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Impact of mobile operators consolidation on unitary price*

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Abstract

We evaluate the impact of mobile operators merger on unitary price of data and voice by using country-level observations on data retail revenue, cellular data traffic, voice retail revenue, outgoing voice minutes. Using difference-in-differences estimation strategy, we estimate the effect of 4-to-3 operators merger by comparing the difference between the no-merging countries and the merging countries before and after the introduction of 4-to-3 operators merger. In accordance with the theoretical prediction provided in this paper, we find that mergers from four to three mobile operators tend to decrease data unitary price and increase voice unitary price.

*Any opinions expressed here are those of authors and not those of Orange. All errors are our own.

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1 Introduction

In Europe, telecommunication regulation remains the least investment-friendly environment of any region globally, despite significant improvements during the last decade, especially in terms of access regulation, although we believe progress in securing investment would have been considerably faster had more mobile consolidation received approval. Telecom industry is not supported by the regulatory framework, which is too heavily geared toward consumer interest and which disregards fair returns on investment. BEREC (2018)[1] recent review analyses the price developments following the four-to-three mobile mergers seen in Austria, Ireland and Germany. BEREC's report shows some evidence of price rises post mergers, but relies on opaque price baskets, not transparent unit prices. HSBC (2018) recommends unitary price analysis and shows continued price falls post Austrian deal.

This paper analyses the causal relationship between the merger of mobile operators and unitary price for voice and data services. We show that technical progress is an important parameter to know whether the merger strengthens dynamic efficiency. We show that mergers have a different impact on unit price depending on the nature of the service: voice or data. Mergers tend to increase the unit price of voice and to decrease the unit price of data, because data is more sensitive to dynamic efficiency than voice. Mergers strengthen market power and thus entail a negative static effect on both voice and data. However, with regard to data, technical progress induces a positive dynamic efficiency that can compensate for the static effect. Using a constructed quarterly panel of country level unitary prices across twenty two countries over seven years, we document empirically an increase in minute price and a decrease in megabyte price following the four to three mergers. In our panel, a merger happened in four countries, Austria, Germany, Ireland and Norway. Our results suggest that although mobile operators merger reduced data unitary price by about 17%, this also led to an increase of 22% for voice unitary price.

[1] the body representing the National Regulatory Authorities (NRAs) in Europe

2 Literature Review

Our paper is related to two main streams of the economic literature. On the one hand, this paper relates to the stream analyzing the relationship between market concentration and prices. On the other hand, we relate to the broader field of research on the link between market structure and investment and innovation. Our paper contributes to works on the trade-off between market power and efficiency gains from mergers in the telecom industry.

The first stream of literature mostly includes empirical papers. Over the last decades the profit-consolidation studies have been replaced by related research that analyzes the relationships between market structure and prices. A general finding in this price-concentration literature is that high concentration is associated with higher prices (Weiss, 1989). Several empirical contributions and case-studies have been recently led, focusing on the effect of mergers on the prices in one or several specific countries. The BEREC Report on Post-Merger Market Developments (2018) analyses with Difference-in-Differences (DiD) and Synthetic Control Methods the price developments following the four-to-three mobile mergers seen in Austria, Ireland and Germany. These methods estimate price effects based on a comparison of the trends in tariff developments in the countries where the merger happened (the so-called "treated" countries) and in several non-affected countries (the control group). In each of the three countries under study, "the data suggest that retail prices for new customers increased as a result of the merger, compared to the prices that would have been observed in the absence of a merger (counter-factual scenario) in the short and medium term".

The second stream we relate to examines the relationship between market consolidation and innovation and quality. This stream includes both theoretical and empirical papers. The merger theoretical debate has recently been relaunched with the paper of Motta and Tarantino (2017) showing that in the absence of economies of scale, mergers reduce total industry investment. Several academic papers have been written in reaction. Among others, Bourreau, Jullien and Lefouili worked on the impact of a merger on investment in demand-enhancing innovation. They designed a decomposition of the various effects at work with a market consolidation (margin expansion effect, demand expansion effect and innovation diversion effect) and show that

the overall impact on the merging firms' incentives to innovate can be either positive or negative. Houngbonon & Jeanjean (2016) find that compared to the current situation, a decrease in the number of operators would increase the investment per subscriber in the long term. The theoretical paper most closely related to our work is "Evaluating Market Consolidation in Mobile Communications" by Genakos, Valletti and Verboven. Using a very large dataset and a "basket-approach" price analysis, Genakos *et al.* (2017) analyse the impact of market structure on prices and investments in the mobile telecommunications industry. They find that "a merger will have static price effects to the detriment of consumers, but also dynamic benefits for consumers to the extent that investments enhance their demand for services". Finally, a recent GSMA report, even if its findings are specific to Austria, shows that a 4-to-3 mobile merger intensified competition in quality-related aspects and that a three-player market delivered more widely available and faster 4G services than those experienced in four-player markets. It also shows that a merger between the two smallest operators in Austria allowed them to significantly outperform other operators in Europe with a similar position in the market.

Pedrós *et al.* (2017) assesses the impact of mobile consolidation on innovation and quality. They find positive effects on the quality of mobile networks in the Austrian market

Our paper is the first empirical paper to specifically assess 4-to-3 mobile operators merger on unitary price both for voice and data services. The unit price seems to us a particularly relevant measure of consumer usage over time. Indeed, from one year to the next, one minute of voice communication remains one minute of voice communication and a megabyte always represents the same amount of information, whereas a same subscription represents a different usage.

