Ex-post analysis of the merger between H3G Austria and Orange Austria

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Deutsche Zusammenfassung

In diesem Papier wird die Preisentwicklung für mobile Sprach- und Datendienste in Österreich im Zeitraum von 2011 bis 2014 im internationalen Vergleich dargestellt und analysiert. Insbesondere wird mit Hilfe ökonometrischer Methoden geschätzt, ob die Fusion zwischen Hutchison 3G (H3G) und Orange Austria (Orange) Anfang 2013 eine signifikante Auswirkung auf die Preise hatte („Merger-Effekt"), bevor die Auflagen der Europäischen Kommission effektiv wurden. Eine Gruppe von zehn europäischen Vergleichsländern, in denen keine Zusammenschlüsse oder Markteintritte stattgefunden haben, wird herangezogen, um die erwartete Preisentwicklung in Österreich ohne Fusion zu schätzen. Im Folgenden werden die verwendete Methodik näher erläutert und die Ergebnisse der Schätzungen dargestellt.

Methodik zur Berechnung des Merger-Effekts

Die Berechnung des Preises erfolgt mit Hilfe eines Nutzungskorbs („Basket"), der den durchschnittlichen Verbrauch von Minuten, SMS und MB von Smartphone-Nutzern abbilden soll. Dies geschieht auch für einen „traditionellen" Nutzer, der die Hälfte der durchschnittlichen Minuten und SMS des Smartphone-Nutzers, jedoch keine Daten konsumiert.

Mit Hilfe der somit berechneten Preise wird in der Folge der Effekt der Fusion auf die Preise geschätzt. Dazu wird die Differenz der Preise zwischen Österreich und der Kontrollgruppe vor dem Merger mit der Differenz nach dem Merger verglichen (Differenz-in-Differenzen- oder DiD-Methode). Ist die Differenz nach dem Merger signifikant verschieden von jener vor dem Merger, so deutet dies auf einen Effekt des Mergers auf die Preise hin. Eine wichtige Voraussetzung dabei ist, dass die Trends der verglichenen Gruppen (d.h. Österreich und der Kontrollgruppe) vor dem Zusammenschluss (statistisch gesehen) parallel sind. Ist dies nicht der Fall, wird die so genannte „Trend-Methode" angewendet, die in der Schätzung die unterschiedlichen länderspezifischen Preistrends berücksichtigt. Zusätzlich werden der Einfluss von Veränderungen der Mobilterminierungsentgelte und des Bruttoinlandsproduktes berücksichtigt.

Weiters wird die Methode der „synthetischen Kontrollgruppe" angewandt. In dieser Methode wird auf Basis der vorhandenen Kontrollgruppe ein gewichtetes „fiktives" Kontrollland erstellt, dessen Preise vor dem Zusammenschluss, sowohl was Trends als auch was Höhe betrifft, am ehesten mit dem Vergleichsland (Österreich) übereinstimmen. Der Preiseffekt des Zusammenschlusses wird dann aus der Differenz der Preise zwischen Österreich und der synthetischen Kontrollgruppe nach dem Zusammenschluss ermittelt.

Während wir mittels der synthetischen Kontrollgruppe den gesamten Zeitraum nach der Fusion betrachten, ermitteln wir für die anderen beiden Methoden einen kurzfristigen (bis ein Jahr nach der Fusion) und langfristigen (im zweiten Jahr nach der Fusion) Effekt.

Ergebnisse der Berechnungen

Zunächst ist eine Überprüfung der Parallelität der Preistrends Österreichs und der Kontrollgruppe nötig, um festzustellen, ob die Differenz-in-Differenzen-Methode ohne länderspezifische Trends angewandt werden kann. Der Trendtest zeigt, dass die Annahme der Parallelität der Trends vor der Fusion mit dem Preiskorb des traditionellen Nutzers erfüllt ist, beim Smartphone-Nutzer jedoch nicht. Daher ist das Ergebnis ohne Berücksichtigung der Preistrends für den Smartphone-Nutzer möglicherweise ungültig, der Vollständigkeit halber wird es aber dennoch dargestellt. Für den traditionellen Nutzer können alle drei Methoden als gültig angesehen werden.

Die Ergebnisse (siehe Tabelle) legen nahe, dass die Preise langfristig für einen österreichischen Smartphone-Nutzer durch die Fusion zwischen durchschnittlich rund 50 % (synthetische Kontrollgruppe) und 90 % (Trend-Methode) gestiegen sind. Auch kurzfristig war eine Steigerung erkennbar, diese fiel aber mit durchschnittlich rund 24 % geringer aus. Für traditionelle Nutzer lag die durchschnittliche langfristige Preissteigerung zwischen 22 % und 31 %. Kurzfristig, also im ersten Jahr nach der Fusion, war für den traditionellen Nutzer keine Preissteigerung erkennbar. Die Ergebnisse ändern sich auch dann nicht wesentlich, wenn (entgegen der ökonomischen Theorie) die Kosten aus Frequenzauktionen in den Preisen berücksichtigt werden.

Insgesamt ist daher festzustellen, dass der Zusammenschluss in den ersten beiden Jahren, noch bevor die Verpflichtungen (Eintritte von MVNOs) wirksam wurden, zu deutlichen Preiserhöhungen sowohl für Smartphone-Nutzer als auch für traditionelle Nutzer geführt hat.

Geschätzte Merger-Effekte – Basisspezifikation

	Smartphone-Nutzer		**traditioneller Nutzer**	
Trendtest	nicht erfüllt		erfüllt	
	Koeffizient	**% Wert**	**Koeffizient**	**% Wert**
DiD langfristig (p-Wert)	**0,263***** **(0,002)**	**30,1 %*****	**0,244***** **(0,003)**	**27,6 %*****
Trend-Methode DiD langfristig (p-Wert)	**0,643***** **(0,000)**	**90,2 %*****	**0,272***** **(0,001)**	**31,3 %*****
Synthetische Kontrollgruppe (Resultate Placebo-Test)	**0,408*** **(1/11)**	**50,4 %***	**0,201*** **(1/11)**	**22,3 %***
DiD kurzfristig (p-Wert)	-0,017 (0,824)	-1,7 %	-0,072 (0,443)	-6,9 %
Trend-Methode (DiD) kurzfristig (p-Wert)	**0,217***** **(0,001)**	**24,2 %*****	-0,059 (0,212)	-5,7 %

Die geschätzten Koeffizienten können mit (exp(Koeffizient)-1)*100 in %-Werte umgerechnet werden. Der p-Wert bzw. die Resultate aus den Placebo-Tests zeigen die statistische Signifikanz des Koeffizienten an. *, ** und *** kennzeichnen dabei statistische Signifikanz auf dem 10 %, 5 % und 1 %-Niveau.

Executive Summary

This paper analyses the price developments of mobile telephony (voice and data) services in Austria in the period from 2011 to 2014 compared to international price trends. Econometric methods are used in order to estimate whether the merger of Hutchison (H3G) and Orange Austria (Orange), which took place at the beginning of 2013, had a significant impact on prices ("merger effect") before the merger commitments (MVNO entries) became effective.

For this purpose, a reference group of ten European countries, in which no merger or new market entry took place, was used to estimate the hypothetical price developments in Austria without the merger.

Methodology for calculating the merger effect

Prices are calculated on the basis of price baskets which reflect the average number of minutes, SMS and MB an average "smartphone user" consumes. We also model a "traditional user" who uses only half of the minutes and SMS the smartphone user does and does not consume any data.

