	-0.55** (0.24)	
1.shock#3.quarter#c.downsPEEDb	-0.03 (0.07)	-0.09 (0.09)	-0.03 (0.07)	0.14 (0.12)	-0.01 (0.06)	-0.45** (0.23)	
1.shock#4.quarter#c.downsPEEDb	-0.07 (0.06)	-0.12 (0.10)	-0.07 (0.06)	0.12 (0.12)	0.13** (0.05)	-0.40* (0.24)	
1.shock#5.quarter#c.downsPEEDb	-0.12** (0.05)	-0.17* (0.09)	-0.13*** (0.05)	0.10 (0.12)	0.11** (0.05)	-0.31 (0.23)	
1.shock#6.quarter#c.downsPEEDb	-0.05 (0.05)	0.09 (0.09)	-0.05 (0.05)	0.10 (0.12)	0.21*** (0.06)	-0.23 (0.23)	
1.shock#7.quarter#c.downsPEEDb	-0.06 (0.06)	-0.17* (0.09)	-0.06 (0.06)	0.10 (0.12)	0.09 (0.06)	-0.29 (0.23)	
1.packmob	-5.83 (5.97)	-0.87 (4.28)	-5.91 (5.96)	5.99** (3.05)	-3.44 (4.66)	10.35*** (3.34)	
1.shock#1.packmob	-2.02 (8.33)	-1.48 (6.07)	-1.38 (8.27)	-16.16** (7.21)	-12.31* (6.79)	-17.98** (6.99)	
2.quarter#1.packmob	-1.23 (10.98)	-1.35 (11.64)	-1.23 (10.97)	-1.00 (3.14)	2.07 (6.61)	1.82 (6.86)	
3.quarter#1.packmob	-11.77 (12.35)	-17.68** (9.01)	-11.77 (12.31)	-0.57 (2.65)	-2.99 (5.33)	-1.20 (3.62)	
4.quarter#1.packmob	-19.01*** (6.60)	-21.68*** (5.94)	-18.75*** (6.58)	12.59 (10.27)	-1.84 (4.99)	0.08 (3.63)	
5.quarter#1.packmob	-30.69*** (9.12)	-24.64*** (9.54)	-30.48*** (9.08)	-6.77 (4.64)	-3.69 (6.78)	-0.39 (3.64)	
6.quarter#1.packmob	-24.22*** (8.97)	-15.85** (7.04)	-19.54** (8.32)	-5.65 (3.84)	-6.67 (6.34)	1.54 (4.03)	
7.quarter#1.packmob	-17.29* (8.84)	-27.17** (12.16)	-10.14 (8.64)	-2.41 (4.19)	-2.64 (6.06)	-1.44 (3.89)	

Table 11: The impact of the merger in Austria (2/5)