The unit price captures the effect of technical progress much better than subscription price or ARPU because operators constantly adapt their offer and a same ARPU represents a very different consumer experience over time. To realize this, just imagine what you could have or do today, with what you spend on mobile telephony based on the offers of five or ten years ago. Some consultancy and policy papers have pointed out that unit price where more appropriate than ARPU to assess the impact of the mergers in mobile industry (e.g., Charles River Associates CRA (2013), HSBC (2014)).

The rest of the paper is organized as follows: Section 3 summarizes the theoretical predictions

concerning the waterbed effect between voice unitary price and data unitary price. Section 4 describes our empirical strategy and section 5 discusses the data used. Section 6 presents the main results. Section 7 derives policy implications of these outcomes and concludes.

3 Theoretical predictions

In this section, we present a theoretical model that highlights the decreasing impact of mergers on prices provided technical progress is high enough.

A merger increases market power and thus have an increasing impact on prices. However, in the same time, technical progress spurs investment in marginal cost reduction which have a decreasing impact on prices. If technical progress is high enough, the decreasing impact on marginal costs may outweigh the increasing impact of market power such that total impact of the merger is a price decrease.

Mobile industry is composed of voice and data services. The impact of a merger may be different on voice and data according to the innovation intensity on these services. Technical progress is much higher on data than on voice which explains why mergers tend to decrease data megabyte prices and to increase voice minute prices.

3.1 The model

The model is a simultaneous game. n Firms invest in marginal cost reduction and set their output (voice or data) simultaneously to compete à la Cournot. P is the market price, Q the total output and q_i the output of firm i, such that $Q = \sum_{i=1}^{n} q_i$. Before investment, the initial marginal cost of firm i is c_{0i}, and the marginal cost reduction due to investment is denoted x_i. After investment, we assume, as in Motta & Tarantino (2017), that the marginal cost becomes $c_i = c_{0i} - x_i$. The cost of investment is $F(x_i)$ which is an increasing and convex function of x_i. In the following, we assume that $F(x_i) = \frac{x_i^2}{2\tau}$, where τ represents a measure of technical progress. The higher is τ, the lower is the cost of investment $F(x_i)$ for a given x_i. We assume a linear demand function: $P = a - bQ$, where a and b are positive constants and $\forall i \in (1, 2, ..., n), a > c_{0i}$.

Profit is written:

$$\pi_i = (P - c_{0i} + x_i)q_i - F(x_i) \tag{1}$$

The simultaneous game involves two simultaneous first order conditions:

A first order condition on investment:

$$\frac{\partial \pi_i}{\partial x_i} = q_i - \frac{x_i}{\tau} = 0 \tag{2}$$

And a first order conditions on output:

$$\frac{\partial \pi_i}{\partial q_i} = -bq_i + (P - c_{0i}) + \tau q_i = 0 \tag{3}$$

Equation (2) leads to: $x_i = \tau q_i$ and equation (3) yields

$$q_i = \frac{P - c_{0i}}{b - \tau} \tag{4}$$

At industry level, we consider, to simplify, the symmetric case where all firms have the same marginal cost before investment . $\forall i, j \in (1, 2, ..., n), c_{0i} = c_{0j} = c_0$. It can be written:

$$Q = \frac{n(a - c_0)}{b(n + 1) - \tau} \tag{5}$$

and

$$P = \frac{a(b - \tau) + nbc_0}{b(n + 1) - \tau} \tag{6}$$

We can observe that if $\tau > b$ then $\frac{\partial P}{\partial n} > 0$ and $\frac{\partial Q}{\partial n} < 0$.

Proof. From equation(5): $\frac{\partial Q}{\partial n} = \frac{(a - c_0)(b - \tau)}{((b(n + 1) - \tau)^2}$

From equation (6): $\frac{\partial P}{\partial n} = \frac{-b(a - c_0)(b - \tau)}{((b(n + 1) - \tau)^2}$

We know that $a > c_0$, thus it is straightforward, if $\tau > b$, then $\frac{\partial Q}{\partial n} < 0$ and $\frac{\partial P}{\partial n} > 0$ □

This means that if technical progress is high enough, a decrease in the number of firms decreases price and increases output.

Since technical progress is much higher for data than for voice, it is expected that a merger in mobile industry increases price of voice minute and decreases price of data megabyte. Indeed, technical progress tends to increase investment and thus stimulates the decrease in marginal cost which tends to reduce price. If technical progress is high enough, this marginal cost reduction outweighs the increasing impact of merger on price. This is the reason why we observe an acceleration of the data price decrease after merger. By cons, this is not the case for voice as technical progress is much lower for voice than for data. In the voice case, technical progress is not high enough to outweigh the increasing impact of merger on price.

3.2 Consumer surplus

Changes in price impact consumer surplus. A decrease in data price increases consumer surplus, while an increase in voice price decreases it. The overall impact is the sum of the consumer surplus of data and the consumer surplus of voice. In the empirical part we estimates the impact of mergers on prices. This will allow us to estimate the changes in consumer surplus. Theoretically, the impact of a change in price on consumer surplus can be calculate with the demand function. Demand function is written as a function of the traffic: $P = \phi(Q)$.