To estimate the effect of the merger on prices, the price differences between Austria and the reference group before the merger is compared to the difference after the merger (difference-in-difference or DiD approach). If the differences before and after the merger change significantly, this indicates that the merger had an effect on prices.

An important prerequisite is that the price trends in the compared groups (i.e. Austria and the reference groups) were (statistically) parallel before the merger. If that is not the case, the so-called "trend specification" estimation method is used which takes the different country-specific price trends into consideration. Additionally, the influence of changes regarding mobile termination rates and the GDP are taken into account.

Furthermore, the "synthetic control group" approach is used. This method creates, on the basis of the available control group countries, a weighted control country. This weighted control country shows approximately equal price trends and levels as the treatment country (Austria) in the period before the merger. The merger effect on prices is then calculated on the basis of the price difference between Austria and the synthetic control group after the merger.

While the synthetic control group approach analyses the entire period after the merger, the other two methods calculate a short-term (until one year after the merger) and a long-term (in the second year after the merger) effect.

Results

First, a trend test is conducted to show whether price trends in Austria and in the control group are parallel in order to determine if the difference-in-difference method can be used without considering country-specific trends. The trend test shows that the hypothesis, which assumes that the trends prior to the merger are parallel, is valid for the traditional user, but

not for the smartphone user. Therefore, if the price trends for the smartphone user are not taken into account, the result of the basic DiD approach might be invalid. However, for the sake of completeness, that result is presented as well. For the traditional user, all three methods can be considered valid.

The results (see table) indicate that prices for an Austrian smartphone user have risen in the long run between around 50% (synthetic control group) and 90% (country-trend DiD method) on average. Short-term increases were also notable but were, with an average of about 24%, smaller. For traditional users, the average long-term price increase is between 22% and 31%. However, there was no short-time increase, i.e. within the first year after the merger, for the traditional user.

These results remain qualitatively the same even if we take into account (against economic theory) the possibility that the costs of the spectrum auction in October 2013 might have led to some price increases.

All in all we conclude that the merger had a significant and strong price increasing effect for smartphone users as well as for traditional users before the merger remedies (MVNO entries) became effective.

Estimated merger effect – basic specification

	Smartphone user		Traditional user	
Common trend test	failed		passed	
	Coefficient	**% Value**	**Coefficient**	**% Value**
Basic DiD long-run (p-value)	**0.263*** (0.002)**	**30.1%*** **	**0.244*** (0.003)**	**27.6%*** **
Country-trend DiD long-run (p-value)	**0.643*** (0.000)**	**90.2%*** **	**0.272*** (0.001)**	**31.3%*** **
Synthetic control group long-run (Result placebo test)	**0.408* (1/11)**	**50.4%***	**0.201* (1/11)**	**22.3%***
Basic DiD short-run (p-value)	-0.017 (0.824)	-1.7%	-0.072 (0.443)	-6.9%
Country-trend DiD short-run (p-value)	**0.217*** (0.001)**	**24.2%*** **	-0.059 (0.212)	-5.7%

The estimated coefficients can be interpreted as percentage values when converted by (exp(coefficient)-1)*100. The p-value and result of the placebo test show the statistical significance of the coefficient. *, ** and *** provide the significance at the 10%, 5% and 1% level. Common trend test if: “Failed” we reject the null hypothesis of common trends at the 10% level.

1 Introduction

This paper examines the impact of the merger between the mobile network operators Hutchison 3G (H3G) and Orange Austria (Orange) in early 2013[1] on prices for mobile telephony services in Austria.

For this purpose, an econometric analysis is performed which compares prices in Austria with prices in ten EU countries where no merger or entry took place before and after the merger. We use detailed tariff data and country-specific data on average voice, SMS and data usage to calculate price baskets for smartphone users and traditional users (which do not use data services). With these price baskets we make a Difference-in-Differences analysis to estimate the effect of the merger on prices. The methodology we use was developed in a joint project by RTR, the European Commission (Chief Economist Team of DG Competition) and the Netherlands Authority for Consumers and Markets (ACM).[2]

With this methodology, we estimate significant price increases in the range of 50-90% for smartphone users and 22-31% for traditional users compared to the control group within the two years after the merger, i.e in the period before the merger commitments (MVNO access) became effective. Further we find that even if the costs of frequencies from the frequency auction in October 2013 were taken into account, prices increased significantly compared to the control group.

The paper is structured as follows: Section 2 briefly explains the situation on the mobile telephony market in Austria before and after the merger and gives some information on the merger proceeding and the commitments. In section 3, we describe the calculation of the price baskets and the data used for the analysis. Section 4 consists of a qualitative analysis of the international price trends on the basis of price data. In section 5, the methodology of the econometric analysis is described and in 6 its results are presented. Section 7 concludes based on the results from the qualitative and the quantitative analyses.

2 Market situation

At the time of the merger there were four mobile network operators (MNOs) active on the Austrian market: the Austrian fixed network incumbent A1 Telekom Austria (with its main brands A1 and bob); T-Mobile Austria (with its main brands T-Mobile and tele.ring); Orange Austria (with its brands Orange and Yesss!); and Hutchison 3G Austria (with its brand Drei).[3]

The merger consisted of the transaction between H3G and Orange and a second transaction in which H3G spun off the Orange sub-brand Yesss! to A1 Telekom Austria. These transactions led to a more symmetric market structure in the Austrian mobile market (see

[1] The transaction was authorised by the European Commission on December 12, 2012 subject to commitments (see section 2) and concluded in January 2013.

[2] see Aguzzoni et al (2015)

[3] Besides the network operators with their sub-brands there were two independent MVNOs and a number of resellers which, however, did not have significant market shares.

Table 1). While A1 Telekom Austria even strengthened its position as market leader due to the purchase of Yesss!, H3G came closer to T-Mobile in terms of subscriber-based market shares.

Table 1: MNO subscriber-based market shares

	A1 Telekom Austria	T-Mobile	Orange	H3G
Market share before merger (Q4/2012)	39.7%	30.7%	17.1% (incl. Yesss!)	12.6%
Market share after merger (Q1/2013)	45.5% (incl. Yesss!)	30.4%	-	24.1%

Both transactions (H3G-Orange and A1 Telekom Austria-Yesss!) were notified to the authorities in May 2012. The Austrian Cartel Court approved the Telekom Austria/Yesss! transaction on November 26, 2012.[4] The transaction between H3G and Orange was authorised by the European Commission on December 12, 2012 subject to commitments.[5] The merger was concluded in January 2013.

The commitments offered by the merging party consisted of

(i) a commitment to facilitate MNO market entry by divesting spectrum to a potential new MNO as well as providing national roaming, preferred collocation rights and the possibility to purchase sites to this new entrant;
(ii) a commitment to facilitate MVNO market entry. This commitment package consists of an upfront agreement with one MVNO and a reference offer for up to 16 MVNOs with wholesale access to up to 30% of H3Gs network.[6]

While the first commitment did not become effective, the second commitment only became effective with significant delay. The MVNO who signed the up-front agreement – UPC – entered the market in December 2014. Significant competitive pressure from MVNOs only developed after the market entry of further MVNOs in the course of 2015.

Since our data go from Q1/2011 to Q4/2014, where the Q4/2014 price data are from November 2014, we measure the price effect of the merger before the MVNOs entered the market, i.e. before the MVNO commitments became effective.

