Efficiency Gains, Remedies, and Internalization of Rivalry: Product Level Evidence from a Mobile Telecom Merger*

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Abstract

This paper empirically investigates merger price effects through three channels – efficiency gains, remedies and internalization of rivalry. To disentangle channels, we exploit product level differences in the applicability of each channel for an arguably exogenous merger in the Norwegian mobile telecommunications market. We find that there were upward price effects from internalization of rivalry. However, for products affected by remedies, downward price effects reduced or neutralized the upward price pressure from internalization of rivalry. Moreover, efficiency gains contributed to a decrease in prices for products where this could be expected. Overall, we find no significant price effect of the merger on the average price paid by consumers across all products. The results underline that mergers may have heterogeneous effects across affected products and provide important feedback for merger control regarding the effectiveness of remedies and presence of efficiency gains.

JEL classification: D22, L11, L13, L42, L96

Keywords: Merger analysis, antitrust, merger efficiency, telecommunication

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1 Introduction

Horizontal mergers in concentrated markets may reduce competition and harm consumers through higher prices, lower product quality, and less innovation. For this reason, mergers that impede effective competition are prohibited in most jurisdictions, and competition authorities often conduct ex-ante merger investigations of notified mergers. These investigations assess potential anti-competitive effects against potential pro-competitive efficiency gains and remedies proposed by the merging parties.[1] The recent of decisions of the Court of Justice of the European Union regarding the acquisition of Telefonica UK by Hutchison 3G UK emphasizes that merger specific efficiencies must be substantiated. In July 2023, the Court of Justice overturned the decisions of the General Court to allow the previously blocked merger, criticizing, among other things, that the General Court falsely had assumed that all mergers lead to efficiencies.[2] Despite the apparent importance of the topic, there is little empirical evidence on the relative size of various channels for price effects of mergers.

In this paper, we empirically identify unilateral price effects that may occur in a merger due to the three key factors in merger evaluation: internalization of rivalry from past competitors, efficiency gains due to marginal costs reductions, and increased competition resulting from remedies. The subject of our study is Telia Company's (henceforth Telia's) acquisition of Tele2 in the Norwegian mobile telecom market in 2015.[3] Before the merger, the parties were the second- and

[1] See e.g., the horizontal merger guidelines of the European Commission (2004).

[2] Court of Justice of the European Union, Judgment in Case C-376/20 P - Commission v CK Telecoms UK Investments, 13 July 2023, paragraph 246.

[3] Before changing its name to Telia Company in 2016, Telia operated under the name TeliaSonera.

third-largest players, respectively, and the merger was approved by the Norwegian Competition Authority conditional on substantial remedies to facilitate the entry and strengthen the rival provider ICE. The trigger for this merger, that would result in two companies (Telenor and Telia) jointly controlling 96 percent of the market, was a shock to Tele2's costs. Prior to the merger Tele2 was operating its own network covering roughly 50 percent of the traffic of its customers. Tele2 did not win frequency rights in an auction in December of 2013, which meant that the firm lost the ability to operate its own network from October 2014. Thus, absent the merger Tele2 would have a significant increase in marginal costs from renting access to other operators' network.

To study the various effects of the merger we exploit differences in the degree to which the differentiated products directly involved in the merger were exposed to the three channels.[4] The products are various brands[5] owned by the merging parties: (i) OneCall, originally a budget-oriented Tele2 brand continued after the merger; (ii) Chess, a budget-oriented Telia brand continued after the merger; and (iii) NetCom, a premium Telia brand also continued after the merger. Tele2 also owned another brand (named "Tele2", henceforth Tele2-brand), which was discontinued after the merger and whose customers were migrated to NetCom. The key differences for these brands are in the possible efficiency gains, and the likely impact of remedies on each product. Obvious efficiency only applied to the Tele2's brands since Tele2 had a large drop in marginal costs when it gained direct access to Telia's network and no longer had to rent access to a third-party net for the 50

[4]We focus on the price effects in the residential segment. The majority of business customers of Tele2 were sold to the rival ICE as part of the remedies imposed by the competition authority. The business segment is therefore of less relevance in this merger.

[5]For the purpose of this study we use the terms product and brand interchangeably.

percent of traffic not covered by its own network. Furthermore, the effect of the remedy of strengthening the rival ICE on the different products depends on the closeness of substitution between these and ICE. As ICE is a budget brand it would predominantly exercise competitive pressure on the budget products OneCall and Chess.

Using this information, we are able to shed light on the contribution of each of the three factors determining the net price-effect of the merger. First, since Chess and OneCall are similar products, they are similarly exposed to the effects of remedies and internalization of rivalry, such that the difference between the two identifies the efficiency gains. Second, since there are no obvious efficiency gains to be expected for Chess, the price effect for Chess indicates the relative size of the effects of the remedies and internalized rivalry on the budget segment of the market. Finally, effects of efficiency gains and remedies were expected to be relatively weak for the premium segment. The price effect for NetCom therefore provides an estimate of the internalization of rivalry effect.

To empirically identify price effects at the brand level, we apply a difference-in-differences (DiD) approach, where we compare the prices of Telia- and Tele2-owned brands in Norway (treated group) with Telia's prices in other Nordic countries as a reference group. The study is based on a unique dataset of accounting data from Telia with monthly observations of the number of customers, revenues, and consumption from Telia in Norway, Sweden, Denmark, and Finland.

Our results indicate that OneCall's prices decreased by between 7 and 13 percent following the merger. For NetCom, the premium brand, we find that prices likely increased by between 6 and 9 percent. For Chess, we find some indication of negative price effects of 6-7 percent in the long term (second year after the

merger). For the total of all Telia and Tele2 customers of the involved brands, we do not find robust evidence of price effects of the merger in either direction.

Combining these results with the information on how brands are expected to be affected differently by efficiency gains and remedies we can identify the contribution of the different causes of the merger price effects. First, the difference between the effects for OneCall and Chess suggests that efficiency gains contributed around 5 percentage points (40 percent) to OneCall's price reduction. Second, the findings for Chess suggest that the impact of remedies was substantial and more than offset the effects from internalized rivalry on the budget segment of the market in the long run. This is also supported by the fact that it took time for the negative effect for Chess to materialize which is consistent with remedies having an increasing impact over time as ICE would need time to establish itself as an efficient rival in the budget segment.[6] Finally, the price increase found for NetCom thus suggests that there were also substantial effects from internalization of rivalry. On aggregate (i.e., across all consumers directly affected by the merger) the three effects of the merger on prices seem to have neutralized each other.

Our paper contributes to a growing literature on the ex-post analysis of mergers within a diverse set of industries.[7] A recent wave of ex-post analyses has also focused on telecom mergers in Europe (e.g., RTR-GmbH, 2016, Lear et al., 2017,

[6]Since ICE entered the market at the same time as the merger was conducted, the entry effect cannot be clearly distinguished from the remedy effect. However, it appears unlikely that ICE would have been able to grow quickly and exercise significant competitive pressure on the budget segment without the remedies which provided it with critical network infrastructure to operate as a partial mobile network operator, wholesale access at guaranteed conditions, and a business customer portfolio as a base for expansion in the private segment. The result for Chess thus provides a reasonable estimate of the net effects of internalization vs. remedies.

[7]Just to name a few, publications cover industries such as banking (Focarelli and Panetta, 2003a), beer (Ashenfelter et al., 2015; Miller and Weinberg, 2017), manufacturing (Ashenfelter et al., 2013), media (Fan, 2013), airlines (Bilotkach, 2011), hospitals (Dafny, 2009), pharmaceuticals (Björnerstedt and Verboven, 2016), and retailers (Aguzzoni et al., 2013; Pires T., 2018).

BEREC, 2018, Aguzzoni et al., 2018 and Grajek et al., 2019).[8] Our approach departs from these studies on ex-post merger effects in telecom and other markets, by studying the price effects on the different brands, which allows us to disentangle various causes of unilateral price effects. Also, ex-post merger analyses based on comparisons between markets with a merger to markets without a merger have been criticized since mergers may be endogenous to market features (i.e., mergers tend to be "unnatural experiments" Besley and Case, 2000). The Telia/Tele2 merger was the consequence of an exogenous shock to Tele2's costs (a surprise outcome of a sealed-bid spectrum auction) and the endogeneity of mergers is therefore less of a concern in our case.

The disentangling of the effects of increased concentration, efficiency gains and remedies on prices is a key contribution to the literature. The only other studies that we are aware of that provide direct empirical evidence of the merger price effects due to efficiency gains are Rickert et al. (2021) and Ashenfelter et al. (2015).[9] Ashenfelter et al. (2015) separate efficiency gains and effects from internalization of rivalry following the merger between brewers Miller and Coors in the US, exploiting differences in efficiency gains in transport costs (with distances as proxy for costs). Rickert et al. (2021) on the other hand investigate concentration, efficiency and remedy effects in the German grocery retail market, exploiting geographic variation in the merger to disentangle effects. Our study focuses on a very different market and exploits a different strategy to disentangle the various sources

[8] We discuss some of these papers in more detail in Section 3, where we describe the data used in our analysis.

[9] Other studies, such as Focarelli and Panetta (2003b), have only indirectly measured efficiency gains arguing that the long-run effects relative to short run effects reveal efficiency gains since these take time to materialize. Again others focus only on efficiencies such as the DiD study by Charpin and Piechucka (2021) or the structural model simulation by Grieco et al. (2018), but do not illuminate price effects and their different channels.

of price effects that exploits variation between brands involved in the merger regarding potential reduction in marginal costs and affects of remedies. Our study based on an exogenous merger in a highly concentrated market thus provides new insights into several causes of merger-price effects, including efficiency gains and remedies.

Our paper also connects to the theoretical literature on ex-ante analyses which provides tools to separate and quantify the relevant channels of price effects. In particular, the "Upward Pricing Pressure" (UPP) framework quantifies first-round (ceteris paribus) price incentives from internalization of rivalry, and quantifies the marginal cost reduction (efficiency gain) necessary to restore pre-merger prices (Werden, 1996; Farrell and Shapiro, 2010). The framework has also been extended to estimate equilibrium price effects (Hausman et al., 2011), and price effects from changes in vertical relations (Moresi and Salop, 2013; Asphjell et al., 2017; Bergh et al., 2020). Tools to estimate and quantify remedy effects are largely absent from this literature, and these are generally challenging to assess. Thus, ex-ante evaluations on likely price effects from remedies must in part be evaluated from empirical evidence of past mergers.