Let us denote $\Phi(Q)$ such that $\dfrac{\partial \Phi(Q)}{\partial Q} = \phi(Q)$

Consumer surplus is written: $CS = \Phi(Q) - PQ + cste$. As a result, a change in price impacts consumer surplus such that:

$\dfrac{\partial CS(Q)}{\partial P} = \dfrac{\partial \Phi(Q)}{\partial P} - (Q + P\dfrac{\partial Q}{\partial P})$

We know that

$\dfrac{\partial \Phi(Q)}{\partial Q} = \phi(Q) = P$ thus $\dfrac{\partial \Phi(Q)}{\partial P} = P\dfrac{\partial Q}{\partial P}$, and as a result:

$$\frac{\partial CS}{\partial P} = -Q \tag{7}$$

Equation (7) will be useful to estimate the impact of

4 Empirical strategy

We considered the following difference-in-differences model:

$$Y_{it} = \alpha + \delta D_i + \sum_t \lambda_t * T_t + \beta * D_i * T_t^{m+} + \sum_i \gamma_i * C_i + \sum_k \mu_k * X_{itk} + \varepsilon_{it} \tag{8}$$

where Y_{it} is unitary price ln(pudata) or ln(puvoice). D_i are treatment dummies,taking value 1 if country i is in the treatment group. T_t are quarterly time dummies, for time specific events common to all countries. β are merging effect from interaction term between D_i and post-treatment period T_t^{m+}. C_i are country dummies to account for time invariant characteristics of a country. X_{itk} are country characteristics (density, GDP per capita).

An alternative approach is synthetic control method that estimates the effect of the merger for each country treated as the difference in unitary price after treatment between merging country and a synthetic country of similar characteristics constructed as an average of untreated countries cf. Abadie & Gardeazabal (2003), Abadie *et al.* (2010) and Abadie *et al.* (2015). The weights are chosen in the range [0,1], so that the effect of the treatment is estimated from an interpolation of untreated countries. If there are more than one merging country, the average treatment effect can be obtained as the average of the treatment effects of all merging countries. More specifically, let's note $Z_i = (Y_{i1}, ...Y_{\bar{t}-1}, X_{i1}, ...X_{iT})'$ the set of pre-treatment price values and control variables at all quarter t. The method of synthetic controls applied to a merging country is to solve the minimization of following expression given by:

$$min_{\omega_j | \omega_j \geq 0, \sum_{j \notin T} \omega_j = 1} (\sum_{j \notin T} \omega_j Z_j - Z_i)' W (\sum_{j \notin T} \omega_j Z_j - Z_i) \tag{9}$$

where W is a symmetric and positive definite matrix. This minimization allows for choose the weights that should be allocated to control countries to obtain a synthetic country (defined as the weighted average of control countries) which is similar to the merging country (treated) in terms of pre-treatment prices and control variables at all dates. The matrix W makes it possible to determine the respective influence of the pre-treatment prices to determine the weights. If we consider that W is a diagonal matrix whose sum of diagonal terms equals one, equation 9

becomes a weighted sum of quadratic errors where the weights are the diagonal terms of W.

If the weights estimated are noted as $\widehat{\omega_j}$, the estimated effect of the treatment for the merging country is given by:

$$\widehat{\theta_i} = \frac{1}{T - \bar{t} + 1} \sum_{t \geq \bar{t}} \sum_{j \notin T} (\hat{\omega_j} Z_j - Z_i) \tag{10}$$

In terms of comparison of approaches, the method synthetic controls constitutes a natural way to get an interpolation-based estimator.

5 The Data

We combine two panel datasets for twenty European countries[2] over 32 quarters from 1Q2011 to 4Q2018. The first dataset comes from the Telecom Market Matrix provided by Analysys Mason in the version of 12 April 2019. It provides the total mobile voice and data traffic and corresponding revenue per country and per quarter. Mobile voice traffic is quite stable over time. However mobile data traffic experiences a quasi exponential growth. The data unitary price "pudata" (euro/GB) is calculated from the data retail revenue divided by the cellular data traffic per country and per quarter. Similarly, the voice unitary price "puvoice" (euro/mn) calculated from the ratio of the voice retail revenue divided by the outgoing voice minutes per country and per quarter.

The second dataset contains country-level characteristics and economic performance, taken from the World Bank "World Development Indicators". GDP per capita is the country-level GDP divided by the population.

[2]Austria,Belgium, Croatia, Czech, Denmark, Estonia, Germany, Hungary, Ireland, Latvia, Lithuania, Norway, Poland, Portugal, Romania, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Table 1: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	source
pudata	640	.0196	.0417	.0005	.414	Analysis Mason
puvoice	640	.0576	.0355	.0093	.2374	Analysis Mason
GDPpcap	640	36318	23817	8542	102722	Worldbank
density	640	116.4	87.0	15.3	377.1	Worldbank
year	640	2014.5	1.661325	2011	2018	