[4] http://www.bwb.gv.at/Zusammenschluesse/Zusammenschluesse_2012/Seiten/BWB_Z-1735.aspx
[5] See "Commission decision of 12 December 2012 declaring a concentration to be compatible with the internal market and the EEA Agreement (Case No COMP/M.6497 – HUTCHISON 3G AUSTRIA/ORANGE AUSTRIA)", http://ec.europa.eu/competition/mergers/cases/decisions/m6497_20121212_20600_3210969_EN.pdf.
[6] The reference offer is available at https://www.drei.at/portal/media/bottomnavi/ueber_3/wholesale/2012h3greferenceoffer.pdf.

3 Data and basket calculations

In this section we describe the data and data sources we use for our analysis. Further, we discuss our approach to the calculation of price baskets. A detailed description of these issues can be found in Annex A1 and A2, respectively.

Compared to other products, mobile telecom services do not consist of a single tariff, but of several tariff elements, which together result in a monthly price a user has to pay based on her or his usage. Such tariff elements are the connection fee, the monthly fee, prices per minute, SMS, MB in- and outside of a bundle, etc. To derive a one-dimensional price index, we define consumption baskets and apply them to detailed tariff data in order to calculate monthly costs for certain user profiles in a certain tariff. The basket is then calculated as the average of the cheapest four tariffs per operator (brand, if available). The calculation of the price baskets is further explained in Annex A1. We consider a basket approach best suited to calculate changes in prices over time since it clearly separates changes in prices (tariffs) from changes in quantities.[7]

Tariff data for Austria and all ten reference countries on various components of tariffs available over the time period of 2011 to 2014 were provided by Tarifica on a quarterly basis. The data are described in Annex A2. They cover the largest brands of each country, which are typically all full MNOs and big MVNOs or sub-brands of the MNOs for 2011 to 2014. For Austria those brands are A1, T-Mobile, Drei, Orange and tele.ring. Handset subsidies are not included in the data and therefore cannot be considered. In this study we focus on tariffs for residential customers.

In order to reflect different market segments and include a larger number of tariffs, we use two different usage baskets based on actual usage of national voice minutes, national SMS and domestic data as provided by BEREC (2014)[8] for the year 2013.

- The “smartphone user” uses exactly the average number of minutes, SMS and data per month. This means, this user represents the average user per country.
- The “traditional user” consumes half of the average number of minutes and SMS and does not use data services.

We use country-specific usage data in order to better reflect the actual prices paid by users in a certain country given their usage and the tariffs available. The usage data for Austria and the ten (potential) control group countries are described in Annex A1. We keep the usage data constant over the whole period in order to avoid distorting price changes through changes in quantity.

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[7] Alternative measures such as the average revenue per user (ARPU) or average revenue per unit have several weaknesses: Both, ARPU and ARPUnit only react to actual price changes in the market with significant delay due to long-term contracts and measure changes in price and quantity at the same time; the ARPU is usually distorted by inactive SIM cards; the ARPUnit does not reflect actual consumer valuations, because usually, voice and SMS services are translated into data volumes based on technical rather than economic parameters.

[8] Available at: http://berec.europa.eu/eng/document_register/subject_matter/berec/opinions/4826-international-roaming-analysis-of-the-impacts-of-8220roam-like-at-home8221-rlah

For the econometric analysis, we need further control variables in order to be able to measure the effect of changes in cost and demand on prices for which we use mobile termination rates and the GDP growth of each country. These data are also described in Annex A2.

4 Qualitative comparison of price developments

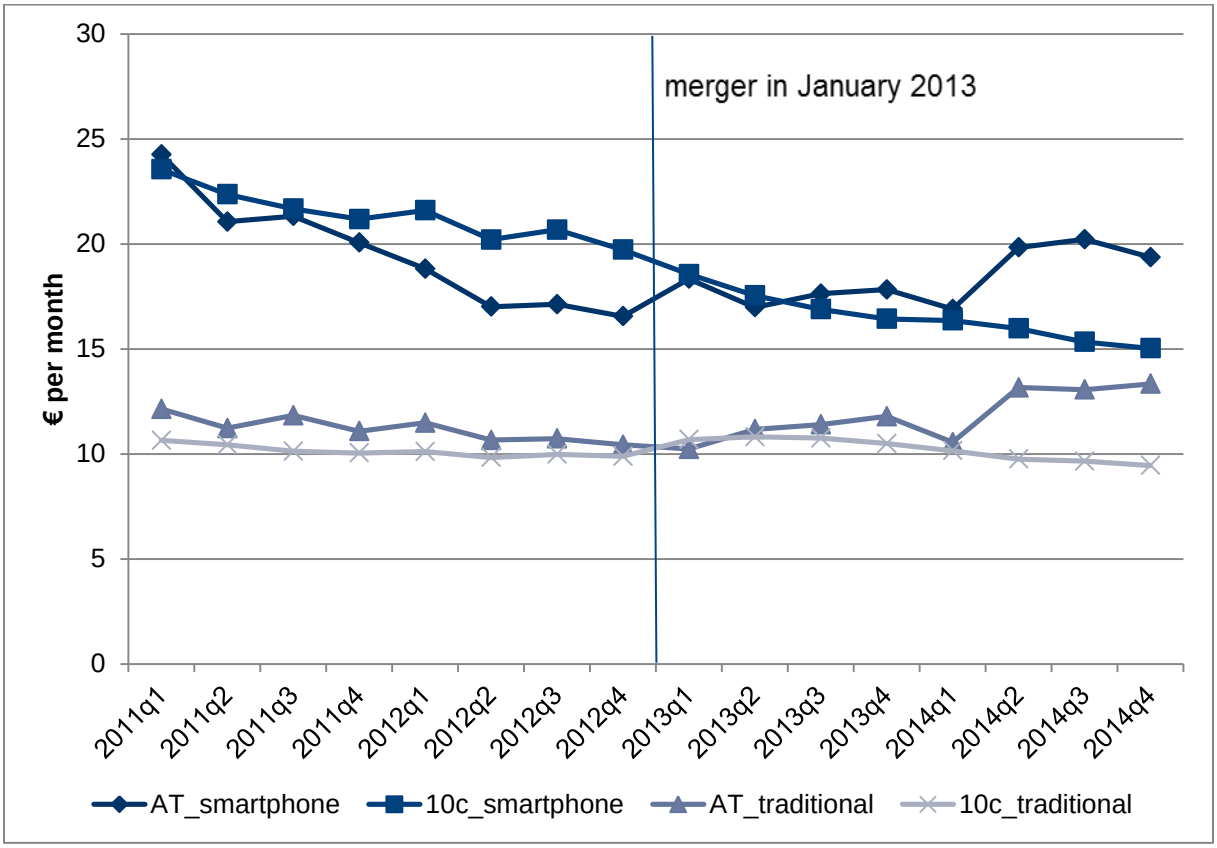
In this section we compare the price developments in the Austrian mobile telephony market to those of the other selected EU countries, where no merger took place. These countries are: Belgium, Denmark, Finland, Greece, Hungary, Italy, the Netherlands, Portugal, Spain, Sweden.

Figure 1 shows the price trends in Austria compared to the average price trend of the control group countries for the smartphone user and the traditional user. For the smartphone user, the price trends before the merger exhibit a downward trend both in Austria and in the ten reference countries. While prices in the control group countries continue to decline after the merger, they exhibit an increasing trend in Austria.