The remainder of the paper is structured as follows. Section 2 explains the details of the Telia/Tele2 transaction and discusses the ex-ante expected price effects, providing predictions for the empirical analysis. Section 3 describes the data. Our empirical strategy is described in Section 4, while results are discussed in Section 5. Robustness analyses and analyses of the timing of effects are presented in Section 6. Section 7 concludes.

2 Details of the merger

In this section, we describe the background for the merger, including characteristics of and events in the Norwegian market for mobile communications. We then discuss the price effects that could be expected ex-ante and how known differences on the product level may be exploited to identify different merger effects.

2.1 Involved products, market shares, and remedies

In the year preceding the merger, there were three main operators in the Norwegian mobile telecom market. In 2014, Telia had a market share of approximately 27 percent in revenues. Tele2 had a market share of approximately 24 percent. The largest operator, Telenor, had a market share of 45 percent.[10] The three main operators all had their own networks, but network coverage differed. Telenor's and Telia's networks covered close to the entire Norwegian population. Tele2's network covered approximately half of the population. In areas with insufficient coverage, Tele2 rented access to the networks of Telia and Telenor (different brands under Tele2 had agreements with different operators).

In a sealed-bid mobile frequency auction in December 2013, Tele2 lost its right to transmit within the 900 MHz band, and was not awarded any new rights to frequencies. This meant that Tele2 was unable to use GSM (2G) and LTE (3G) technologies over its cellular network and was in practice excluded from operating as an independent mobile operator. ICE, a small operator without a network, won several rights to frequency in the auction.

[10]Information on market shares comes from the decision by the Norwegian Competition Authority (public version of the decision (Norwegian language): https://konkurransetilsynet.no/decisions/1232-v2015-1/).

Telia sought to acquire Tele2 in July 2014, and the acquisition was cleared in February 2015 by the Norwegian Competition Authority, conditional on several remedies meant to counteract concerns of anti-competitive effects of the merger.[11] The remedies, both structural and behavioral, were designed to increase the competitiveness of the newcomer, ICE. The most significant remedies were (i) transfer of Tele2's mobile network to ICE, (ii) transfer of Network Norway's customer portfolio to ICE (approximately two-thirds of Tele2's business portfolio), (iii) commitment to offer wholesale access to Telia's network to ICE at predetermined conditions, and (iv) network co-location offered to ICE (to reduce the costs of ICE's network investments).[12]

The two companies that would later merge, Telia and Tele2, offered mobile services under various brand names. Telia offered the brands NetCom and Chess, of which NetCom had offerings within both the residential and business segments, while Chess was a purely residential brand. Tele2 offered the brands Tele2 (henceforth Tele2-brand), Network Norway, OneCall, and MyCall. The Tele2-brand had offerings within both the residential and business segments, Network Norway was purely a business brand, and OneCall and MyCall were purely residential brands. Table 1 provides a summary of the brands involved in the merger.

After the merger, the Tele2-brand was discontinued and its customers were migrated to NetCom. The brands OneCall and MyCall were continued under Telia's ownership. MyCall is a niche brand specializing in international calls and we therefore do not report results on MyCall in the analysis. However, including MyCall does not change our main findings.[13]

[11] See the public version of the decision.
[12] Co-location means that ICE could install radio transmitters on cell towers owned by Telia.
[13] Results available on request.

Table 1: Brands involved in the merger

Brand	**Explanation**	**Customers in Jan. 2015***
Telia:		
NetCom	Continued. Tele2-brand customers transferred to NetCom.	710,000
Chess	Continued. No changes in customer portfolio.	360,000
Tele2:		
Tele2 (brand)	Discontinued. Customers transferred to NetCom.	320,000
OneCall	Continued. No changes in customer portfolio.	430,000
MyCall	Continued. No changes in customer portfolio.	230,000
Network Norway**	Discontinued. Customers sold to ICE as part of the remedies.	90,000

*Month before the merger. Numbers rounded to nearest ten-thousand.
**Network Norway had customers only in the business segment which is not subject of this analysis.

2.2 Expected price effects

From a theoretical ex-ante perspective, the merger has multiple counteracting effects on prices. This leads to different predictions of the price effects on both the company and the brand level. The three most important effects relate to (i) the internalization of rivalry, (ii) efficiency gains from reductions in marginal costs for Tele2, and (iii) remedies designed to make ICE a stronger rival. Below we briefly discuss these three effects verbally. A simple presentation of the theoretical foundations for the effects can be found in Appendix A.

The internalization of the rivalry between Telia and Tele2 is expected to lead to a substantial upward pricing pressure. In its investigation, the NCA estimated diversion ratios to the respective other merging party of around 30 percent for both Telia and Tele2. Combined with high margins, this indicates that Telia and Tele2 were close competitors, meaning that the merging firms have incentive to

raise prices after the merger.[14] Large efficiency gains are expected for Tele2 as it became fully integrated in Telia, which reduced marginal costs by eliminated network access fees Tele2 had to pay as a mobile virtual network operator (i.e., an operator that does not have its own telecommunication network, henceforth MVNO) in the counterfactual situation. Efficiency gains were also substantial relative to the pre-merger situation, where Tele2 operated as a partial MVNO. This reduction in marginal costs creates incentives to compete more aggressively and to lower retail prices. Finally, through remedies the merger helped establish ICE as a stronger competitor. This increased competitive pressure on the merging parties and thus caused downward pressure on prices.

These three effects are of different relevance for the different brands involved in the merger. The efficiency gains only apply to the Tele2 brands (OneCall and the Tele2-brand) but not to NetCom or Chess. Moreover, the effects of internalization of rivalry and the impact of remedies depend on the extent to which the brands compete for the same customers. Figure 1 illustrates the closeness of competition by showing the location of the relevant brands on a budget-to-premium scale. Since OneCall and Chess are similar products one can expect non-negligible incentive to increase prices (internalization of rivalry effect) from the merger. However, since they are also close competitors to ICE, we expect reduced demand and downward pressure on prices through the rivalry with ICE (remedy effect). The Tele2-brand and NetCom are close competitors in the more premium segment, implying non-negligible internalization of rivalry effects but little effects from the remedies strengthening the low budget competitor ICE.

[14] After the merger, a significant share of sales diverted by increased prices is expected to be recaptured by the other merging party.

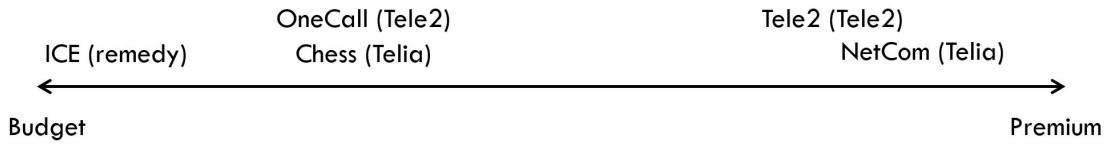


Figure 1: Illustration of the location of the consumer brands of Tele2 and Telia involved in the merger and ICE on a budget-to-premium scale (Telenor, the incumbent, is present in all segments).

Combining the known differences in products with the fact that the efficiency gains only applied to Tele2's products allows us to separate and identify the different merger effects. First, the merger is expected to have similar effects on One Call and Chess through the internalization of rivalry and the remedies but obvious efficiency gains in marginal costs only are present for OneCall. The difference in the net price effect of the two brands thus approximately reflects the effect of the efficiency gain on prices.

Second, as Chess was only directly affected by the internalization of rivalry and increased competition from ICE (remedy), the sign of the net price effect for Chess provides information on which of the two dominated.[15] A potential challenge for identification is that ICE entered the mobile phone market around the time as the merger was conducted. The entry effect can therefore not clearly be distinguished from the remedy effect. However, it appears unlikely that ICE would have been able to grow quickly and exercise significant competitive pressure on the budget segment without the remedies, which provided it with critical network infrastructure to operate as a partial MNO, wholesale access to Telia's network at guaranteed conditions, and a portfolio of business customers as a base for expansion in the private segment. The effect of the merger on Chess thus provides a reasonable

[15]This is provided that feedback effects and effects from recalibration in prices are not too large.

estimate of the net effects of internalization vs. remedies in the budget segment.

Finally, since NetCom and Tele2-brand were close rivals, the merger is expected to lead to a non-negligible incentive to increase prices through the internalization of rivalry for NetCom. As the Tele2-brand was discontinued and integrated into NetCom after the merger, there are no substantial efficiency gains to be expected for NetCom. Moreover, while remedies in the budget segment may have some knock on effect on the premium brand NetCom these are likely small. The effect of the merger on NetCom prices can therefore be seen as an estimate of the internalization of rivalry effect.

Table 2 provides an overview of the discussed ex-ante expected price effects from the merger.

Table 2: Summary of expected price effects for the brands involved in the merger

Brand	**Competition**	**Eff. gain**	**Remedies**	**Net price effect**
OneCall	upward	strong downward	strong downward	downward
Chess	upward	neutral	strong downward	uncertain
NetCom+Tele2	upward	weak downward	weak downward	uncertain
All brands	upward	downward	downward	uncertain

3 Data

Our analysis uses a unique data set based on income statements with monthly observations for Telia in Norway, Sweden, Denmark, and Finland for the period January 2013 until December 2016 (i.e., a pre-merger period of 25 months and a post-merger period of 22 months, with one month being the merger period). We also have income statements for Tele2 in Norway in the pre-merger period. For simplicity, we will sometimes refer to the four countries as the Nordic countries,

and to Denmark, Finland, and Sweden as the other Nordic countries – in contrast to Norway, where the merger took place.[16]

The income statements include billed revenues and number of subscribers, which can be used to calculate average revenue per user (ARPU) as proxy for prices (see below). In addition, the income statements include consumption data, which we will use to control for data usage.

For Sweden, Denmark, and Finland, we have aggregate data for Telia's residential segment. For Norway, the data are split among the residential brands NetCom, Tele2-brand, OneCall, and Chess. Brand-level data for NetCom and aggregates for Telia are subject to portfolio composition effects in connection with the merger. When Telia acquired Tele2, the composition of customers in Telia's portfolio changed, because the Tele2-brand was discontinued and its customers were transferred to NetCom.[17] To avoid our results picking up potential portfolio composition effects, we construct a unit of observation (brand) that aggregates data for NetCom and the Tele2-brand before the merger. We will refer to this constructed brand henceforth as NetCom+Tele2. To construct a series for the aggregate residential sector of Telia and Tele2-brand, we sum all the involved brands over the entire period of the study (i.e., NetCom, Chess, Tele2-brand, and OneCall). Through this aggregation, we measure prices for the average customer of the merging parties.