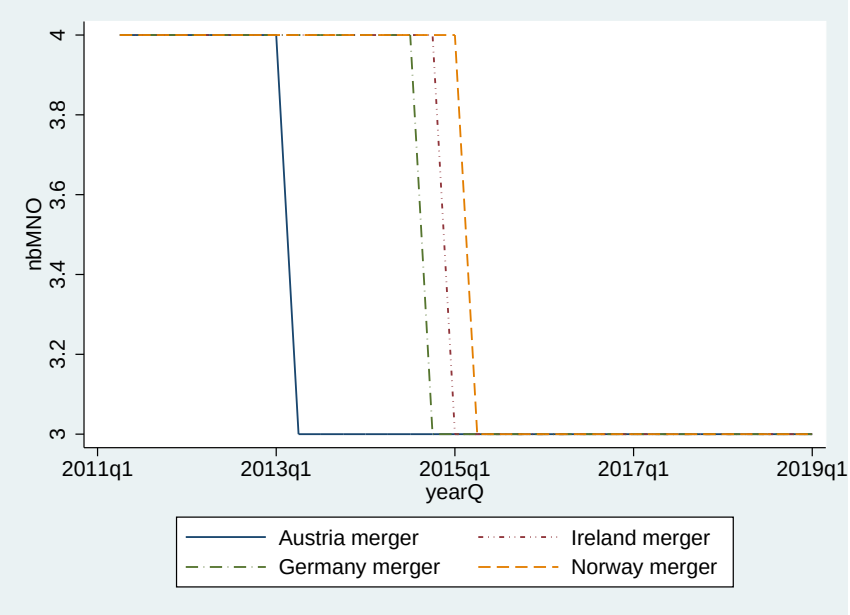

Figure 1: 4-to-3 merging countries: Austria Germany Ireland Norway

Figure 1 shows fours cases of 4-to-3 mobile operators merger. The first case is the merger of Orange and Hutchinson 3 in Austria in the first quarter of 2013. The second case is the merger in Ireland, , between Hutchinson 3 and O2,in 2014Q3. The third case is in Germany, between E-plus and O2, in 2014Q4 and the last case is in Norway, between Telia company and Network Norway, in 2015Q1.

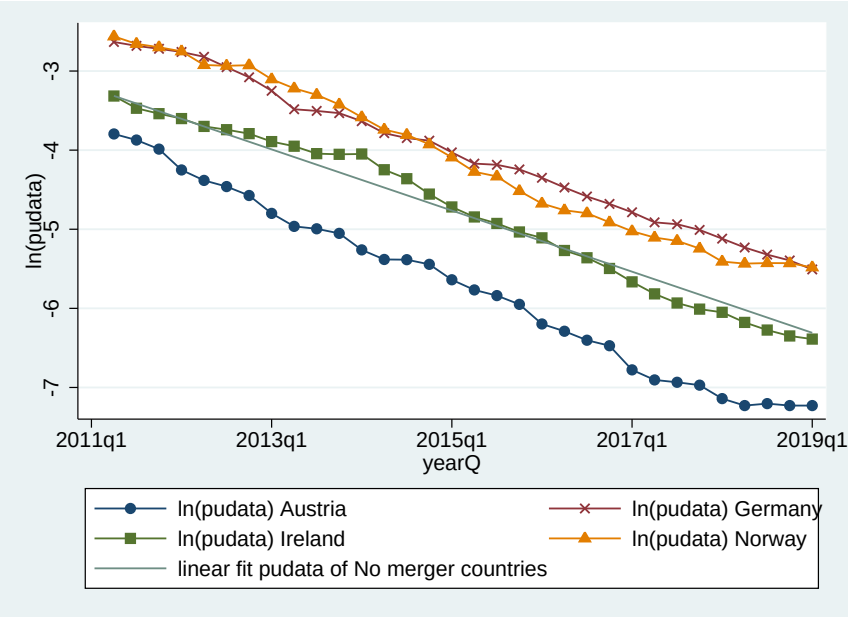

Figure 2: mobile data unitary price decreases exponentially over time (source: Analysis Mason)

With the evolution of mobile technology, the data unit price decreases exponentially over time. The figure 2 shows that the drop of data unit price in Austria is stronger than the drop in non-merger countries.

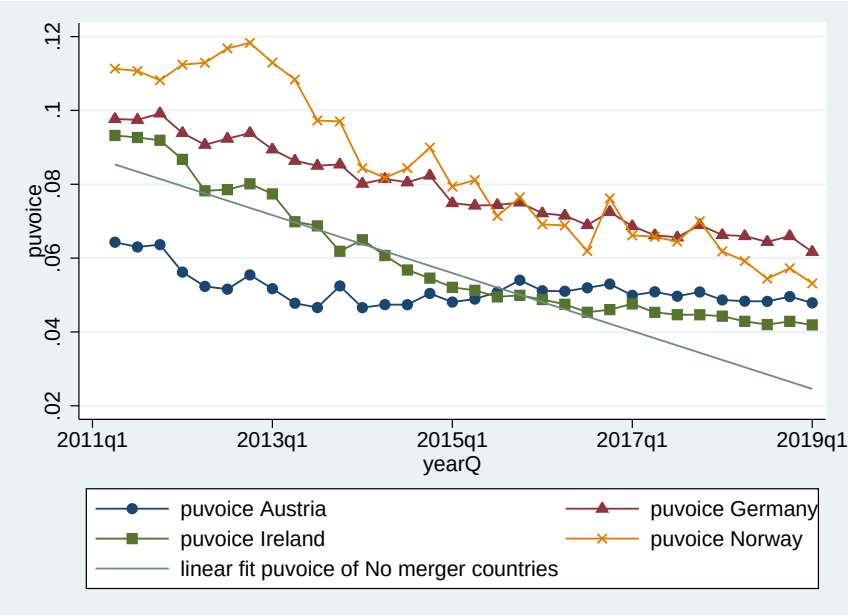

Figure 3: mobile voice unitary price decreases linearly over time (source: Analysis Mason)

Over the same period, the voice unit price decreases linearly over time. The figure 3 shows that the decrease of voice unit price in merger countries seems lower than the decrease in non-merger countries.

6 Main results

We now present the empirical results from the empirical model and data discussed above. Firstly, we investigate the average merger effect on unitary price by considering together four merging countries (Austria, Germany, Ireland and Norway) as treated countries in difference-in-differences regressions. Then, two cases of merger from 4-to-3 operators are separately examined. As shown in Figure 1, the first case is the merger of Orange and Hutchinson 3 in Austria in the first quarter of 2013. The second case is the merger in three countries, Germany Ireland and Norway at close dates in 2014Q4, 2014Q3 and 2015Q1 respectively. For these three countries, we evaluate average impact of merger on unitary price. The impact of merger on each individual country is presented and discussed in Appendix.