Since usage is country-specific, the higher price level in Austria at the end of the observation period might also be explained by the above-average usage level. But even if compared to single countries with a similar (Denmark) or even higher data usage (Finland, Sweden), Austria is either clearly more expensive (Finland, Denmark) or at a similar level (Sweden) at the end of the observation period.

With regard to the traditional user, we observe that the price level in Austria before the merger is quite similar to the average of the other countries and both price series follow a somewhat declining trend. After the merger, the average prices in the ten countries remain roughly at the same level as before the merger while the prices in Austria have an increasing trend with a particular sharp increase in the last three quarters of 2014.

Figure 1: Austrian (AT) mobile prices compared to the 10 control group countries (10c)



Subsequently, on the basis of statistical methods, we want to determine whether this increase, compared to price trends in other countries, can be attributed to the merger or to other factors such as cost changes or changes in demand.

5 Methodology of the estimation

In this section we explain the methodology we use to estimate the effect of the merger on prices in Austria. The methodology and parts of the text of this chapter are based on Aguzzoni et al (2015).

In general, the effect of a merger is identified by comparing the actual outcome after the merger to the hypothetical outcome which would have occurred in the absence of the merger (the counterfactual). The latter has to be estimated using econometric methods, as it cannot be actually observed. We follow two methods, a difference-in-differences (DiD) approach and a synthetic control group approach.

The rationale for the difference-in-differences approach is explained in section 5.1. There, we discuss the implementation of the basic DiD method and an alternative implementation using country-specific trends. In section 5.2, the synthetic control group approach is presented. In section 5.3, we describe our basic specification and possible robustness checks for both methods.

5.1 The difference-in-differences method (DID)

The DiD approach, which goes back to Ashenfelter (1978) and Ashenfelter and Card (1985), has been widely applied in the economic literature on program evaluation for the estimation of treatment effects (see for example the review by Imbens and Wooldridge, 2009). While this approach has traditionally been applied in labour and development economics, in more recent years it was implemented also in industrial economics, and in particular for the ex post evaluation of mergers (see for example Focarelli and Panetta (2003), Ashenfelter and Hosken (2008), Aguzzoni et al. (2011), Choné and Linnemer, (2012) and Ashenfelter et al. (2013)).

To determine the effect of the merger, one must first estimate how prices would have evolved in Austria, if no merger had occurred. This requires a control group whose price trend is the basis for the estimation of the prices in Austria. In this study, we compare prices in Austria to a set of European countries where no merger and no MNO exit or entry occurred in the relevant time period. Under the assumption of common price trends, the merger is identified by comparing the average (across group) differences in prices before and after the merger. In its simplest form, the DiD an be calculated as:

$$(1) \quad DiD = (p_i^{post} - p_i^{pre}) - (p_j^{post} - p_j^{pre})$$

where p_i are the prices of tariffs in the treatment country averaged across the post- or pre-merger period (indicated by the superscripts *post* and *pre*) and p_j are the respective prices of the control group. A positive merger effect, for example, would mean that prices of the treatment group increased on average relative to the control group after the merger, indicating a negative effect on competition.

However, the prices in Austria and the average prices in the control countries do not necessarily share the same pre-merger trend (see Figure 1). Additional explanatory variables such as MTRs or GDP development, may explain these differences to some extent. Hence, we include them in the regression and estimate the following fixed effects model ("Base specification"):

$$(2) \quad \log(p_{j,i,t}) = \alpha + \gamma_{short} D_{i,t}^{short} + \gamma_{long} D_{i,t}^{long} + \sum_t \tau_t + \sum_i S_i + \delta_1 GDP\ growth_{i,t} + \delta_2 \log(MTR_{i,t}) + \varepsilon_{j,i,t}$$

where $\log(p_{j,i,t})$ are the log real prices of tariff j in country i at time t, $\sum_t \tau_t$ is a series of time fixed effect dummies, $\sum_i S_i$ is a series of country-MNO fixed effects, $D_{i,t}^{short}$ and $D_{i,t}^{long}$ are dummies which take the value 1 in the treated country (i.e. Austria) in the first and second year after the merger, respectively, and ε_i^t is a random term assumed to be independent and identically distributed (iid).

For our analysis, the coefficients of interest are γ_{short} , γ_{long} , which can be interpreted as the respective merger effect in the first (Q2-Q4 2013) and second year (Q1-Q4 2014)

following the merger. In our basic specification, we exclude the quarter in which the merger was consummated (Q1 2013); hence the short term effect has to be interpreted with caution, as there may be a seasonal effect included. Moreover, we consider this short-term effect less relevant, as the adjustment to new market conditions usually takes some time and the former Orange tariffs remained in the market until the third quarter of 2013.

If the price trend of the control group is different to the price trend in Austria before the merger, the estimate of the price differences after the merger may be distorted. Therefore, first of all, we examine whether the price trends prior to the merger run parallel. If the null hypothesis, i.e. the prices of the control group and Austria follow the same trend, cannot be dismissed, the entire set of countries is a valid control group. Otherwise, we introduce country-specific linear price trends to control for different trends ("Trend specification"). Furthermore, we implement the synthetic control group approach (see section 5.2), which weights the control group countries such that the pre-merger trend is most similar to the merging country's pre-merger trend.[9]

Using the trend specification, the merger effect is identified by assuming that the merger potentially has an effect on prices but that country-specific (linear) price trends pre-merger remain unchanged post-merger. Formally, we estimate the following specification:

$$(3)\quad \log(p_{j,i,t}) = \alpha + \sum_{t>t^M} \gamma_t D_{i,t} + \sum_i \partial_i t + \sum_t \tau_t + \sum_i S_i + \delta_1 GDP\ growth_{i,t} + \delta_2 \log(MTR_{i,t}) + \varepsilon_{j,i,t}$$

Here, $\sum_i \partial_i t$ represent the country-specific linear trends. We estimate the effect of the merger using the dummies $D_{i,t}$ for each quarter after the merger (where t^M is the date of merger).[10] In our analyses these are seven dummies and $D_{i,t}$ takes the value of one only for the treated country in quarter t. The coefficients γ_t capture for each quarter the estimated effect of the merger relative to the counterfactual. We then compute the average effect of the merger in the short run and in the long run, that is, in the first and second year after the merger, by taking the average of the estimated coefficients of, respectively, the first three dummies and the last four dummies.

In both regression specifications (Base and Trend), we account for autocorrelation and heteroscedasticity in the residuals by using a cluster-robust estimator with clustering at the country level.[11]

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[9] We report the results of these alternative methods also, if the pre-merger trends match. However, in these cases, we believe the basic specification is more valuable.

[10] This model is similar to what is proposed by Wolfers (2006). As set out below, it turns out that the effects of the mergers only gradually materialize over time. Therefore, as discussed in detail by Wolfers (2006) there is a risk that the estimated linear trend for the treated country is confounded by the merger effects. We therefore follow Wolfers (2006) in estimating the linear trend of the treated country exclusively based on the pre-merger period by using a separate treatment dummy for each quarter after the merger.

[11] As pointed out in Aguzzoni et al (2015), the small sample of available countries (and, therefore, clusters) likely introduces a downward bias in the standard errors, and, in turn, spuriously increases the statistical

5.2 The synthetic control group approach

The synthetic control group approach was developed by Abadie and Gardeazabal (2003) and was later extended by Abadie, Diamond and Hainmüller (2010 and 2014). In the context of ex-post merger evaluation, the same approach, together with a standard DiD analysis is used by Hosken et al. (2012).