[16]We are fully aware that the Nordic countries also include Iceland.

[17]The customers who were transferred could keep their old Tele2-brand price plan under new ownership.

3.1 Price measure

Measuring prices in mobile telecoms is challenging, as the operators have several ways of generating revenue from their customers. The final price paid by consumers depends on several components, including a monthly fixed price on consumption bundles, tariffs for consumption exceeding the included bundle, foreign roaming fees, hardware sales, additional services (handset insurance, free music streaming, etc.), and discounts and other benefits to new subscribers.

In the literature, we find two types of approaches to measure prices. The first uses ARPU as a price measure (e.g., Hausman and Ros, 2013; Affeldt and Nitsche, 2014; Lear et al., 2017). The second alternative is the price basket approach, which aims to construct representative (average) consumption baskets and prices them based on the list prices of the most popular products (e.g., RTR-GmbH (2016), BEREC (2018), Aguzzoni et al. (2018), and Lear et al. (2017).

Both approaches have their advantages and disadvantages. However, the price basket approach with its fixed consumption baskets is problematic in light of rapidly changing consumption patterns in mobile telecom services (c.f. Affeldt and Nitsche, 2014). Furthermore, it does not capture price discounts and campaigns, which constitute a significant part of pricing and competition for new customers in the mobile telecom market.

We argue therefore that billed[18] ARPU is the preferable price for the analyses in the present paper. The ARPU approach is *close to reality*, as it reflects the actual average prices the consumers pay, including discounts and introduction offers. Moreover, using ARPU ensures *consistency* with ex-ante merger analysis

[18]I.e., non-billed revenues, such as termination fees, are not included.

conducted by competition authorities, where ARPU is used as a proxy for prices.[19] The issue that ARPU may be affected by changes in usage patterns, in particular increasing data usage in the period of the merger, can be addressed by controlling for these changes (c.f. Affeldt and Nitsche, 2014). To the extent that these changes develop in parallel in the Nordic countries, our difference-in-differences approach will resolve the issue. Moreover, we present results where we control for data usage to address the issue directly.

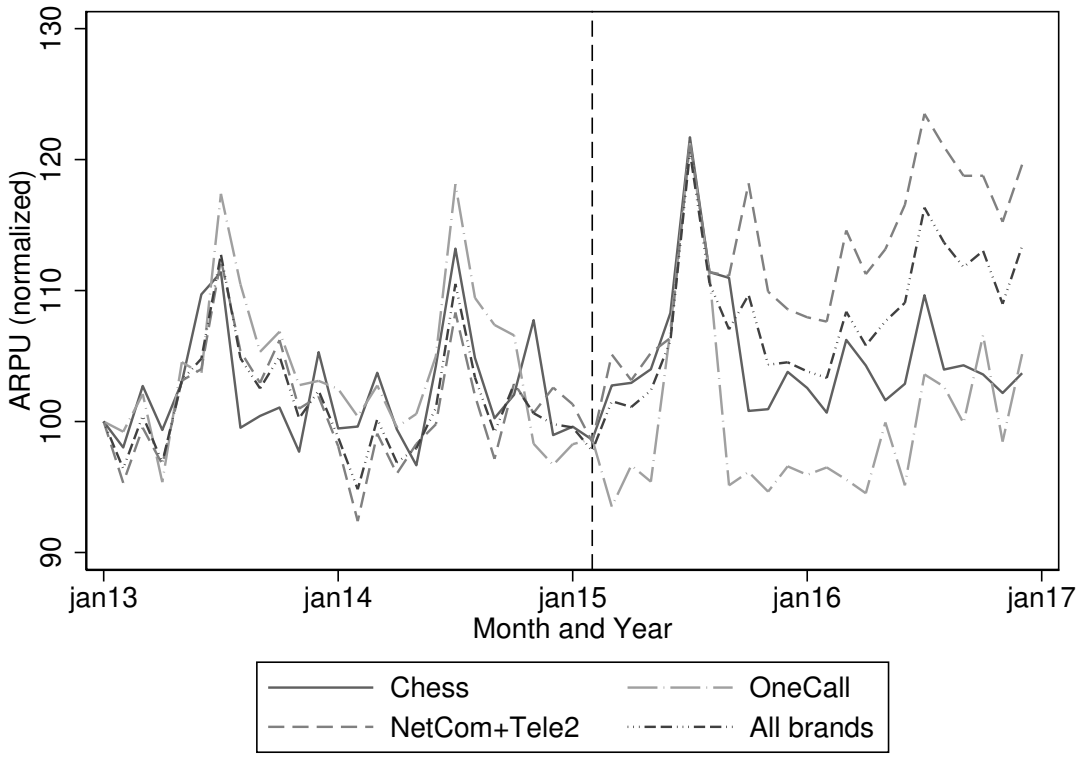
3.2 Price development in Norway

Figure 2 shows the price development for the brands of Telia and Tele2 in Norway. We have normalized ARPU to 100 in January 2013 (the beginning of our sample period) for each brand/all brands. Before the merger (February 2015, marked by the dashed line in Figure 2), prices for the three brands and the total of all brands develop similarly.[20] After the merger, the ARPUs for the different brands clearly diverge. OneCall's ARPU is generally lower in the period after the merger, whereas that of Chess remains at roughly the same level, possibly with small increases. The ARPU of NetCom+Tele2 appears to have increased after the merger. This divergence in the price developments is largely consistent with the prediction of differential price effects for different brands summarized in Section 2.2. The figure thus clearly indicates that the merger had different impacts on prices for the different brands.

The marked spikes in ARPU in the summer months of the years 2013–2015

[19] See e.g., Section 3.3.2 of European Commission (2016), Case M.7612 - Hutchison 3G UK/Telefonica UK.

[20] ARPU for all brands is effectively a weighted average of the brand ARPUs. Since NetCom+Tele2 has by far the largest number of customers (see Table 1), it has a relatively high influence on the aggregate price.



ARPU is normalized to 100 in January 2013 for each series. The dashed line indicates the time of the merger.

Figure 2: ARPU for Chess, OneCall, NetCom+Tele2, and all brands in Norway.

are due to increased revenues from foreign roaming. Summer holidays in Norway are very concentrated in July and August. This marked increase in ARPU is not present (less marked) in 2016, which is the summer after which new EU regulation forbade roaming fees for roaming within the European Economic Area.[21]

[21]In summer 2015, we observe a particularly high spike for OneCall. This may be connected to a potential inconsistency of data for OneCall during the summer months in 2015 that may stem from errors when integrating Tele2's accounts into TeliaSonera's accounting system at that time. See also section 6.

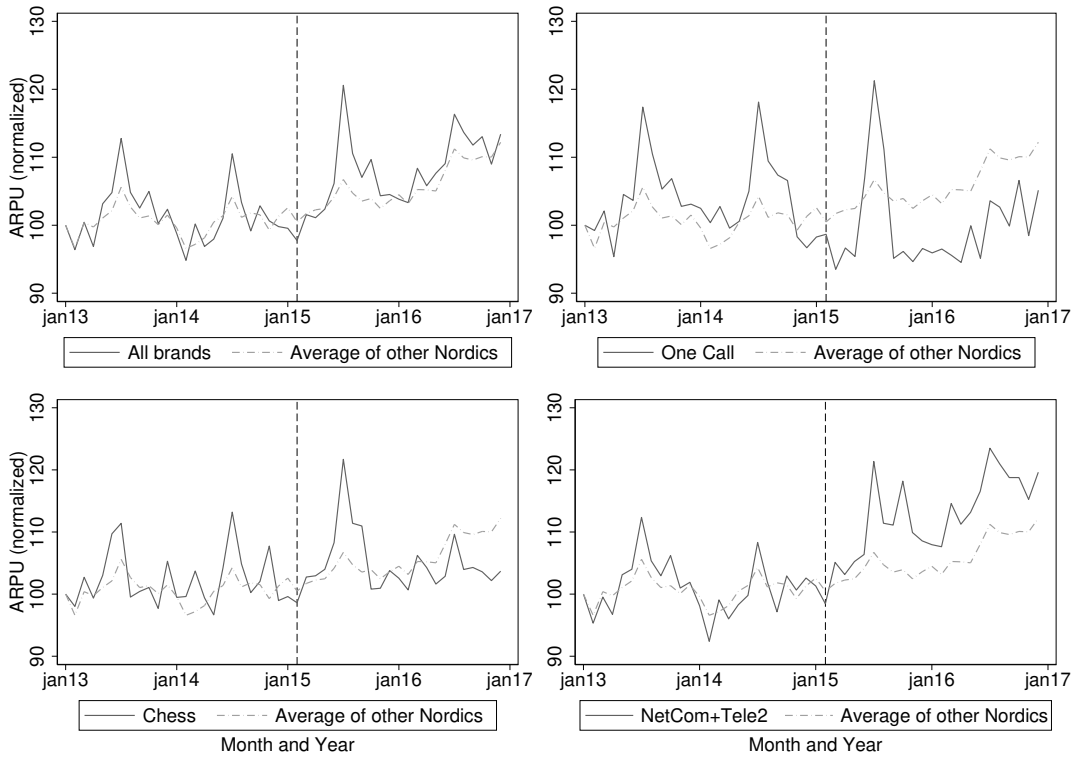
4 Empirical strategy

The price effect of the merger is the difference between the actual price that we observe in the market and a counterfactual price that would have prevailed absent the merger. To establish a counterfactual situation and estimate the merger price effect, we employ a difference-in-differences strategy. The core idea of the DiD model, applied to merger price effects, is to compare the development of prices in the market that is affected by the merger (the treated market) with prices in similar markets that are unaffected by the merger (the control markets). The underlying assumption necessary for identification of causal effects is that prices in the merger market would have developed in the same way as the average price in the comparison markets. Economically, that means that (unobservable) time-varying price determinants, other than the merger, develop similarly in the treated and control markets (on average).

Our empirical strategy implies a counterfactual for Norway that is similar to the pre-merger market structure. In the pre-merger period, Tele2 is still operating its own network. Our results thus reflect the price effects of a merger from three to two major operators with their own network (including the effects of remedies) and are therefore relevant for the understanding of such mergers.

We use the development of prices for Telia in three other Nordic countries – Denmark, Finland, and Sweden – as counterfactual. These other Nordic countries share many characteristics with Norway and their markets can therefore (a priori) be assumed to be relatively similar and fulfill the assumption of the DiD model. No mergers or significant structural changes have occurred in the other Nordic countries during the period we analyze.