6.1 Average impact on four merging countries: Austria, Germany, Ireland and Norway

Based on the variables outlined in the data section, we estimate, by using DiD method, the causal impact of 4-to-3 merger on unitary price for four countries: Austria, Germany, Ireland and Norway.

Table 2: Difference-in-differences regressions for four merging countries: Austria, Germany, Ireland and Norway

VARIABLES	lnpudata	lnpuvoice
DiD	-0.1716***	0.2233***
	(0.033)	(0.027)
merg_country	-11.8130***	-0.0476
	(0.813)	(0.460)
density	-63.7872***	1.3408
	(5.023)	(2.805)
GDPpcap	-1.3224	3.2270***
	(1.247)	(1.054)
country dummies	Y	Y
quarter dummies	Y	Y
Constant	14.1045***	-2.8695***
	(1.322)	(0.750)
Observations	640	640
R-squared	0.968	0.952
Robust standard errors in	parentheses	
*** p<0.01, ** p<0.05,	*p<0.1	

Table 2 approximates the merger effect by building a counter factual for four merging countries based on the post-merger trend of control countries (cf Figure **??**: 16 countries that experienced no merger in the period 2011-2017). DiD (difference-in-differences) between treated (with merger) and control countries (without merger) is statistically significant. Data unitary price is decreased by an average of 17% for four merging countries after merging event with respect to no-merging countries. Voice unitary price is increased by an average of 22% for four merging countries after merging event with respect to no-merging countries. The coefficient of control variables seem reasonable and in the correct direction. Data unitary price is decreasing in population density, due to the decreasing deployment cost in higher density countries. Voice unitary price is increasing in GDP per capita.

6.2 Case of Austria

In this subsection, we analyze the causal impact of 4-to-3 merger in Austria on unitary price. We provide estimates from difference-in-differences regression, followed by synthetic control re-

gressions.

Table 3: Difference-in-differences regressions for Austria

VARIABLES	lnpudata	lnpuvoice
DiD	-0.4159***	0.4852***
	(0.074)	(0.052)
merg_country	-12.1724***	0.3536
	(0.929)	(0.493)
density	-67.8893***	5.6967*
	(5.828)	(3.076)
GDPpcap	-21.2050**	20.9826***
	(8.326)	(4.506)
country dummies	Y	Y
quarter dummies	Y	Y
Constant	16.0414***	-4.7750***
	(1.729)	(0.905)
Observations	544	544
R-squared	0.965	0.954
Robust standard errors in	parentheses	
*** p<0.01, ** p<0.05,	*p<0.1	

Table 3 approximates the merger effect by building a counter factual for Austria based on the post-merger trend of control countries (cf Figure **??**: 16 countries that experienced no merger in the period 2011-2017).

DiD (difference-in-differences) between treated (with merger) and control countries (without merger) is statistically significant. Data unitary price is decreased in average by 42% in Austria after merging event with respect to no-merging countries. Voice unitary price is increased by 49% in Austria after merging event with respect to no-merging countries.

Some robustness checks are performed by using synthetic control specification to overcome DiD assumptions.