The idea behind the synthetic control group is a quantitative procedure which chooses an optimal control group with different weightings of the potential reference countries. The optimal control group is the weighted control group which is the most similar to the treatment group before the treatment with regard to a set of variables ("predictors"). In our case the following predictors are used: GDP growth, termination rates and prices from the time prior to the merger, i.e. the quarters Q1/2011 Q1/2012 and Q4/2012.

In the period after the merger, the price development of the synthetic control group is used to statistically illustrate the theoretical development of the treatment group without the merger (the counterfactual). The price developments in Austria and the synthetic control group are shown in Figure 2. The price developments of the synthetic control group are calculated using the "synth" command in Stata 14.[12]

The effect of the merger can now be calculated as the average difference between the actually observed and the synthetic price over time.

significance of the merger effects estimated by the models. Given our very low p-values and the results of the synthetic control group approach we are convinced that our results can be viewed as statistically significant.

[12] see http://web.stanford.edu/~jhain/synthpage.html

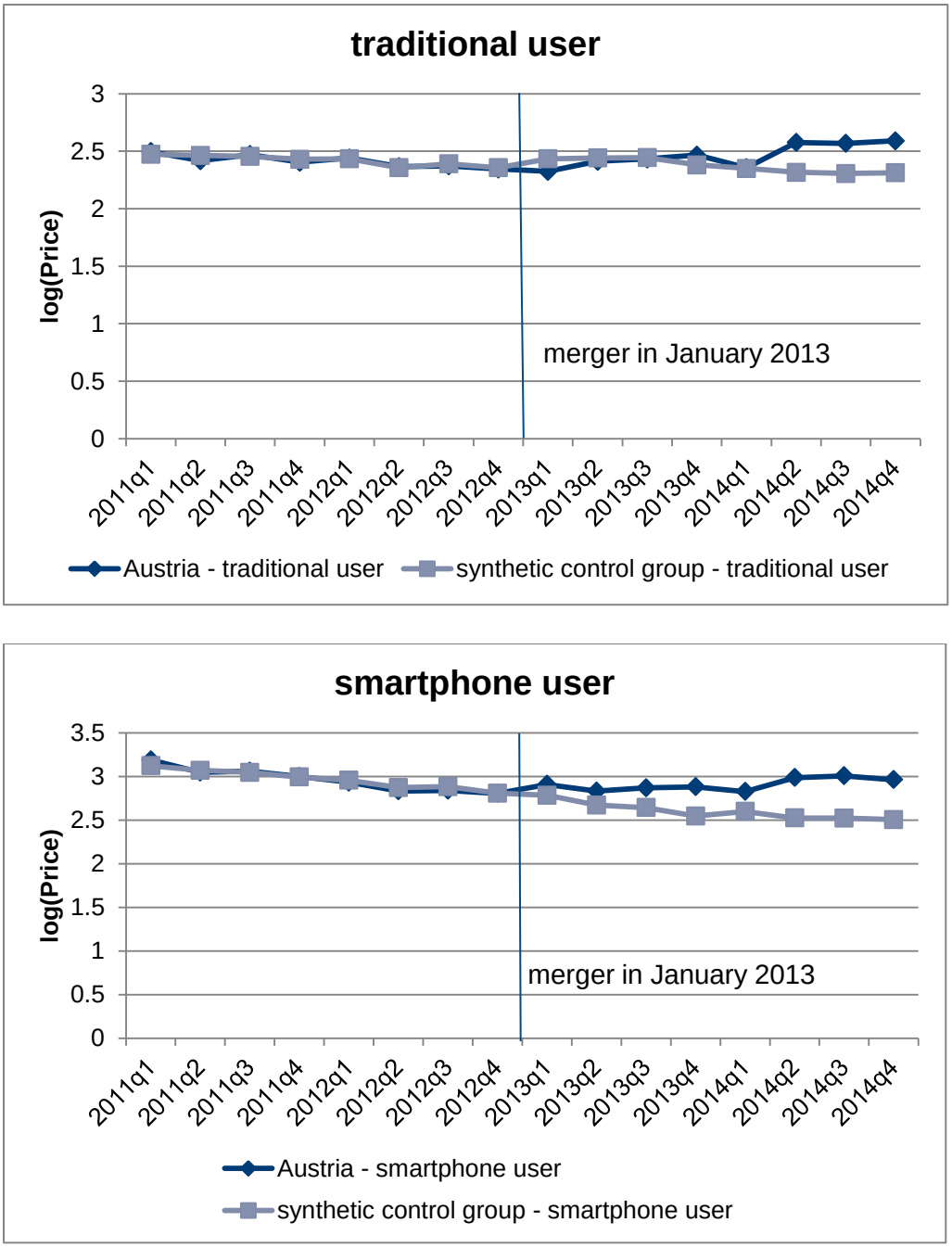

Figure 2: Price development in Austria compared to the synthetic control group

To determine the statistical significance of the price effect using the synthetic control group approach, we use a "falsification" approach following Abadie, Diamond and Hainmüller (2010 and 2014). To this end we conduct a series of placebo tests, i.e. we assume that the merger had also taken place in the other countries at the same time, determine the synthetic control group and compare the synthetic and the actual development of prices. The control group consists of all countries except Austria, which is not included due to the actual "treatment".

Subsequently, we compare the effect of the actual merger in Austria with the effects of the placebo tests. From the relative magnitude of the effect of the actual merger, we can draw conclusions whether the difference between the actual price changes over time and the synthetic price changes over time happened randomly or if it was statistically significant. In

order to do so, we calculate the "Root Mean Squared Prediction Error" (RMSPE) for the "treatment group" and the placebo measurements before and after the merger and compare the RMSPE ratio before and after the merger. The higher this ratio, the higher is the effect of the merger. If the relation of the two values for the merging country, Austria, is larger than in the placebo studies, we consider the resulting effect of the merger statistically significant.[13] In this case, it can be ruled out with great probability that the effect occurs due to random factors and can therefore be ascribed to the merger.

5.3 Basic specification and robustness checks

For the basic specification of our estimation we use the following assumptions:

- Prices are calculated on the basis of the four lowest tariffs per operator;
- Termination rates and GDP growth are used as control variables;
- Country-specific and time-specific fixed effects are used;
- The usage is constant over the entire period and country-specific.

In addition to this basic specification we conduct two robustness checks:

- Instead of the four lowest tariffs, only the two lowest tariffs of each operator are used (see Annex A3);
- We not only exclude the quarter in which the merger has been consummated (Q1/2013), but also three quarters before this date, in which the merger proceedings took place to control for potential anticipation effects (see Annex A3).

Moreover, we calculate an alternative specification, where costs of recently auctioned spectrum are considered in the price (i.e. the depreciation amount of the spectrum costs per end customer per time period will be deducted from the price, resulting in a new price, which is reduced by spectrum costs).

6 Results of the estimation

In this section, we describe the results of the basic DiD approach, the trend method and the synthetic control group approach using the specifications described in section 5.3. As described in Section 1.3, we first compare the price trends prior to the takeover using a trend test in order to examine whether the basic DiD approach is appropriate. In a second step, we conduct the three estimation methods.

The trend test shows that the null hypothesis that the trends prior to the merger are parallel is only valid for the traditional user. Hence, for this approach, the basic DiD method is valid. However, this requirement is not met for the smartphone user. A look at the trends in Figure 1 suggests that this result is plausible. For comparison, we report the results of the three estimation methodologies for the smartphone user as well as for the traditional user.