We begin our analysis with a visual inspection. Figure 3 shows the average ARPU for Telia in Denmark, Finland, and Sweden against ARPU in Norway. The dashed vertical lines indicate the time of the merger (February 2015).The upper-left quadrant displays the aggregated normalized ARPU for all brands in Norway against the average of normalized ARPU in the other Nordic countries. The other three quadrants display the normalized ARPU at the brand level for Norway against the average of the other Nordic countries.



ARPU is normalized to 100 in January 2013 for each series. The dashed line indicates the time of the merger.

Figure 3: ARPU for OneCall, Chess, NetCom+Tele2, and all brands in Norway, compared to the average of Telia in other Nordic countries.

Before the merger the average ARPU in the other Nordic countries follows the

same long term-trend as prices in Norway. Also for the three brands separately, we observe no clear difference in the long-term price trend in the pre-merger period in Norway compared to the trend of the average price in other Nordic countries. The similarity of trends in the pre-merger period in the treated country (Norway) and the average of the control group (other Nordic countries) is the identification assumption of the DiD model. The visual inspection thus provides a first indication that the average of the other Nordic countries can be used as a counterfactual for price development in Norway (we will further explore this issue below).

Figure 3 also indicates the merger effects. After the merger, prices for the aggregate of all brands in Norway appear slightly higher than average normalized prices in the other Nordic countries. Nonetheless, the graphical analysis does not suggest a clear merger effect on overall prices. Prices for Chess do not appear to depart substantially from those of the other Nordic countries immediately after the merger, but we observe a somewhat smaller price increase for Chess in 2016. In contrast, after the merger, we can observe clear differences for OneCall and NetCom+Tele2 compared to the other Nordic countries. For NetCom+Tele2, prices appear to increase immediately after the merger before stabilizing at a higher level. For OneCall, the development is the opposite: Prices decrease after the merger and appear to stabilize below the average price of the other Nordic countries.

The visual inspection in this section gives a good indication of the merger's differential effects on prices for different brands. These observed price effects are also roughly in line with the direction predicted by the ex-ante analysis. However, a visual inspection is limited. We therefore use an econometric application of the DiD model in order to further investigate the merger prices effects. The next section describes this model.

4.1 Econometric model

We are interested in estimating the effects of the merger on prices. In order to distinguish short-run from long-run effects, we separately estimate effects in the first and second years after the merger. Formally, we can write the difference-in-difference model as the following regression equation:

$$ln(ARPU_{i,j,t}) = \mu_i + \tau_t + \gamma^1 D_{i,j,t}^{ShortRun} + \gamma^2 D_{i,j,t}^{LongRun} + X'_{i,j,t}\beta + \varepsilon_{i,j,t} \ , \qquad (1)$$

where i indicates the country, j the brand, and t the period (identified by month and year). μ_i is a country fixed effect, τ_t a time fixed effect, $X_{i,j,t}$ a vector of control variable, and $\varepsilon_{i,j,t}$ is the error term. We estimate the equation by OLS and report standard errors that are robust to heteroscedasticity (robust standard errors).[22]

The key variables $D^{ShortRun}$ and $D^{LongRun}$ are two dummy variables that take the value 1 in the first and second years after the merger (February 2015), respectively, in Norway. Thus, γ^1 and γ^2 are the effects of the merger in the short and in the long run.

The common trends assumption. The key assumption of the DiD approach is that the trends of prices (conditional on observables) are the same in Norway as the average of the other Nordic countries. A visual analysis in Figure 3 indicates that the asumption likely holds. However, since the common trend assumption

[22]Basing inference on robust standard errors (Huber-White standard errors) is not entirely innocuous. In most DiD models, there is a potential concern of serial correlation in the error terms for a given group (country, in our case). This may lead to problems of power and size. In applications with few groups, such as our case (four groups), there is no optimal solution for correcting standard errors for these problems. Using Huber-White standard errors for inference when discussing the main results is a pragmatic approach to this challenge. In Appendix B.2, we discuss issues of inference in more detail and present alternative standard errors, confirming the robustness of our main findings.

is the key to identification of causal effects, we apply several checks, including a formal test of the assumption, which will substantiate that the common trend assumption holds.[23]

5 Main Results

This section presents and discusses the main findings for different brands and the aggregate for all investigated Telia and Tele2 brands (all brands) in Norway. Table 3 presents the main results. Columns 1–2 show the estimates for OneCall, columns 3–4 for Chess, columns 5–6 for NetCom+Tele2, and columns 7–8 for all brands. Odd-numbered columns contain estimates from a baseline model including country and month fixed effects. In even numbered columns, we add additional variables in order to control for several country-specific factors that can affect price levels. These are GDP per capita growth, the log of data usage, and a dummy for summers in Norway from 2013 to 2015.[24] Throughout, we separately estimate the short-run (first-year) and long-run (second-year) effects.

The test for the common trend assumption indicates that we cannot reject the

[23]The formal test of the common trend assumption we employ follows Aguzzoni et al. (2018) and is inspired by the test suggested by Angrist and Pischke (2009) and Ashenfelter et al. (2013). The test is conducted by replacing the two treatment dummies with dummies for each quarter, before and after the merger (excluding the first quarter in the data set), that take the value 1 only for the treated country. We then estimate the slope of a linear trend of the estimated coefficients of all pre-treatment quarters. This slope captures differences in the trend in the treated country's price to the trend in the average price in the control countries during the pre-treatment period. A two-sided test of the significance of this test therefore amounts to a test of common trends. A failure to reject the null hypothesis of this test is interpreted as a non-violation of the common trend assumption. In addition, the estimates of the pre-treatment effects provide a placebo test (this is the test suggested by test suggested by Angrist and Pischke, 2009 Ashenfelter et al., 2013 - see Section 6 and Appendix B.1).

[24]The OECD Database is the source of consumer price indices and GDP per capita. GDP data are only available at quarterly observations, and we therefore interpolate the data linearly when we use GPD per capita as a control variable.

null hypothesis of common trends. This holds for all brands and specifications in Table 3. Hence, the test suggests that the identification assumption of the DiD model is not violated and the model identifies the merger effect.

For OneCall (columns 1–2), we find that the merger leads to a statistically significant reduction in prices. The magnitude of the estimated effect is around 7 percent in the short run (first-year) and 12 to 13 percent in the long run (second-year). This is a sizable price reduction. Moreover, the results indicate that the effect of the merger increases over time. The price reduction after the merger is in line with the predictions from the ex-ante analysis. The findings indicate that the efficiency gains and remedies (establishing ICE as stronger rival) more than outweighed the effects of eliminating competition with Telia on OneCall's prices.

Table 3: Main Results – Difference-in-Differences Estimates

	OneCall		Chess		NetCom+Tele2		All brands	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1st-year Effect	-0.0735***	-0.0703***	0.0015	0.0046	0.0462***	0.0507***	0.0121	0.0154
	(0.0234)	(0.0229)	(0.0183)	(0.0203)	(0.0166)	(0.0171)	(0.0163)	(0.0150)
2nd-year Effect	-0.1314***	-0.1198***	-0.0763***	-0.0689**	0.0486***	0.0592***	-0.0095	-0.0003
	(0.0193)	(0.0249)	(0.0192)	(0.0320)	(0.0177)	(0.0197)	(0.0174)	(0.0174)
GDP pc growth		0.0111		0.0094		0.0034		0.0063
		(0.0108)		(0.0106)		(0.0101)		(0.0102)
Log data per user		-0.0032		-0.0022		-0.0215		-0.0205
		(0.0515)		(0.0523)		(0.0559)		(0.0576)
Summer in Norway		0.1115***		0.0670**		0.0507*		0.0657**
		(0.0307)		(0.0277)		(0.0273)		(0.0269)
Common trend test	passed	passed	passed	passed	passed	passed	passed	passed
(p-value)	(0.986)	(0.793)	(0.704)	(0.556)	(0.835)	(0.674)	(0.776)	(0.603)
Observations	188	188	188	188	188	188	188	188
Adjusted R^2	0.76 0.67	0.76 0.68	0.66	0.66	0.67	0.67	0.67	0.67

Robust standard errors in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications control for country and month fixed effects.

The results for Chess (columns 3–4) indicate no effect of the merger in the short run, but a statistically significant reduction of prices in the long run of about 7

percent. This is in line with increasing effects from remedies as ICE became a stronger rival over time, which in turn put Chess under pressure to respond with price reductions.[25]

In columns 5–6, we show results for NetCom+Tele2, which comprises the customers of the brands NetCom (Telia) and the Tele2-brand (Tele2) in both the pre- and the post-merger period to eliminate composition effects. The empirical results suggest a statistically significant price increase for NetCom+Tele2 after the merger. The magnitude of the effect is 5 percent in the short run and 5–6 percent in the long run.

Finally, we analyze the effects on the average price of all brands (the aggregate of OneCall, Chess, and NetCom+Tele2). The results for all brands in columns 7–8 indicate that there was likely no price effect of the merger. Point estimates for the short- and long-run effects are relatively small and never significant. These effects can be interpreted as the effects on the average customer directly affected by the merger. The absence of evidence for price effects indicates that the merger on average was likely neutral.[26]

Comparing the results for the different brands provides information on the contribution of the three key factors driving price effects of the merger. As discussed in Section 2, the difference in the net price effect between OneCall and Chess provides an estimate of the price effect of the efficiency gain. Thus, the efficiency gain roughly contributes to a 5 percentage point price decrease for OneCall (40 per-

[25]Ice's market share (measured in revenues) in the residential mobile telecom sector where 0.1 percent in 2015 and then grew to 1.8 percent in 2016 and 4.7 percent in 2017 (according to data from the Norwegian Communications Authority (Nkom), the telecom regulator in Norway).

[26]The results for all brands can be seen as a weighted average of the results for the individual brands with the weights being proportional to the number of customers for each brand. While the number of customers (weights) for each brand changes somewhat over time, numbers in Table 1 provide an indication of the relative size of the brands at the time of the merger.

cent of the long-term price decrease), relative to the pre-merger situation.[27] The negative net price effect for Chess suggests that the remedies had a larger downward impact on pricing than the upward price effect from internalization of rivalry with Tele2. Furthermore, as the potential for efficiency gains and the exposure to increased competition through remedies were relatively low for the premium segment, the price increase for NetCom provides an estimate of the lower bound of the internalization of rivalry effect. In the aggregate (i.e. across all consumers directly affected by the merger) the three effects of the merger on prices seem to have neutralized each other.