Figure 4: Synthetic control regression for unitary data revenue of Austria

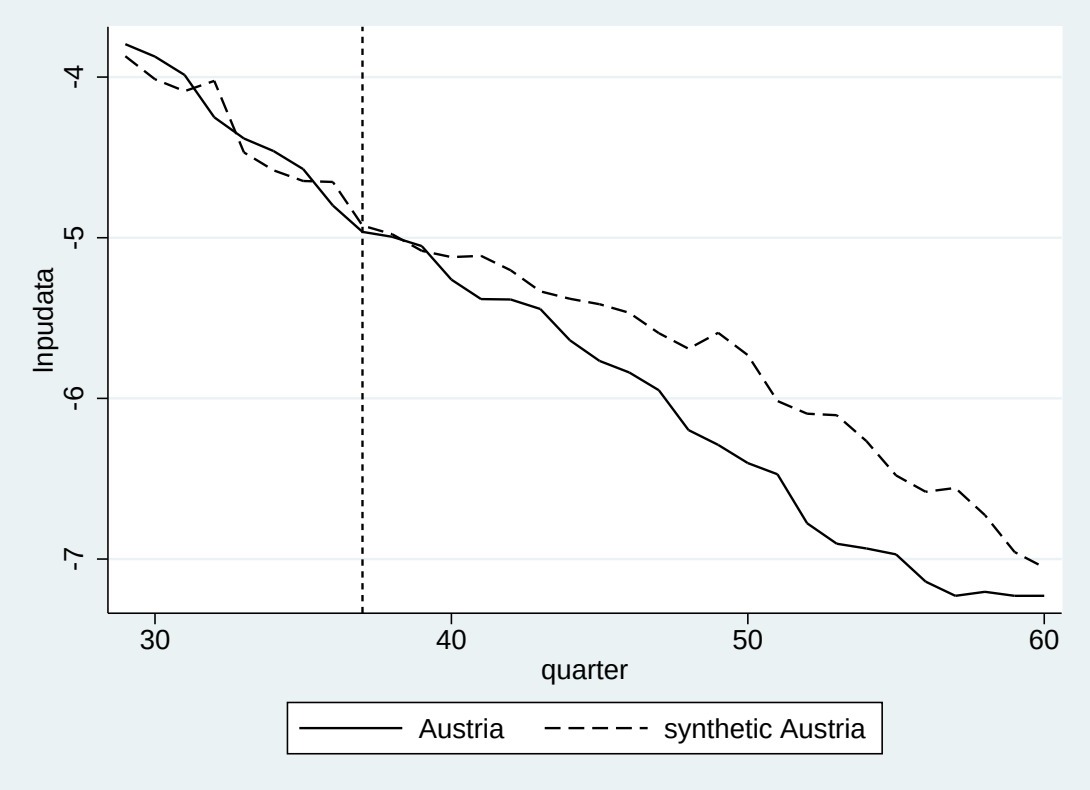

Figure 4 shows the impact of merger assessed by synthetic control regression. We develop a counter-factual scenario of Austria that the merger not taken place. By using weighted combination of no-merging countries, we compare the data unitary price that resulted after the merger with the data unitary price in the counter-factual scenario. We observe that the data unitary price is lower compared to the counter-factual scenario after merging.

Figure 5: Synthetic control regression for unitary voice revenue of Austria

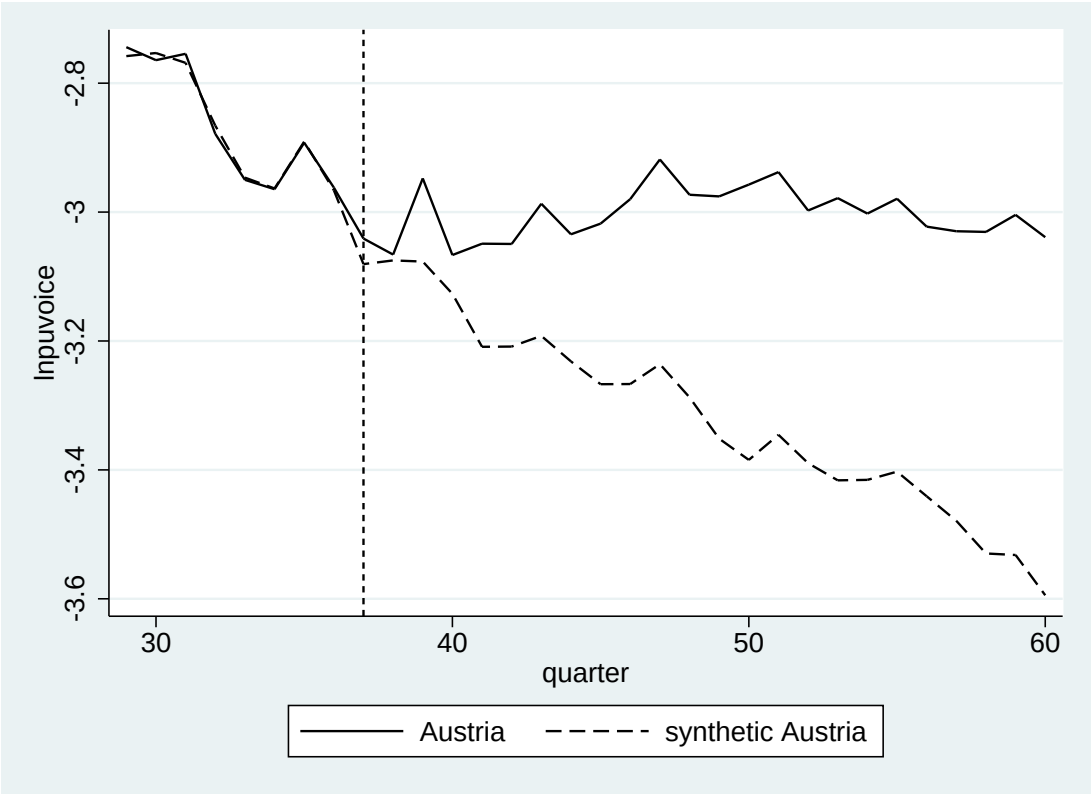

Figure 5 displays the impact of merger assessed by synthetic control regression for voice unitary price. By using the same counter-factual scenario, we compare the voice unitary price that resulted after the merger with the voice unitary price in the counter-factual scenario. We observe that the voice unitary price is significantly higher compared to the counter-factual scenario after merging.

6.3 Case of Germany Ireland and Norway

Similar to Austria merging case, We provide in a same regression for the merger of the three countries, Germany Ireland and Norway at close dates in 2014Q4, 2014Q3 and 2015Q1 respectively. We firstly present estimates from difference-in-differences regression, followed by synthetic control regressions as robustness checks.

Table 4: Difference-in-differences regressions for Germany Ireland and Norway

VARIABLES	lnpudata	lnpuvoice
DiD	-0.1217***	0.1803***
	(0.030)	(0.024)
merg_country	-23.3392***	-0.1527
	(1.787)	(0.996)
density	-63.2825***	0.7428
	(5.050)	(2.839)
GDPpcap	-1.3517	3.3957***
	(1.329)	(0.936)
country dummies	Y	Y
quarter dummies	Y	Y
Constant	21.7275***	-2.2414**
	(1.871)	(1.049)
Observations	608	608
R-squared	0.967	0.959
Robust standard errors in	parentheses	
*** p<0.01, ** p<0.05,	*p<0.1	

Table 3 approximates the merger effect by building a counter factual for Germany, Ireland and Norway based on the post-merger trend of same control countries than Austria case. DiD (difference-in-differences) between treated (with merger) and control countries (without merger) is also statistically significant. Data unitary price is decreased by an average of 12% in merging countries after merging event with respect to no-merging countries. Voice unitary price is increased by an average of 18% in merging countries after merging event with respect to no-merging countries.