Dependant variable	Mobile price plan					
	Italy	Italy	Italy	Estonia	Sweden	Czech Republic
	Counterfactual market	Weighted OLS by consumption	Including prepaid plan	OLS	OLS	OLS
Estimation	OLS			OLS	OLS	OLS
1.shock#2.quarter#1.packmob	16.42 (12.83)	19.56 (12.54)	9.82 (12.73)	17.51** (8.38)	13.47 (10.61)	15.55 (10.02)
1.shock#3.quarter#1.packmob	12.92 (15.77)	26.66 (17.28)	20.36 (13.82)	-4.52 (10.84)	3.14 (13.57)	-2.33 (11.15)
1.shock#4.quarter#1.packmob	3.49 (13.18)	-33.36*** (8.70)	23.59*** (9.12)	-31.88* (18.79)	-18.53 (13.02)	-11.96 (11.93)
1.shock#5.quarter#1.packmob	5.61 (15.82)	-4.04 (14.76)	36.47*** (11.70)	-16.67 (16.01)	-18.76 (17.12)	-24.46* (14.08)
1.shock#6.quarter#1.packmob	7.87 (18.80)	-19.22 (15.30)	27.42*** (10.57)	-7.04 (21.03)	9.63 (23.38)	-10.97 (17.66)
1.shock#7.quarter#1.packmob	-10.49 (17.76)	11.54 (21.40)	20.36* (11.32)	-23.86 (19.30)	-10.21 (21.28)	-17.69 (16.68)
nbhrmob	-0.40 (0.56)	-0.41 (1.22)	-0.39 (0.56)	0.32 (0.20)	-0.42*** (0.15)	4.16*** (1.23)
1.shock#c.nbhrmob	0.38 (0.57)	0.22 (1.23)	0.39 (0.58)	-0.34 (0.25)	0.07 (0.21)	-4.15*** (1.23)
2.quarter#c.nbhrmob	-0.04 (0.74)	-0.72 (1.72)	-0.04 (0.75)	0.07 (0.25)	0.03 (0.23)	-4.40*** (1.24)
3.quarter#c.nbhrmob	0.07 (0.78)	0.08 (1.36)	0.08 (0.79)	0.13 (0.25)	0.11 (0.22)	-4.10*** (1.26)
4.quarter#c.nbhrmob	0.49 (0.56)	0.20 (1.22)	0.48 (0.57)	0.16 (0.32)	0.27 (0.23)	-4.03*** (1.26)
5.quarter#c.nbhrmob	0.71 (1.01)	-0.91 (1.11)	2.47*** (0.79)	0.32 (0.33)	-0.14 (0.22)	-4.05*** (1.26)
6.quarter#c.nbhrmob	1.04 (1.18)	-0.79 (1.05)	2.06*** (0.74)	-0.17 (0.34)	0.19 (0.24)	-4.08*** (1.26)
7.quarter#c.nbhrmob	0.36 (1.12)	0.85 (1.36)	2.05*** (0.75)	-0.10 (0.33)	0.11 (0.25)	-4.23*** (1.21)
1.shock#2.quarter#c.nbhrmob	0.96 (0.78)	2.11 (1.74)	0.95 (0.79)	0.86** (0.35)	1.10*** (0.33)	5.34*** (1.25)
1.shock#3.quarter#c.nbhrmob	0.87 (0.81)	1.14 (1.39)	0.82 (0.81)	0.71** (0.32)	0.97*** (0.30)	4.98*** (1.26)
1.shock#4.quarter#c.nbhrmob	0.38 (0.59)	1.15 (1.24)	0.38 (0.59)	0.63* (0.37)	0.82*** (0.30)	4.93*** (1.27)
1.shock#5.quarter#c.nbhrmob	0.62 (1.00)	1.26 (1.02)	-1.16 (0.77)	1.12*** (0.38)	1.92*** (0.28)	5.44*** (1.26)
1.shock#6.quarter#c.nbhrmob	0.18 (1.15)	1.68* (0.98)	-0.86 (0.70)	1.49*** (0.43)	1.42*** (0.36)	5.33*** (1.27)
1.shock#7.quarter#c.nbhrmob	1.22 (1.09)	0.56 (1.31)	-0.51 (0.70)	1.84*** (0.43)	1.79*** (0.37)	5.76*** (1.18)

Table 12: The impact of the merger in Austria (3/5)

Dependant variable	Mobile price plan					