[13] As one treatment group is compared to ten placebo measurements, the maximal probability that a country has the highest RMSPE ratio is at 1/11 = 0.09. Generally, statistical estimates above 5% or 10% are considered significant. We use this term in the case that the "treatment value" shows a larger RMSPE ratio.

The results of the different approaches are shown in Table 2. As prices are logarithmised, the coefficients can be transformed to percentage changes by applying *(exp(coefficient)-1)*100*. Short run effects are the effects in the first year after the merger while long-run effects are the effects in the second year.

For the smartphone user, we identify a merger effect on prices between 50% (synthetic control group approach) and 90% (country-trend DiD method) in the long-run ncompared to the control groups. These results are statistically significant. In the short run (i.e. in 2013), we find a lower but also statistically significant increase of 24%.

The long-run effects for the traditional user are also statistically significant but of lower magnitude compared to the smartphone user. The effect of 22-31% is still economically significant, however. In the short run, no statistically significant effect can be found.

Table 2: Estimated merger effect – basic specification

	Smartphone user		Traditional user	
Common trend test	failed		passed	
	Coefficient	**% Value**	**Coefficient**	**% Value**
Basic DiD long-run (p-value)	**0.263***** **(0.002)**	**30.1%***	**0.244***** **(0.003)**	**27.6%***
Country-trend DiD long-run (p-value)	**0.643***** **(0.000)**	**90.2%***	**0.272***** **(0.001)**	**31.3%***
Synthetic control group long-run (Result placebo test)	**0.408*** **(1/11)**	**50.4%***	**0.201*** **(1/11)**	**22.3%***
Basic DiD short-run (p-value)	-0.017 (0.824)	-1.7%	-0.072 (0.443)	-6.9%
Country-trend DiD short-run (p-value)	**0.217***** **(0.001)**	**24.2%***	-0.059 (0.212)	-5.7%

The estimated coefficients can be interpreted as percentage values when converted by (exp(coefficient)-1)*100. The p-value shows the statistical significance of the coefficient. *, ** and *** provide the significance at the 10%, 5% and 1% level. Common trend test if: “Failed” we reject the null hypothesis of common trends at the 10% level.

An argument put forward in this context is that it was not the merger, but the frequency auction in Austria in October 2013 that led to the subsequent price increases. In our view, this argumentation contradicts economic theory since costs for spectrum are sunk costs, which – once they have accrued – should not have an impact on business decisions such as prices or output.

Having said that, we investigate in this study whether the results of the price analysis would change if the costs for spectrum are deducted from the price. We calculate the average cost of spectrum per subscriber per month of all auctions in Austria and the control group

countries in the years 2011-2014.[14] In doing so, we assume a WACC[15] of 8% and straight-line depreciation over 15 years. This results in costs of €0.85 per customer and month for the Austrian spectrum auction of October 2013, which are deducted from the basket prices.

Table 3 shows the results which account for the costs of the spectrum auction. The results are very similar to those of the basic specification with somewhat lower but still quite significant price increases. This shows that even after taking into account the costs for newly acquired spectrum, a strong merger effect can be detected that is statistically significant in most specifications.

Table 3: Estimated merger effect (long-run) – deducting the costs of the spectrum auction in October 2013

	Smartphone user		Traditional user	
Common trend test	failed		passed	
	Coefficient	**% Value**	**Coefficient**	**% Value**
Basic DiD (p-value)	**0.192** **(0.024)**	**21.2%****	**0.194*** **(0.069)**	**21.4%***
Country-Trend DiD (p-value)	**0.546***** **(0.000)**	**72.6%*****	**0.174***** **(0.004)**	**19.0%*****
Synthetic control group (Result placebo test)	**0.390*** **(1/11)**	**47.7%***	0.168 (2/11)	18.3%

The estimated coefficients can be interpreted as percentage values when converted by (exp(coefficient)-1)*100. The p-value and result of the placebo test show the statistical significance of the coefficient. *, ** and *** provide the significance at the 10%, 5% and 1% level.

All in all, the estimates discussed above show a positive and statistically significant effect of the merger on the prices for an average smartphone or traditional user, in particular in the second year after the merger in Austria (i.e. before the remedies became effective). Even after taking into account the costs of the frequency auctions, this effect is clearly measurable and significant.

7 Conclusion

Based on the results of the qualitative and quantitative analysis which compare the price developments in Austria with the ones in ten other EU countries, it can be concluded that the merger had a significantly increasing effect on retail prices in the Austrian mobile communications market in the years 2013 and 2014, i.e. before the merger remedies (MNVO entry) became effective. Even after considering the possible effects of recent spectrum auctions on prices, price increases at a similar level can be observed.

[14] Auctions before 2011 are considered as fixed effects, which are taken into account in the regression analysis anyways.

[15] Weighted average cost of capital

Annex

A1. Definition of baskets and price calculation

In this section we explain how the baskets are defined and how the prices over time are calculated on the basis of usage and tariff data. A description of the tariff data is provided in the next section of this Annex.

The usage data consist of the following elements:

- Number of minutes to (national) landlines
- (National) on-net minutes
- (National) off-net minutes to mobile
- (National) SMS
- Data

Not included are international calls, voicemail calls and MMS, because those services are rarely used and consistent tariff data over the entire period are not available for all countries. Neither is there any consistent information about additional services such as music or TV streaming available; therefore those services aren't considered in the calculations of the prices over time either.

The usage data for the basket calculation was provided by BEREC (2014) – this data is based on information of national regulatory authorities for an average user of mobile services in 2013 and depicted in Table A1.

Table A1: Average usage 2013 per month

	AT	BE	DK	FI	GR	HU	IT	NL	PT	ES	SW	Ø[16]
min to fixed	28	21	26	29	32	26	27	20	29	23	30	27
min on-net	56	41	51	57	64	52	54	40	57	46	60	53
min off-net	56	41	51	57	64	52	54	40	57	46	60	53
SMS	37	176	98	40	34	27	65	23	172	6	84	70
data in MB	361	36	366	803	32	10	151	133	39	117	832	131

The usage data include (dedicated) mobile broadband services, which are not considered in our analysis. Since such services accounted for about half of the amount of data transmitted according to calculations in Ericsson's Mobility Report[17] in 2013, data usage has been halved as well (e.g. Austria: 361 MB instead of 722 MB on average per month).

The usage is assumed to be constant over the entire period in order to prevent that changes in consumption patterns have an impact on the observed prices.

[16] All numbers are rounded up.

[17] See http://www.ericsson.com/res/docs/2014/ericsson-mobility-report-november-2014.pdf

In principle, a chained index would also be suited to reflect the actual prices over a certain period as such an index considers changes in usage in that period but, at the same time, the observed price trend is not itself affected by the changes in usage. However, as usage data are not available for three of the four observed years, we would not be able to calculate the chained index correctly in this case.

In order to reflect different market segments and the largest possible number of tariffs, we use two different user types.

- The "smartphone user" uses exactly the average amount of minutes, SMS and data per month, representing therefore the average user.
- The "traditional user" uses half of the average number of minutes and SMS and does not use any data.

We calculate the monthly expenses for each tariff based on the data presented and the following assumptions:

- The average duration of a call is two minutes. Billing intervals are not included in the calculations.
- Activation fees are divided equally over 24 months, which often corresponds to the minimum contract period; an annual service fee is divided over 12 months.