Same robustness checks are performed for this case study by using synthetic control specification to overcome DiD assumptions.

Figure 6: Synthetic control regression for unitary data price of Germany_Ireland_Norway

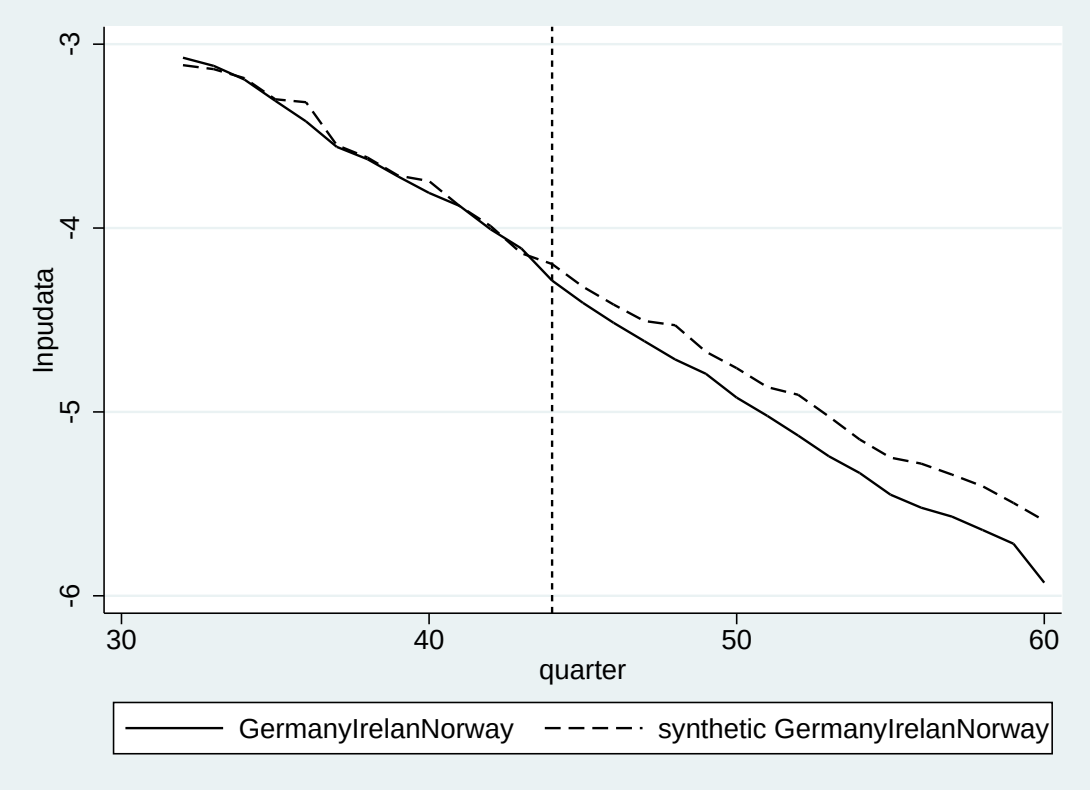

Figure 6 shows the impact of merger assessed by synthetic control regression. We use similar counter-factual scenario than the Austria case that the merger not taken place. By using weighted combination of no-merging countries, we compare the data unitary price that resulted after the merger with the data unitary price in the counter-factual scenario. Similar to Austria case, we observe that the data unitary price is lower compared to the counter-factual scenario after merging.

Figure 7: Synthetic control regression for unitary voice revenue of Germany_Ireland_Norway