	Counterfactual market			Estonia	Sweden	Czech Republic
	Italy	Italy	Italy			
Estimation	OLS	Weighted OLS by consumption	Including prepaid plan	OLS	OLS	OLS
1.packmob#c.nbhrmob	1.48** (0.73)	1.12 (1.27)	1.47** (0.73)	-1.78*** (0.27)	0.87*** (0.32)	0.21 (1.03)
1.shock#1.packmob#c.nbhrmob	-0.92 (0.81)	-1.40 (1.33)	-0.95 (0.81)	2.51*** (0.47)	0.30 (0.46)	0.35 (0.95)
2.quarter#1.packmob#c.nbhrmob	-0.23 (1.12)	-0.07 (1.93)	-0.24 (1.13)	-0.07 (0.36)	-0.05 (0.47)	3.56** (1.46)
3.quarter#1.packmob#c.nbhrmob	0.96 (1.18)	0.98 (1.47)	0.96 (1.18)	-0.13 (0.36)	0.15 (0.42)	-0.03 (1.07)
4.quarter#1.packmob#c.nbhrmob	1.14 (0.82)	2.35 (1.71)	1.14 (0.83)	-0.12 (0.41)	0.04 (0.39)	-0.09 (1.07)
5.quarter#1.packmob#c.nbhrmob	0.26 (0.78)	1.96** (0.83)	-1.51*** (0.46)	0.68 (0.56)	0.18 (0.45)	-0.28 (1.07)
6.quarter#1.packmob#c.nbhrmob	-0.16 (1.01)	1.57* (0.90)	-1.49*** (0.45)	1.21 (0.78)	0.33 (0.40)	-0.26 (1.06)
7.quarter#1.packmob#c.nbhrmob	0.36 (0.96)	0.66 (1.15)	-1.75*** (0.48)	2.49*** (0.46)	0.48 (0.43)	-0.11 (0.99)
1.shock#2.quarter#1.packmob#c.nbhrmob	-1.61 (1.20)	-1.45 (1.99)	-1.22 (1.21)	-1.71*** (0.61)	-1.64** (0.72)	-5.42*** (1.45)
1.shock#3.quarter#1.packmob#c.nbhrmob	-1.89 (1.31)	-1.89 (1.75)	-2.26* (1.25)	-0.41 (0.71)	-1.15 (0.85)	-0.68 (1.10)
1.shock#4.quarter#1.packmob#c.nbhrmob	-1.12 (1.08)	0.11 (1.77)	-2.34** (0.92)	0.43 (0.84)	0.28 (0.83)	-0.09 (1.17)
1.shock#5.quarter#1.packmob#c.nbhrmob				-0.62 (1.07)	-0.34 (1.04)	0.53 (1.25)
1.shock#6.quarter#1.packmob#c.nbhrmob				-1.66 (1.44)	-1.77 (1.37)	-0.26 (1.35)
1.shock#7.quarter#1.packmob#c.nbhrmob				-2.28* (1.22)	-1.12 (1.29)	
gbmobdata	0.07* (0.04)	0.15*** (0.05)	0.07* (0.04)	0.52*** (0.12)	0.18*** (0.06)	0.63*** (0.08)
1.shock#c.gbmobdata	-0.13 (0.10)	-0.47*** (0.17)	-0.12 (0.10)	-0.64*** (0.15)	-0.30*** (0.11)	-0.68*** (0.12)
2.quarter#c.gbmobdata	0.01 (0.05)	-0.22*** (0.07)	0.01 (0.05)	0.03 (0.12)	0.01 (0.11)	-0.07 (0.09)
3.quarter#c.gbmobdata	-0.01 (0.05)	-0.08 (0.06)	-0.01 (0.05)	0.05 (0.11)	0.19* (0.11)	-0.00 (0.09)
4.quarter#c.gbmobdata	0.04 (0.05)	-0.15** (0.06)	0.04 (0.05)	0.00 (0.11)	0.53*** (0.09)	0.45* (0.25)
5.quarter#c.gbmobdata	0.08 (0.05)	-0.11* (0.06)	0.08 (0.05)	-0.15 (0.10)	0.37*** (0.09)	0.62*** (0.20)
6.quarter#c.gbmobdata	0.38*** (0.13)	0.76*** (0.21)	0.39*** (0.13)	-0.23** (0.11)	0.63*** (0.10)	0.90*** (0.23)
7.quarter#c.gbmobdata	0.90*** (0.31)	0.73** (0.30)	0.89*** (0.31)	-0.21** (0.10)	0.78*** (0.12)	0.71*** (0.19)