Once a price has been calculated for each tariff considering the relevant usage data, the four (or two) cheapest tariffs per operator are selected. The reason why we include in the basic specification four tariffs per operator rather than just one or two, is that consumers are rarely perfectly informed about their own consumption and the range of tariffs in the market.

A maximum of 50% prepaid plans are taken into account per operator and point of time. This is to prevent that only the usually cheaper prepaid plans are included in the average price per operator, while postpaid tariffs usually have even larger market shares. Youth and social tariffs are not considered. Using the average of the four (or two) tariffs per operator, the mean per country and point of time weighted by the operators' market shares is calculated which shows the price development over time.

A2. Data description

We use Tarifica's[18] mobile tariff data base that covers the tariffs of mobile network operators in Austria and ten European countries in the time frame between 2011 and 2014. Since we focus on the residential segment, we only use tariffs for residential users. Furthermore, we use IRG/BEREC reports as source for data on mobile termination rates (MTRs) and Eurostat as source for gross domestic product per capita (GDP) as well as exchange rates for non-Euro countries (Denmark, Hungary, Sweden) and inflation (HICP) to calculate real prices.

[18] see http://www.tarifica.com/MobilePricingDatabase.aspx

The tariff elements included in our data base are:

- Activation charge/connection fee/yearly service fee
- Monthly rental/fixed fee
- Minimum rental per month
- Number of minutes/SMS included in the fixed fee by target network (i.e. onnet, offnet or fixed networks)
- Data included total and until throttling of speed
- Price per minute/SMS and one-time connection fee by target network

Information on handset subsidies is not available.

With regard to tariffs for the use of data services only those are considered, where some amount of data is included in a bundle or if a supplementary data package is available. Per-unit data charges are not available over the whole period and are thus not considered.

Table A2 gives an overview of the different tariff data sets available. The pool of control countries in the data include all EU Member States of which sufficient data could be provided by Tarifica and in which no merger and no market entry or exit occurred during the period 2010-2014. Thus, ten European countries remain as potential control pool for Austria.

Table A2: Overview of Tarifica tariff data

Countries covered	Austria, Belgium, Denmark, Finland, Greece, Hungary, Italy, Netherlands, Portugal, Spain, Sweden
Frequency	quarterly
Period	2011-2014
Sub-brands	Only partly included (e.g. tele.ring for Austria)

We have 16,791 tariff observations. The average number of tariffs by operator and quarter is 27.1. The absolute number of tariffs per operator and quarter is always larger or equal than two and larger or equal than four in 99.7% of all cases. Numerical data descriptions for each country can be found in Table A3.

The tariff data provided by Tarifica seem rather complete with regard to MNOs. However, MVNOs, resellers and – in some cases – sub-brands are not included. This affects, for instance, the brands Yesss! and bob in Austria. The main sub-brand of T-Mobile, tele.ring, is included over the whole timeframe.

We compared the Austrian Tarifica data to the AK[19] data in order to check consistency between these data sets. Besides the fact that not all sub-brands are available in the Tarifica data set, there are only small differences between Tarifica and AK data, which can be mostly attributed to different times of inquiry – while the AK data is collected once a month, Tarifica collects their data once a quarter.

[19] Austrian Chamber of Labour („Arbeiterkammer“)

The price trends for all countries are shown in Figure A1 and Figure A2.