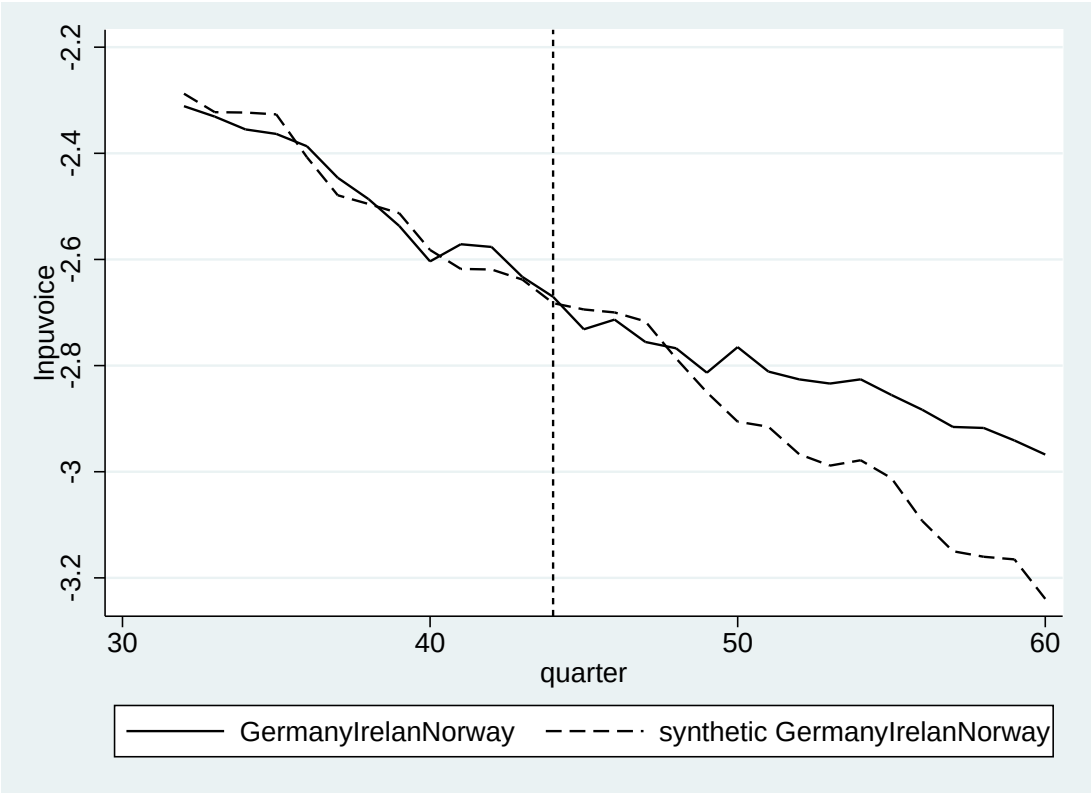

Figure 7 displays the impact of merger assessed by synthetic control regression for voice unitary price. We observe that the voice unitary price, similar to Austria case, is significantly higher compared to the counter-factual scenario after merging.

7 Conclusions of the causal analysis and policy implications

The aim of this paper is to assess the impact of mobile operators merger on unitary price of data and voice by using country-level observations on unitary data and voice price. A simple theoretical model predicts that mergers from 4-to-3 mobile operators tend to decrease data unitary price and increase voice unitary price, provided that technical progress is high enough for data services. In that case, the positive impact of dynamic efficiency outweigh the negative impact of static efficiency. The decrease in production costs involved by investment offsets the growth of margin involved by increased market power. We address also this issue by providing

empirical evidence on the impact of mergers. Consistent with the theoretical prediction, we find that 4-3 mergers tend to lower data unit price by an average of 17% for four merging countries after merging event with respect to no-merging countries. At the same time, voice unitary price is increased by an average of 22%. With the technological progress of the mobile network, data services are rapidly increasing, while voice services are decreasing. In the future, the decline in the data price could offset the growth of the voice price.

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Appendix

Following regressions include only one merging country in treated group. Estimations show similar merger impact. Except for Germany, no significant impact on data unitary price.

Table A-1: Difference-in-differences regressions for each merging country (Germany, Ireland and Norway) with lnpudata

VARIABLES	Germany lnpudata	Ireland lnpudata	Norway lnpudata
DiD	-0.0085	0.1180	-0.5926***
	(0.036)	(0.092)	(0.190)
merg_country	-10.8806***	-21.7070***	-23.6362***
	(0.846)	(1.644)	(1.861)
density	-68.6878***	-66.4776***	-66.5797***
	(5.873)	(5.443)	(5.626)
GDPpcap	-24.7703***	-16.0267***	-16.1297**
	(8.516)	(5.066)	(7.467)
country dummies	Y	Y	Y
quarter dummies	Y	Y	Y
Constant	24.7916***	23.5718***	23.6165***
	(2.373)	(2.091)	(2.239)
Observations	544	544	544
R-squared	0.965	0.964	0.965
Robust standard errors in	parentheses		
*** p<0.01, ** p<0.05,	*p<0.1		

Table A-2: Difference-in-differences regressions for each merging country (Germany, Ireland and Norway) with lnpuvoice

VARIABLES	Germany lnpuvoice	Ireland lnpuvoice	Norway lnpuvoice
DiD	0.3255***	-0.2210***	0.6063***
	(0.034)	(0.060)	(0.104)
merg_country	0.5435	0.7402	0.5183
	(0.429)	(0.900)	(1.006)
density	6.6279**	4.7332	5.3010*
	(3.019)	(3.006)	(2.992)
GDPpcap	26.5170***	18.1715***	20.3648***
	(4.235)	(2.980)	(3.939)
country dummies	Y	Y	Y
quarter dummies	Y	Y	Y
Constant	-5.4696***	-4.3777***	-4.6970***
	(1.188)	(1.151)	(1.169)
Observations	544	544	544
R-squared	0.961	0.960	0.961
Robust standard errors in	parentheses		
*** p<0.01, ** p<0.05,	*p<0.1		

Table A-3: Difference-in-differences regressions for all and each merging country (Germany, Ireland and Norway) with lnARPUdata

VARIABLES	4 mergers lnARPUdata	Austria lnARPUdata	Germany lnARPUdata	Ireland lnARPUdata	Norway lnARPUdata
DiD	-0.2537***	-0.2919***	-0.1709***	-0.3648***	0.1025
	(0.018)	(0.043)	(0.022)	(0.069)	(0.084)
merg_country	-2.5528***	-1.8900***	-1.5323***	-3.4330***	-3.6119***
	(0.436)	(0.433)	(0.379)	(0.822)	(0.913)
density	-13.4747***	-8.8745***	-8.6914***	-12.4652***	-9.5346***
	(2.707)	(2.677)	(2.667)	(2.750)	(2.664)
GDPpcap	1.1260	19.4019***	19.1060***	5.0684	16.2421***
	(0.865)	(3.425)	(3.461)	(3.334)	(3.145)
country dummies	Y	Y	Y	Y	Y
quarter dummies	Y	Y	Y	Y	Y
Constant	5.5326***	3.5087***	4.3061***	6.3517***	4.7486***
	(0.712)	(0.758)	(1.034)	(1.058)	(1.022)
Observations	640	544	544	544	544
R-squared	0.977	0.975	0.975	0.975	0.978
Robust standard	errors in	parentheses			
*** p<0.01, **	p<0.05,	*p<0.1			