6 Robustness and timing of the effects

In this section, we conduct robustness checks and explore the timing of effects. Table 4 shows the results of the robustness checks. Columns 1 and 5 repeat the main results (for different brands) for comparison. All specifications include control variables but for simplicity we report only estimates of the merger effects (results for specification without control variables are very similar - see Appendix B.2).

A first robustness investigates the large increase in ARPU in Norway in July and August 2015 – see Figure 2. The increase appears much larger – particularly for OneCall – than in previous summers in Norway and would not fully be captured by our control dummy for summers in Norway in the period 2013–2015. It is

[27] A potential concern might be that the merged firm, could have repositioned the two brands OneCall and Chess to differentiate them stronger affecting changes in relative prices. An analysis of the price level indicated that the difference between the brands is reduced after the merger. The total average difference in the prices of Chess and OneCall is 5 percent pre-merger and 1.6 percent post-merger, indicating that the brands became more similar as measured in ARPU rather than more differentiated. Thus it is unlikely that strategic repositioning is a major force driving the relative price effects.

reasonable to assume that these increases in ARPU are not due to the merger, as the summer increases are typically driven by costly roaming abroad during holidays. Moreover, when analyzing the data for this project, we found signs of potential inconsistencies in the data for Tele2 in July and August 2015 that likely stem from integrating Tele2's accounts into Telia's accounting system at that time.[28] This represents potential measurement error. For this reason, we check the robustness of our analysis to excluding data for July and August (summer) 2015.

The results of this exercise are shown in columns 2 and 6 of Table 4. For OneCall this leads to slightly stronger negative price effects, confirming the main results. Also for the other brands and on aggregate the estimated effects are slightly more negative (positive effects slightly weaker) but the differences to the main estimates are nor very large. This confirms our main findings.

The second robustness check further explores the common trend assumption. The formal test shows that we cannot reject the common trend assumption in all specifications presented in the previous section. Nevertheless, due to the centrality of the common trend assumption, we conduct a further check to probe the sensitivity of our results. This is done by adding a country specific trend to the model. This test suggested by Besley and Burgess (2004) is commonly used in the recent literature on merger effects.

The results for this robustness check for the main sample are reported in columns 3 and 7 of Table 4 while columns 4 and 8 report the robustness check for the sample excluding data for summer 2015. For OneCall, the estimated effects

[28]The integration occurred during the six months after the merger while both accounts were continued separately. In the summer of 2015, Telia discontinued Tele2's accounting system, and at this point, we find some inconsistency comparing data from the two systems.

Table 4: Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel A: OneCall				Panel B: Chess			
1st-year Effect	-0.0703***	-0.0926***	-0.0340	-0.0565**	0.0046	-0.0083	0.0460**	0.0310
	(0.0229)	(0.0228)	(0.0250)	(0.0245)	(0.0203)	(0.0233)	(0.0186)	(0.0198)
2nd-year Effect	-0.1198***	-0.1232***	-0.0629**	-0.0692**	-0.0689**	-0.0724**	-0.0065	-0.0163
	(0.0249)	(0.0246)	(0.0314)	(0.0314)	(0.0320)	(0.0319)	(0.0277)	(0.0277)
Country specific trends	no	no	yes	yes	no	no	yes	yes
Common trend test	passed	passed	na	na	passed	passed	na	na
(p-value)	(0.793)	(0.888)			(0.556)	(0.581)		
Adjusted R^2	0.68	0.68	0.94	0.95	0.66	0.65	0.94	0.94
Observations	188	180	188	180	188	180	188	180
	Panel C: NetCom+Tele2				Panel D: All brands			
1st-year Effect	0.0507***	0.0444**	0.0746***	0.0694***	0.0154	0.0048	0.0471***	0.0366***
	(0.0171)	(0.0200)	(0.0149)	(0.0162)	(0.0150)	(0.0171)	(0.0129)	(0.0128)
2nd-year Effect	0.0592***	0.0569***	0.0967***	0.0943***	-0.0003	-0.0032	0.0493***	0.0452***
	(0.0197)	(0.0197)	(0.0181)	(0.0179)	(0.0174)	(0.0172)	(0.0166)	(0.0164)
Country specific trends	no	no	yes	yes	no	no	yes	yes
Common trend test	passed	passed	na	na	passed	passed	na	na
(p-value)	(0.674)	(0.720)			(0.603)	(0.653)		
Adjusted R^2	0.67	0.65	0.95	0.95	0.67	0.65	0.96	0.96
Observations	188	180	188	180	188	180	188	180

Robust standard errors in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications control for country and month fixed effects, GDP per capita growth, log data per user, and a dummy variable for the summer season in Norway (in 2013, 2014 and 2015).

are still negative but somewhat weaker and the effect in the first year is no longer statically significant for the main sample (column 3). However, when excluding the potentially problematic data for the summer of 2015, the significance of the first year effect is restored (column 4). For Chess, the first year effect is significantly positive and the second year effect is no longer significant when using the main sample (column 7), but neither effect is significant when excluding data for summer 2015 (column 8). For NetCom+Tele2 the estimated positive effects are somewhat stronger. For the aggregate, previously insignificant effects are turned into significantly positive effects.

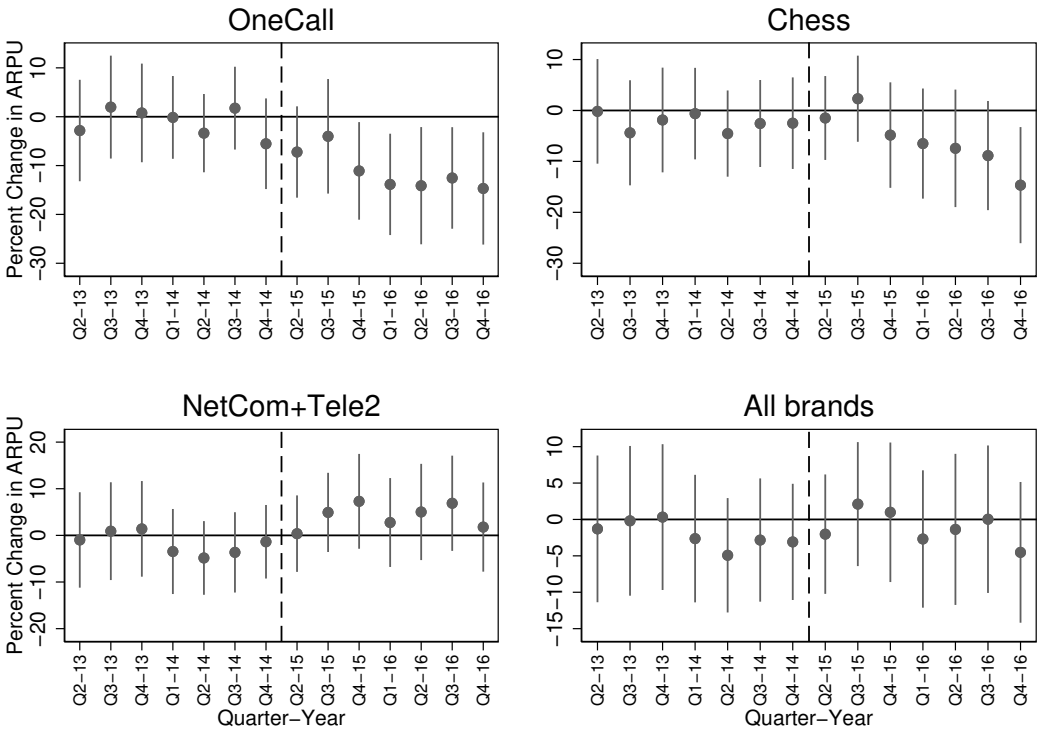
Adding country specific effect thus largely confirms our main finding for OneCall and NetCom+Tele2, but results for Chess and the aggregate appear less robust. However, adding country specific trends can produce misleading results when ef-

fects are dynamic, as the country specific trend will pick up and mask the dynamic effects (c.f. Wolfers, 2006). In our specific case, one may expect that the effects of the merger strengthen over time. Efficiency gains from vertical integration may take time to be fully realized because the existing national roaming agreements between Tele2 and Telenor will take time to phase out. Similarly, it will take time for remedies to fully take effect because ICE first has to become strong enough to exercise sufficient competitive pressure. Thus there are likely dynamic effects that challenge the validity of the trend specification.

The fact that estimated effects pointing to price decreases (OneCall and Chess) are stronger in the second year is a first indication of dynamic effects in accordance with this hypothesis. In order to further explore the dynamics we estimate separate effects for each quarter after the merger. At the same time we extend the model by adding dummies for each quarter before the merger in Norway. This provides an additional test for the trend specification, as suggested by Angrist and Pischke (2009). The intuition behind this placebo test is that if the treatment effects are simply driven by country-specific trends, there would likely be measurable effects for Norway also before the merger.

Figure 4 shows point estimates and confidence bands for the 95-percent confidence interval for the effect within each quarter after and before the merger.[29] Obviously, this test is executed without controlling for country-specific trends, since it is these trends we want to detect by adding the pre-merger placebo dummies. Using only post-merger quarter dummies and adding the trend specification leads to very similar dynamic patterns of the estimated effects (see Appendix B.2).

[29]Quarter 1 of 2015 in which the merger lies is excluded from the dataset when estimating quarterly merger effects.



Displayed are point estimates and confidence bands for the 95-percent confidence interval for the effect within each quarter before and after the merger (except the first quarter in the dataset). Estimates of a standard DiD model including additional controls (GDP pc growth, Log data per user, Summer in Norway.

Figure 4: Effect dynamics and placebo test.

The results confirm that the merger effects that reduce prices grow stronger over time. The estimated effects become more negative for OneCall and Chess. For NetCom+Tele2 and the aggregate of all brands we do not see a clear tendency. This is in line with remedies and efficiency gains taking time to fully take effect, whereas upward pressure on prices through reduced competition immediately takes effect. Moreover, the estimated coefficients for the pre-merger dummies - the placebo effects show no signs of trends pre-merger. The estimates fluctuate mostly around

zero. Overall, the analysis of the quarterly merger effects implies that adding country specific trends is not only not required (as such trends appear to be absent) but also is problematic as it may confound some of the dynamics with the treatment effect confirms. Consequently the standard DiD model without country specific trends produces more reliable results. Overall, the robustness checks and analysis of effect dynamics thus confirm our main findings.