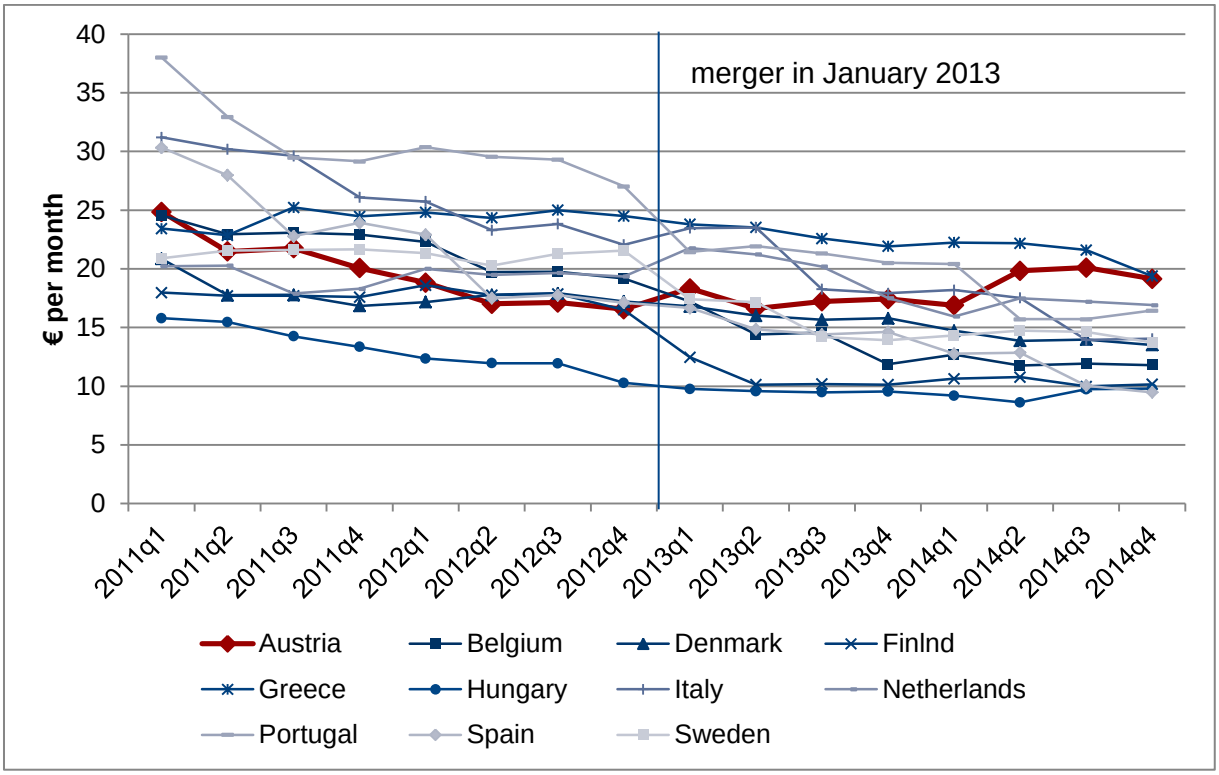

Figure A1: Price trends for the smartphone user 2011 – 2014

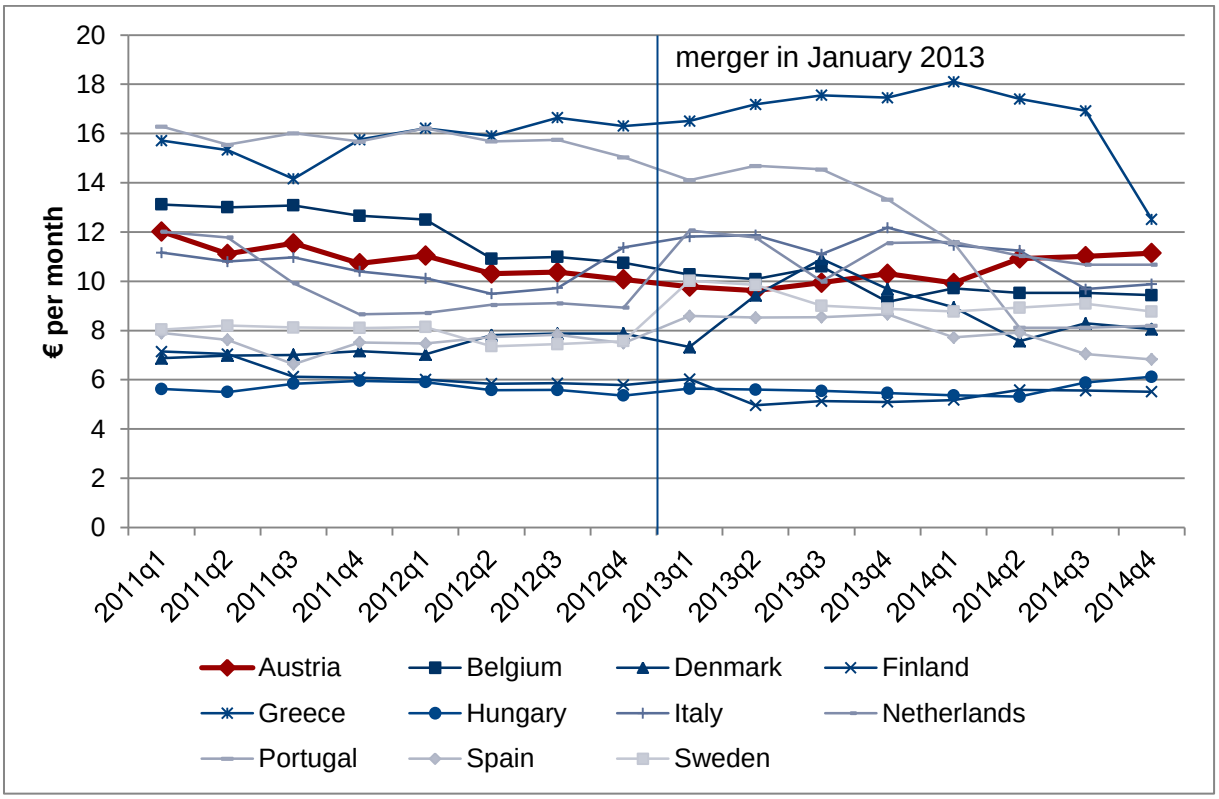

Figure A2: Price trends for the traditional user 2011 – 2014

Table A3: Data description

	Mean	Standard deviation	Number of periods	Minimum	Maximum
Austria					
Price traditional user (in €)	11.52	0.98	16	10.23	13.33
Price smartphone user (in €)	18.96	2.10	16	16.56	24.26
GDP growth per capita	0.00	0.01	16	-0.02	0.01
Mobile termination rates (in €)	0.02	0.01	16	0.01	0.02
Belgium					
Price traditional user	10.98	1.48	16	9.17	13.24
Price smartphone user	17.73	4.63	16	11.86	24.55
GDP growth per capita	0.00	0.02	16	-0.03	0.02
Mobile termination rates	0.02	0.01	16	0.01	0.04
Denmark					
Price traditional user	8.74	1.06	16	7.37	10.91
Price smartphone user	16.87	1.77	16	13.74	20.84
GDP growth per capita	0.00	0.01	16	-0.02	0.02
Mobile termination rates	0.02	0.02	16	0.01	0.05
Finland					
Price traditional user	5.81	0.62	16	5.02	7.15
Price smartphone user	13.80	2.84	16	10.13	18.61
GDP growth per capita	0.00	0.01	16	-0.02	0.01
Mobile termination rates	0.03	0.01	16	0.02	0.04
Greece					
Price traditional user	16.40	1.05	16	13.95	18.11
Price smartphone user	23.67	1.15	16	21.92	25.33
GDP growth per capita	-0.01	0.02	16	-0.05	0.03
Mobile termination rates	0.03	0.02	16	0.01	0.04
Hungary					
Price traditional user	5.66	0.25	16	5.31	6.12
Price smartphone user	11.32	2.33	16	8.62	15.80
GDP growth per capita	0.00	0.02	16	-0.05	0.03
Mobile termination rates	0.02	0.01	16	0.02	0.03
Italy					
Price traditional user	11.55	1.06	16	9.84	13.60
Price smartphone user	23.33	4.54	16	15.78	31.20
GDP growth per capita	-0.01	0.02	16	-0.04	0.02
Mobile termination rates	0.03	0.02	16	0.01	0.07
The Netherlands					
Price traditional user	10.49	1.30	16	8.66	12.25

Price smartphone user	19.55	1.30	16	16.64	21.76
GDP growth per capita	0.00	0.01	16	-0.03	0.01
Mobile termination rates	0.02	0.01	16	0.02	0.04
Portugal					
Price traditional user	14.61	2.42	16	10.44	17.35
Price smartphone user	25.14	6.65	16	16.29	38.00
GDP growth per capita	-0.01	0.02	16	-0.03	0.02
Mobile termination rates	0.02	0.01	16	0.01	0.04
Spain					
Price traditional user	7.96	0.83	16	6.63	9.67
Price smartphone user	17.57	5.16	16	9.56	25.97
GDP growth per capita	-0.01	0.02	16	-0.04	0.03
Mobile termination rates	0.03	0.01	16	0.01	0.05
Sweden					
Price traditional user	9.56	1.02	16	8.16	10.99
Price smartphone user	20.46	1.41	16	17.87	23.02
GDP growth per capita	0.00	0.01	16	-0.02	0.02
Mobile termination rates	0.02	0.01	16	0.01	0.02
Total					
Price traditional user	10.30	3.38	176	5.02	18.11
Price smartphone user	18.95	5.28	176	8.62	38.00
GDP growth per capita	0.00	0.02	176	-0.05	0.03
Mobile termination rates	0.02	0.01	176	0.01	0.07

A3. Robustness checks

In this annex, we present two additional robustness check. In the first robustness check (Table A4), we include only two instead of four tariffs per operator to get the price series. The results appear to be in a similar range as our main approach. Only the synthetic control group approach for the traditional user now delivers an insignificant result.

Table A4. Robustness check with only two included tariffs per operator (long-run)

	Smartphone user	Traditional user
Base specification (DiD)	0.296***	**0.232*** **
(p-value)	(0.000)	**(0.009)**
Trend specification (DiD)	**0.755*** **	**0.354*** **
(p-value)	**(0.000)**	**(0.008)**
Synthetic control group	**0.529***	0.167
(Result placebo test)	**(1/11)**	(3/11)

*, ** and *** shows the significance at the 10%, 5% and 1% level.

In the second robustness check presented in this Annex (Table A5), we account for a potential anticipation effect of the merger that might have influenced prices already before the merger. Hence, we exclude one full year (Q2/2012 – Q1/2013) in this robustness check. The results are, again, very similar to those of the main approach. Similar to above, in one specification (trend specification), the merger effect is not statistically significant for the traditional user any more.

Table A5. Robustness check accounting for anticipation effect (long-run)

	Smartphone user	Traditional user
Base specification (DiD)	0.188**	**0.183** **
(p-value)	(0.045)	**(0.017)**
Trend specification (DiD)	**0.691*** **	0.132
(p-value)	**(0.000)**	(0.227)
Synthetic control group	**0.408***	**0.215***
(Result placebo test)	**(1/11)**	**(1/11)**

*, ** and *** shows the significance at the 10%, 5% and 1% level.

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