Table 13: The impact of the merger in Austria (4/5)



Dependant variable	Mobile price plan					
	<i>Italy</i>	<i>Italy</i>	<i>Italy</i>	<i>Estonia</i>	<i>Sweden</i>	<i>Czech Republic</i>
<i>Counterfactual market</i>	<i>OLS</i>	<i>Weighted OLS by consumption</i>	<i>Including prepaid plan</i>	<i>OLS</i>	<i>OLS</i>	<i>OLS</i>
<i>Estimation</i>	<i>OLS</i>	<i>Weighted OLS by consumption</i>	<i>Including prepaid plan</i>	<i>OLS</i>	<i>OLS</i>	<i>OLS</i>
1.shock#2.quarter#c.gbmobdata	0.03 (0.13)	0.60*** (0.19)	0.03 (0.13)	-0.00 (0.17)	0.03 (0.17)	0.10 (0.15)
1.shock#3.quarter#c.gbmobdata	0.12 (0.12)	0.48*** (0.18)	0.13 (0.12)	0.07 (0.15)	-0.06 (0.15)	0.06 (0.14)
1.shock#4.quarter#c.gbmobdata	0.08 (0.11)	0.57*** (0.17)	0.08 (0.11)	0.14 (0.15)	-0.37*** (0.14)	-0.37 (0.27)
1.shock#5.quarter#c.gbmobdata	0.17 (0.11)	0.56*** (0.18)	0.16 (0.11)	0.43*** (0.14)	-0.07 (0.14)	-0.42* (0.23)
1.shock#6.quarter#c.gbmobdata	-0.17 (0.17)	-0.33 (0.27)	-0.19 (0.17)	0.47*** (0.15)	-0.37** (0.15)	-0.73*** (0.26)
1.shock#7.quarter#c.gbmobdata	-0.43 (0.33)	-0.04 (0.35)	-0.44 (0.33)	0.74*** (0.15)	-0.38** (0.16)	-0.35 (0.23)
1.packmob#c.gbmobdata	1.99*** (0.42)	1.84*** (0.40)	1.99*** (0.42)	5.97*** (0.77)	3.05*** (0.60)	2.93 (5.17)
1.shock#1.packmob#c.gbmobdata	1.08 (0.85)	4.55*** (1.18)	1.08 (0.86)	-2.95*** (0.97)	0.06 (0.80)	0.07 (5.21)
2.quarter#1.packmob#c.gbmobdata	2.94** (1.34)	3.09*** (1.16)	2.94** (1.34)	0.54 (0.96)	-0.32 (0.85)	-5.30 (21.67)
3.quarter#1.packmob#c.gbmobdata	-4.54*** (0.99)	-3.52*** (0.95)	-4.54*** (0.99)	0.52 (0.95)	-0.15 (0.91)	4.30 (5.46)
4.quarter#1.packmob#c.gbmobdata	-4.70*** (0.98)	-6.07*** (2.25)	-4.69*** (0.98)	-2.21 (1.70)	-0.73 (0.66)	3.85 (5.46)
5.quarter#1.packmob#c.gbmobdata	7.07*** (1.12)	7.19*** (1.74)	7.07*** (1.12)	-0.49 (1.69)	0.31 (0.75)	5.14 (5.44)
6.quarter#1.packmob#c.gbmobdata	5.77*** (0.94)	5.72*** (0.86)	6.01*** (0.95)	-0.96 (2.66)	-0.71 (0.76)	4.87 (5.45)
7.quarter#1.packmob#c.gbmobdata	5.44*** (0.76)	5.19*** (0.83)	5.60*** (0.79)	-6.73*** (0.78)	-2.14*** (0.72)	5.06 (5.44)
1.shock#2.quarter#1.packmob#c.gbmobdata	0.35 (2.08)	-6.34*** (2.02)	-0.20 (1.87)	1.02 (1.84)	-3.13 (2.00)	6.89 (21.79)
1.shock#3.quarter#1.packmob#c.gbmobdata	3.58*** (1.25)	-0.19 (1.53)	3.76*** (1.25)	-1.67 (1.14)	-0.80 (1.08)	-5.44 (5.50)
1.shock#4.quarter#1.packmob#c.gbmobdata	3.34* (1.81)	3.68 (2.86)	5.48*** (1.44)		-3.69** (1.83)	-5.89 (5.88)
1.shock#5.quarter#1.packmob#c.gbmobdata	-8.03*** (1.59)	-11.17*** (2.12)	-7.01*** (1.51)	-1.04 (1.98)	-2.52* (1.30)	-6.39 (5.55)
1.shock#6.quarter#1.packmob#c.gbmobdata	-6.12*** (1.56)	-9.83*** (1.64)	-5.67*** (1.43)	0.05 (2.91)	-0.52 (1.42)	-5.40 (5.54)
1.shock#7.quarter#1.packmob#c.gbmobdata	-7.12*** (1.62)	-10.63*** (1.91)	-6.29*** (1.48)	4.25** (1.65)	-0.68 (1.56)	-6.76 (5.50)
Operator fixed effects	√	√	√	√	√	√
Constant	4.19*** (1.60)	6.08** (2.44)	4.33*** (1.59)	-8.20** (3.75)	16.45*** (2.11)	17.87*** (2.38)
Observations	1,901	1,901	1,936	1,571	1,333	1,271
R-squared	0.698	0.779	0.700	0.746	0.725	0.699

Significant at 1%(\*\*\*), 5%(\*\*) and 10%(\*). Robust Standard errors in parentheses.

Table 14: The impact of the merger in Austria (5/5)

## A.5 Testing the pre-treatment parallel trend assumption

	Monthly rental price			
	France-Korea		Austria-Italy	
	Q1-2011	Q1-2012	Q1-2011	Q1-2012
Download speed (Mbps)	0.05** (0.02)	0.04** (0.02)	0.18*** (0.04)	0.20*** (0.04)
Fiber	-2.78* (1.59)	-2.20* (1.32)	0.37 (1.72)	-1.41 (2.27)
Satellite			56.57*** (7.82)	55.65*** (7.94)
Fixed voice required	6.42*** (0.93)	6.79*** (0.89)	11.70*** (3.33)	11.32*** (2.81)
Fixed voice included	3.85*** (1.14)	1.83*** (0.65)	13.48*** (1.82)	12.10*** (2.18)
Mobile voice included	21.70*** (2.46)	22.73*** (1.99)	8.36*** (1.30)	8.45*** (2.01)
Mobile broadband included	15.27*** (1.42)	15.34*** (1.32)	3.89* (1.98)	3.36 (2.74)
Television included	1.96* (1.16)	4.84*** (0.73)	-0.10 (1.58)	-1.62 (1.92)
France	2.57 (3.77)	0.22 (1.55)		
Austria			2.30 (4.11)	4.82 (4.00)
Constant	19.56*** (3.68)	21.42*** (1.43)	15.63*** (3.30)	16.42*** (3.53)
Observations	129	170	294	265
R-squared	0.852	0.852	0.455	0.463
Test of systematic difference between 2011 and 2012 (SUEST)	Suest Chi2(17)= 23.62, P-value=0.13		Suest Chi2(20)= 14.11, P-value=0.82	

Significant at 1%(\*\*\*) , 5%(\*\*) and 10%(\*). Robust Standard errors in parentheses.

Table 15: Data source: Broadband Internet Access Cost, 2011 and 2012