7 Discussion and conclusion

This paper empirically investigated the price effects of the merger between Telia and Tele2 in the Norwegian mobile telecommunications market in 2015. From an ex-ante perspective the merger is predicted to affect the prices of the brands involved in the merger differently through internalization of rivalry from past competitors, efficiency gains due to marginal costs reductions, and remedies (facilitating entry of a rival). Reduced competition puts upward pricing pressure on all brands. However, efficiency gains only apply to the Tele2 products (OneCall and Tele2-brand) which save costs from roaming in an external network. Moreover, the remedies strengthen competition by the rival ICE as a competitor in the budget segment and thus predominantly exercised competitive pressure on OneCall and Chess, which were close competitors to ICE in this segment.

Combining these differences in potential for effects with an empirical analysis based on a unique dataset with brand-level data we are able to identify the contribution of the different causes of the merger price effect. Our results suggest that all three factors contributed substantially to the net effect of the merger on prices. First, our results suggest that efficiency gains contributed around 5 per-

centage points (40 percent) to the observed price reduction for the brand where these efficiency gains were expected (OneCall). Second, the impact of remedies was substantial and more than offset the effects from internalized rivalry on the budget segment (where remedies could be expected to be effective) of the market in the long run. Finally, the results for the premium segment brand (NetCom), where there were no obvious potential for efficiency gains and no direct strong exposure to increased competition through remedies, provide an estimate of the internalization of rivalry effect. The findings for the premium segment suggest that the merger led to substantial upward pricing pressure through internalization of rivalry.

On the aggregate, i.e., across all consumers directly affected by the merger, the three effects of the merger on prices seem to have neutralized each other. Conservatively interpreted, this suggest that there is no consistent evidence for an effect on overall prices in either direction. The average consumer affected by the merger thus likely did not have to pay higher prices as a consequence of the merger.

Evaluation of merger control in the specific case also has to consider that the counterfactual for Norway in the analysis deviates from the most likely post-merger counterfactual – that Tele2 would become a full MVNO after losing its frequency rights. While this does not affect the validity of results it has implications for the interpretation and policy evaluation of the merger in question. Our results should be interpreted as the effects of a merger from three to two large operators with their own network. When it comes to policy evaluation (i.e. the evaluation of the competition authority's decision) the situation with Tele2 as full MVNO and substantially higher variable costs is the more relevant counterfactual. As we base

Tele2's pricing on a situation with 50 percent own network coverage rather than 0 percent own network coverage, the relevant efficiency gains for policy evaluation (i.e. the gains that the ex-ante analysis assumed) are larger in this situation than what we estimate. (as we discussed above). This suggests that the true effects for consumers was likely a stronger reduction of prices, relative to the most likely counterfactual, than that found by the analysis. Overall, our analysis suggests that the merger control that lead to allowing the merger with remedies was successful in this case.

More generally, our analysis shows that efficiency gains and remedies may have substantial downward effects on prices. Our results thus underline the importance of carefully consideration of all possible effect in merger control, as suggested by the recent ruling of the General Court of the European Union mentioned before.

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A Theoretical foundation for the ex-ante analysis

In this section, we briefly present the theoretical foundations for analyzing unilateral price effects ex-ante from the three main merger-specific effects: internalization of rivalry, efficiencies, and remedies.

We first illustrate price effects from internalization of rivalry and efficiencies (no remedies). We then formalize the pure unilateral effects of entry of a new rival. Finally, we formally illustrate the interplay between remedies and unilateral merger effects.

A.1 Price effects from internalization of rivalry and efficiency gains

We build on the setup as presented in Farrell and Shapiro (2010), where price effects are evaluated on the basis of pre-merger first order conditions. I.e., we assume that firms are optimizing given the market conditions.

Thus, the profit for a single product firm (named Firm 1) is given by:

$$\pi_1 = Q_1(\boldsymbol{p})(p_1 - c_1),$$

where $Q_1(\boldsymbol{p})$ is demand facing Firm 1 at a given vector of prices, and p_1 and c_1 is the price and the (linear) marginal cost of Firm 1. The pre-merger first order condition is:

$$\frac{\partial Q_1}{\partial p_1}(p_1 - c_1) + Q_1(\boldsymbol{p}) = 0 \tag{2}$$

After Firm 1 and Firm 2 merge, the joint profit is:

$$\pi_1 + \pi_2 = Q_1(\boldsymbol{p})(p_1 - c_1 + \Delta c_1) + Q_2(\boldsymbol{p})(p_2 - c_2).$$

In the above expression, $\Delta c_1 < 0$ represents an efficiency gain in marginal costs. Differentiating for p_1 at pre-merger prices (i.e., where equation (2) is true), and reshuffling we obtain the following expression.[30]

$$\frac{\partial(\pi_1 + \pi_2)}{\partial p_1}\Big|_{p_1=p_1^0} = (-\frac{\partial Q_1}{\partial p_1})\Big[\Delta c_1 + D_{12}(p_2 - c_2)\Big]. \tag{3}$$

The first expression in the square bracket is the efficiency gain. The final expression is the diversion ratio from Firm 1 to Firm 2 interacted with Firm 2's contribution margin. This expression is referred to as the Upward Pricing Pressure (UPP). The sign of equation (3) depends on which of the two effect that dominates. Thus, equation (3) illustrates the ceteris paribus trade-off between internalization of rivalry and efficiency gains on the incentives to adjust prices after the merger.

A.2 Price effects from remedies

The merger studied in this paper was cleared conditioned on a remedy of facilitating the entry of a new rival. The effects of this kind of remedy is difficult to formalize as adding a new firm with new products into the market, will affect the functional form of demand.

In order to simplify the presentation of remedies, we first illustrate the remedy effect without the merger, before we study the interaction between the merger-

[30] We have exploited the relation:

$$\frac{\partial Q_2}{\partial p_1} = -\frac{\partial Q_1}{\partial p_1} D_{12}$$

specific effects and the remedies.

A.2.1 Remedies without merger

Adding new products that are substitutes to existing products in the same market has two main effects on the demand facing each firm:

- The demand facing each firm is lower at pre-merger prices
- The demand elasticity facing each product is higher at pre-merger prices

Revisiting "Firm 1", we formalize these two effects ad-hoc by rewriting the demand functions (the superscript "r" denotes with remedies):

$$Q_1^r(\boldsymbol{p}) = Q_1(\boldsymbol{p}) - R; \quad \frac{\partial Q_1^r}{\partial p_1} = \frac{\partial Q_1}{\partial p_1} - r; \quad R, r > 0$$

Thus, at pre-remedy prices and quantities, total demand for each product is lower – and demand facing each product becomes more price sensitive. The derivative of the profit evaluated at pre-remedy prices becomes:

$$\frac{\partial(\pi_1 + \pi_2)}{\partial p_1}\Big|_{p_1 = p_1^0} = -r(p_1 - c_1) - R < 0 \tag{4}$$

Thus, remedies by facilitating the entry give incentives to reduce prices for two reasons. First, a price increase leads more customers to divert to the new rival, which gives incentives to reduce prices. Second, each firm is expected to have fewer customers (as the newcomer will steal some of the market share). This, reduces the negative price effect from reducing prices on existing customers.

A.2.2 Remedies with merger

When we take into account that the remedy happens as a consequence of a merger, we must take into account that there are interactions between the merger effects (internalization of rivalry and efficiency gains) and the remedies. The main effect is that the entry of a new rival reduces both of the components in the UPP measure.

- Entry of a new competitor decreases diversion between the merging parties
- Competition from a new rival decreases prices, which decreases margins.

Thus, remedies reduce the unilateral incentive to increase prices following the merger. Going back to "Firm 1" we formalize the reduced diversion by adding a $\Delta D_{12}^r < 0$, which denotes the reduction in diversion from Firm 1 to Firm 2. Reduced margins for the other merging firm which is due to the remedies is denoted by $\Delta p_2^r < 0$. The derivative of the profit evaluated at pre-remedy and pre-merger prices, i.e., when including all effects, becomes:

$$\frac{\partial(\pi_1+\pi_2)}{\partial p_1}\Big|_{p_1=p_1^0} = \underbrace{(-\frac{\partial Q_1}{\partial p_1}+r)\Big[\Delta c_1 + D_{12} + \Delta D_{12}^r(p_2+\Delta p_2^r - c_2)\Big]}_{\text{Eff.gain and rivalry effects interacted with remedies}} \underbrace{-r(p_1-c_1)-R}_{\text{Pure remedy effect}} \tag{5}$$

It must be stressed that the above equations only describe the "first-round" price effects for each firm. In addition, there will be feedback effects, and it can be challenging to assess the net price effect from first-round measures alone. Thus, in order to quantify expected net price effects, the new equilibrium must be identified

using simulation methods and assumptions on the demand functions.[31]

[31] See e.g., Bergh et al. (2020).

B Additional results of the empirical analysis

This appendix presents further results. Appendix B.1 presents the estimates that are shown in Figure 4 in Section 6 in table format and some related additional specifications. Appendix B.2 discusses issue with inference in DiD models and presents results with alternative standard errors as well as GLS results.

B.1 Timing and dynamics of merger effects

In this section, we show further results that explore the effects' dynamics. The tabulated results include the estimates underlying Figure 4 (Section 6) in table format. The figure in Section 6 is based on specifications with control variables and the extended model with quarterly dummies for pre-merger period (placebo test). In addition, we present specifications without the pre-merger dummies, without controls and for the trend specification.[32] This does not change our main findings. We point to the discussion of the timing of effects and placebo tests above for a discussion of results.

Table 5 displays estimates of the models with quarterly treatment effects and leads for OneCall. The results in column 6 correspond to Figure 4.

[32]When leads are added to the model, the trend specification is not relevant, as discussed above.

Table 5: OneCall - Timing of Effects

	(1)	(2)	(3)	(4)	(5)	(6)
Lead Q2 2013					-0.0246	-0.0283
					(0.0540)	(0.0524)
Lead Q3 2013					0.0461	0.0197
					(0.0546)	(0.0532)
Lead Q4 2013					0.0038	0.0078
					(0.0513)	(0.0510)
Lead Q5 2014					0.0024	-0.0014
					(0.0448)	(0.0428)
Lead Q6 2014					-0.0284	-0.0336
					(0.0426)	(0.0404)
Lead Q7 2014					0.0410	0.0175
					(0.0447)	(0.0428)
Lead Q8 2014					-0.0458	-0.0553
					(0.0464)	(0.0468)
Effect Q2 2015	-0.0727**	-0.0624**	-0.0540	-0.0363	-0.0734	-0.0723
	(0.0293)	(0.0296)	(0.0332)	(0.0307)	(0.0496)	(0.0472)
Effect Q3 2015	-0.0070	-0.0341	0.0150	-0.0116	-0.0077	-0.0401
	(0.0497)	(0.0423)	(0.0531)	(0.0412)	(0.0646)	(0.0592)
Effect Q4 2015	-	-	-	-0.0740**	-0.1188**	-0.1110**
	0.1182***	0.1030***	0.0927***			
	(0.0240)	(0.0335)	(0.0307)	(0.0312)	(0.0465)	(0.0504)
Effect Q1 2016	-	-	-	-	-0.1309**	-
	0.1302***	0.1251***	0.1013***	0.0961***		0.1386***
	(0.0303)	(0.0357)	(0.0352)	(0.0339)	(0.0503)	(0.0524)
Effect Q2 2016	-	-	-	-0.0961**	-0.1451**	-0.1412**
	0.1444***	0.1317***	0.1121***			
	(0.0388)	(0.0450)	(0.0423)	(0.0428)	(0.0562)	(0.0606)
Effect Q3 2016	-	-	-0.0995**	-0.0659	-	-0.1254**
	0.1352***	0.1187***			0.1358***	
	(0.0295)	(0.0367)	(0.0421)	(0.0410)	(0.0498)	(0.0525)
Effect Q4 2016	-	-	-0.0887*	-0.0903*	-0.1284**	-0.1468**
	0.1277***	0.1295***				
	(0.0306)	(0.0410)	(0.0505)	(0.0491)	(0.0505)	(0.0580)
Control variables	no	yes	no	yes	no	yes
Country specific trends	no	no	yes	yes	no	no
Observations	180	180	180	180	180	180
Adjusted R^2	0.66	0.66	0.93	0.94	0.65	0.65

Robust standard errors in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications control for country and month fixed effects.

Table 6 displays estimates of the models with quarterly treatment effects and leads for Chess. The results in column 6 correspond to Figure 4.

Table 6: Chess - Timing of Effects

	(1)	(2)	(3)	(4)	(5)	(6)
Lead Q2 2013					0.0052	-0.0017
					(0.0536)	(0.0519)
Lead Q3 2013					-0.0199	-0.0438
					(0.0558)	(0.0521)
Lead Q4 2013					-0.0225	-0.0187
					(0.0520)	(0.0519)
Lead Q1 2014					-0.0049	-0.0061
					(0.0464)	(0.0454)
Lead Q2 2014					-0.0425	-0.0453
					(0.0444)	(0.0427)
Lead Q3 2014					-0.0083	-0.0256
					(0.0465)	(0.0431)
Lead Q4 2014					-0.0199	-0.0249
					(0.0482)	(0.0454)
Effect Q2 2015	-0.0033	0.0048	0.0133	0.0120	-0.0174	-0.0148
	(0.0197)	(0.0197)	(0.0223)	(0.0214)	(0.0443)	(0.0416)
Effect Q3 2015	0.0618**	0.0465**	0.0814***	0.0513**	0.0477	0.0231
	(0.0243)	(0.0208)	(0.0283)	(0.0239)	(0.0466)	(0.0427)
Effect Q4 2015	-0.0414*	-0.0317	-0.0188	-0.0384	-0.0555	-0.0483
	(0.0247)	(0.0388)	(0.0267)	(0.0335)	(0.0469)	(0.0523)
Effect Q1 20165	-0.0430	-0.0478	-0.0174	-0.0579	-0.0571	-0.0650
	(0.0299)	(0.0426)	(0.0295)	(0.0364)	(0.0499)	(0.0546)
Effect Q2 2016	-0.0645*	-0.0576	-0.0358	-0.0628	-0.0785	-0.0743
	(0.0354)	(0.0459)	(0.0332)	(0.0386)	(0.0537)	(0.0582)
Effect Q3 2016	-	-0.0713*	-0.0505	-0.0703*	-0.0962*	-0.0885
	0.0821***					
	(0.0298)	(0.0412)	(0.0354)	(0.0421)	(0.0499)	(0.0541)
Effect Q4 2016	-	-	-0.0794**	-	-	-0.1466**
	0.1141***	0.1294***		0.1413***	0.1282***	
	(0.0256)	(0.0458)	(0.0399)	(0.0463)	(0.0474)	(0.0576)
Control variables	no	yes	no	yes	no	yes
Country specific trends	no	no	yes	yes	no	no
Observations	180	180	180	180	180	180
Adjusted R^2	0.65	0.65	0.94	0.95	0.63	0.63

Robust standard errors in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications control for country and month fixed effects.

Table 7 displays estimates of the models with quarterly treatment effects and leads for NetCom. The results in column 6 correspond to Figure 4.

Table 7: NetCom+Tele2 - Timing of Effects

	(1)	(2)	(3)	(4)	(5)	(6)
Lead Q2 2013					-0.0014	-0.0098
					(0.0523)	(0.0516)
Lead Q3 2013					0.0301	0.0090
					(0.0535)	(0.0529)
Lead Q4 2013					0.0140	0.0139
					(0.0514)	(0.0518)
Lead Q1 2014					-0.0300	-0.0346
					(0.0470)	(0.0460)
Lead Q2 2014					-0.0432	-0.0484
					(0.0416)	(0.0399)
Lead Q3 2014					-0.0229	-0.0364
					(0.0455)	(0.0435)
Lead Q4 2014					-0.0079	-0.0137
					(0.0416)	(0.0398)
Effect Q2 2015	0.0088	0.0195	0.0384**	0.0505***	0.0011	0.0037
	(0.0187)	(0.0199)	(0.0166)	(0.0146)	(0.0439)	(0.0414)
Effect Q3 2015	0.0747***	0.0652***	0.1097***	0.0980***	0.0671	0.0492
	(0.0236)	(0.0205)	(0.0229)	(0.0167)	(0.0463)	(0.0429)
Effect Q4 2015	0.0684**	0.0884**	0.1088***	0.1326***	0.0607	0.0730
	(0.0295)	(0.0367)	(0.0258)	(0.0253)	(0.0498)	(0.0513)
Effect Q1 2016	0.0350	0.0446	0.0807***	0.0925***	0.0273	0.0276
	(0.0310)	(0.0324)	(0.0242)	(0.0230)	(0.0507)	(0.0481)
Effect Q2 2016	0.0480	0.0660*	0.0991***	0.1178***	0.0403	0.0502
	(0.0341)	(0.0365)	(0.0241)	(0.0225)	(0.0528)	(0.0521)
Effect Q3 2016	0.0648**	0.0844**	0.1213***	0.1402***	0.0571	0.0688
	(0.0289)	(0.0374)	(0.0258)	(0.0251)	(0.0494)	(0.0515)
Effect Q4 2016	0.0327	0.0360	0.0946***	0.0966***	0.0250	0.0178
	(0.0260)	(0.0322)	(0.0316)	(0.0285)	(0.0476)	(0.0483)
Control variables	no	yes	no	yes	no	yes
Country specific trends	no	no	yes	yes	no	no
Observations	180	180	180	180	180	180
Adjusted R^2	0.65	0.65	0.95	0.95	0.64	0.63

Robust standard errors in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications control for country and month fixed effects.

Table 8 displays estimates of the models with quarterly treatment effects and leads for NetCom. The results in column 6 correspond to Figure 4.

Table 8: All brands (aggregated TeliaSonera plus Tele2) - Timing of Effects

	(1)	(2)	(3)	(4)	(5)	(6)
Lead Q2 2013					-0.0050	-0.0130
					(0.0524)	(0.0509)
Lead Q3 2013					0.0214	-0.0019
					(0.0538)	(0.0519)
Lead Q4 2013					0.0023	0.0032
					(0.0508)	(0.0506)
Lead Q1 2014					-0.0221	-0.0263
					(0.0458)	(0.0442)
Lead Q2 2014					-0.0440	-0.0492
					(0.0418)	(0.0397)
Lead Q3 2014					-0.0117	-0.0283
					(0.0452)	(0.0427)
Lead Q4 2014					-0.0242	-0.0309
					(0.0420)	(0.0403)
Effect Q2 2015	-0.0119	-0.0020	0.0176	0.0290**	-0.0223	-0.0202
	(0.0191)	(0.0193)	(0.0165)	(0.0138)	(0.0440)	(0.0414)
Effect Q3 2015	0.0536**	0.0392*	0.0884***	0.0714***	0.0431	0.0211
	(0.0264)	(0.0200)	(0.0249)	(0.0149)	(0.0478)	(0.0430)
Effect Q4 2015	0.0094	0.0264	0.0496**	0.0662***	-0.0011	0.0099
	(0.0254)	(0.0310)	(0.0197)	(0.0186)	(0.0472)	(0.0484)
Effect Q1 2016	-0.0142	-0.0080	0.0314	0.0350*	-0.0247	-0.0269
	(0.0297)	(0.0299)	(0.0212)	(0.0193)	(0.0498)	(0.0476)
Effect Q2 2016	-0.0116	0.0033	0.0394*	0.0519**	-0.0220	-0.0137
	(0.0342)	(0.0353)	(0.0224)	(0.0207)	(0.0528)	(0.0524)
Effect Q3 2016	-0.0002	0.0172	0.0562**	0.0732***	-0.0106	0.0003
	(0.0288)	(0.0357)	(0.0239)	(0.0233)	(0.0493)	(0.0511)
Effect Q4 2016	-0.0243	-0.0248	0.0374	0.0320	-0.0347	-0.0452
	(0.0262)	(0.0306)	(0.0301)	(0.0266)	(0.0477)	(0.0488)
Control variables	no	yes	no	yes	no	yes
Country specific trends	no	no	yes	yes	no	no
Observations	180	180	180	180	180	180
Adjusted R^2	0.65	0.65	0.95	0.96	0.63	0.63

Robust standard errors in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications control for country and month fixed effects.

B.2 Inference – alternative standard errors

The main concern for inference in most DiD models is potential serial correlation in the error terms for a given group (country, in our case). Serial correlation can lead to underestimation of the standard error and therefore to falsely high rejection rates of the null hypothesis. Bertrand et al. (2004) suggest that a correction of standard errors for clustering at the group level can achieve more reasonable rejection rates. Unfortunately, this solution will work less well in our case due to the small number of groups. Moreover, Brewer et al. (2018) argue that clustered standard errors lead to a power problem when the number of groups is small. That means that we would be less likely to reject the null hypothesis of zero effects even if the true effects are non-zero. They suggest that a feasible GLS estimator in combination with clustered robust standard errors (that account for serial correlation) can remedy or at least mitigate the power problem and lead to a more correct test size (especially in cases with observations for many periods (large T) as in our panel). Unfortunately, this solution works again less well for a very small number of groups.

There is thus no optimal solution to correct the standard errors, given that our application has few groups (four groups). As a pragmatic solution, we base inference in the main body of the paper on standard errors that are robust to arbitrary patterns of heteroscedasticity. In this section, we present and discuss further results that explore the issue of inference. This is done by calculating additional standard errors, including i.i.d. standard errors and cluster robust standard errors. We also present feasible GLS estimates in combination with cluster robust standard errors (as suggested by Brewer et al., 2018). There is some variation

in accordance with the issues to be expected from the different types of standard errors when there are few groups. Nevertheless, overall, the results of this exercise confirm our main findings.

Panel A of Table 9 repeats our main results (see Table 3) and reports various standard errors. Standard errors in brackets are i.i.d. standard errors. Standard errors in parentheses are our preferred robust standard errors, which correspond to those presented above. Stars indicating significance are attached to the standard errors instead of the point estimates. We see that i.i.d. and robust standard errors lead to almost identical results when it comes to the significance of effects.

Table 9: Alternative standard errors and Feasible GLS estimation for main results

	OneCall		Chess		NetCom+Tele2		All brands	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A - OLS								
1st-year Effect	-0.0735	-0.0703	0.0015	0.0046	0.0462	0.0507	0.0121	0.0154
i.i.d. SE	[0.0270]***	[0.0277]**	[0.0263]	[0.0274]	[0.0259]*	[0.0276]*	[0.0258]	[0.0265]
Robust SE	(0.0234)***	(0.0229)***	(0.0183)	(0.0203)	(0.0166)**	(0.0171)***	(0.0163)	(0.0150)
Cluster robust SE	{0.0686}	{0.0931}	{0.0686}	{0.0958}	{0.0686}	{0.0530}	{0.0686}	{0.0614}
2nd-year Effect	-0.1314	-0.1198	-0.0763	-0.0689	0.0486	0.0592	-0.0095	-0.0003
i.i.d. SE	[0.0270]***	[0.0282]***	[0.0263]***	[0.0303]**	[0.0259]*	[0.0287]**	[0.0258]	[0.0266]
Robust SE	(0.0193)***	(0.0249)***	(0.0192)***	(0.0320)**	(0.0177)***	(0.0197)***	(0.0174)	(0.0174)
Cluster robust SE	{0.0893}	{0.1181}	{0.0893}	{0.1486}	{0.0893}	{0.0776}	{0.0893}	{0.0817}
Panel B - Feasible GLS:								
1st-year Effect	-0.1349	-0.1046	0.0026	0.0751	0.0937	0.0985	0.0432	0.0495
Cluster robust SE	{0.0402}**	{0.0168}***	{0.0349}	{0.0271}*	{0.0227}**	{0.0263}**	{0.0260}	{0.0195}*
2nd-year Effect	-0.1212	-0.1055	-0.0110	0.0512	0.1037	0.1107	0.0485	0.0548
Cluster robust SE	{0.0469}*	{0.0283}**	{0.0419}	{0.0210}*	{0.0305}**	{0.0406}*	{0.0331}	{0.0332}
Control variables	no	yes	no	yes	no	yes	no	yes
Country specific trends	no	no	no	no	no	no	no	no

Robust standard errors in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications control for country and month fixed effects.

In braces, we present the cluster-robust standard errors suggested by Bertrand et al. (2004). These standard erorrs are larger, and if tests are based on clustered standard errors, none of the the estimated coefficients are significant. As Brewer et al. (2018) point out, cluster robust-standard errors lead to a power problem when there are few groups. We therefore cannot rely on these standard errors.

To further explore the issue, we follow Brewer et al. (2018) and combine robust standard errors with feasible GLS. This is still not optimal with so few groups as four but should alleviate the power problem somewhat. The results are presented in panel B. Obviously, using GLS also affects the point estimates. This leads to somewhat different results for some specifications for Chess and all brands. The main effects for OneCall and NetCom+Tele2 are, however, confirmed (although the size of the coefficients may be different). This is in line with Brewer et al. (2018)'s finding that this combination can alleviate the power problem. Nevertheless, we are not fully convinced of these results because GLS is basesd on a stronger assumption (compared to OLS) and it is not clear that GLS with clustered standard errors alleviates the power problem of clustering with only four groups. We therefore prefer OLS with robust (but not cluster-robust) standard errors.

In Table 10, we repeat the analysis for the robustness checks for OneCall. We include specifications with and without control variables. This confirms our discussion of different standard errors and overall confirms our main finding of a negative price effect of the merger on prices for OneCall.

In Table 11, we repeat the analysis for the additional results for Chess. We include specifications with and without control variables. This confirms our discussion of different standard errors. The GLS results are somewhat more different from the OLS results than for most other brands, which underlines that the results for Chess are somewhat mixed.

In Table 12, we repeat the analysis for the additional results for NetCom+Tele2. We include specifications with and without control variables. This confirms our discussion of different standard errors and overall confirms our main finding of a positive price effect of the merger on NetCom+Tele2 .

Table 10: Alternative standard errors and Feasible GLS estimation for OneCall

	Main sample				Excluding Summer 2015			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
OLS: 1st-year Effect	-0.0735	-0.0703	-0.0401	-0.0340	-0.1019	-0.0926	-0.0707	-0.0565
i.i.d. SE	[0.0270]***	[0.0277]**	[0.0221]*	[0.0195]*	[0.0286]***	[0.0303]***	[0.0200]***	[0.0192]***
Robust SE	(0.0234)***	(0.0229)***	(0.0303)	(0.0250)	(0.0182)***	(0.0228)***	(0.0255)***	(0.0245)**
Cluster robust SE	{0.0686}	{0.0931}	{0.0129}*	{0.0082}**	{0.0705}	{0.0937}	{0.0166}**	{0.0126}**
2nd-year Effect	-0.1314	-0.1198	-0.0787	-0.0629	-0.1314	-0.1232	-0.0824	-0.0692
i.i.d. SE	[0.0270]***	[0.0282]***	[0.0310]**	[0.0271]**	[0.0266]***	[0.0284]***	[0.0272]***	[0.0257]***
Robust SE	(0.0193)***	(0.0249)***	(0.0345)**	(0.0314)**	(0.0194)***	(0.0246)***	(0.0340)**	(0.0314)**
Cluster robust SE	{0.0893}	{0.1181}	{0.0318}*	{0.0166}**	{0.0893}	{0.1160}	{0.0322}*	{0.0219}*
Feasible GLS:								
1st-year Effect	-0.1349	-0.1046	-0.0245	-0.0313	-0.1424	-0.1188	-0.0754	-0.0639
Cluster robust SE	{0.0402}**	{0.0168}***	{0.0132}	{0.0129}*	{0.0241}***	{0.0181}***	{0.0154}**	{0.0174}**
2nd-year Effect	-0.1212	-0.1055	-0.0333	-0.0439	-0.1290	-0.1125	-0.0536	-0.0501
Cluster robust SE	{0.0469}*	{0.0283}**	{0.0158}	{0.0192}	{0.0309}**	{0.0273}**	{0.0146}**	{0.0218}
Control variables	no	yes	no	yes	no	yes	no	yes
Country specific trends	no	no	yes	yes	no	no	yes	yes

Robust standard errors in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications control for country and month fixed effects.

Table 11: Alternative standard errors and Feasible GLS estimation for Chess

	Main sample				Excluding Summer 2015			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
OLS: 1st-year Effect	0.0015	0.0046	0.0417	0.0460	-0.0142	-0.0083	0.0248	0.0310
i.i.d. SE	[0.0263]	[0.0274]	[0.0193]**	[0.0192]**	[0.0284]	[0.0306]	[0.0189]	[0.0202]
Robust SE	(0.0183)	(0.0203)	(0.0221)*	(0.0186)**	(0.0173)	(0.0233)	(0.0202)	(0.0198)
Cluster robust SE	{0.0686}	{0.0958}	{0.0129}**	{0.0172}*	{0.0705}	{0.1034}	{0.0166}	{0.0207}
2nd-year Effect	-0.0763	-0.0689	-0.0128	-0.0065	-0.0763	-0.0724	-0.0151	-0.0163
i.i.d. SE	[0.0263]***	[0.0303]**	[0.0271]	[0.0282]	[0.0264]***	[0.0309]**	[0.0257]	[0.0282]
Robust SE	(0.0192)***	(0.0320)**	(0.0282)	(0.0277)	(0.0193)***	(0.0319)**	(0.0278)	(0.0277)
Cluster robust SE	{0.0893}	{0.1486}	{0.0318}	{0.0244}	{0.0893}	{0.1486}	{0.0322}	{0.0257}
Feasible GLS:								
1st-year Effect	0.0026	0.0751	0.0612	0.0763	-0.0154	0.0681	0.0388	0.0637
Cluster robust SE	{0.0349}	{0.0271}**	{0.0129}**	{0.0119}***	{0.0379}	{0.0271}*	{0.0167}	{0.0136}**
2nd-year Effect	-0.0110	0.0512	0.0252	0.0458	-0.0219	0.0479	0.0171	0.0404
Cluster robust SE	{0.0419}	{0.0210}*	{0.0164}	{0.0121}**	{0.0434}	{0.0226}	{0.0184}	{0.0125}**
Control variables	no	yes	no	yes	no	yes	no	yes
Country specific trends	no	no	yes	yes	no	no	yes	yes

Robust standard errors in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications control for country and month fixed effects.

Table 12: Alternative standard errors and Feasible GLS estimation for NetCom+Tele2

	Main sample				Excluding Summer 2015			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
OLS: 1st-year Effect	0.0462	0.0507	0.0712	0.0746	0.0381	0.0444	0.0624	0.0694
i.i.d. SE	[0.0259]*	[0.0276]*	[0.0180]***	[0.0170]***	[0.0281]	[0.0308]	[0.0181]***	[0.0175]***
Robust SE	(0.0166)**	(0.0171)***	(0.0173)***	(0.0149)***	(0.0175)**	(0.0200)**	(0.0168)***	(0.0162)***
Cluster robust SE	{0.0686}	{0.0530}	{0.0129}**	{0.0170}**	{0.0705}	{0.0555}	{0.0166}**	{0.0211}**
2nd-year Effect	0.0486	0.0592	0.0881	0.0967	0.0486	0.0569	0.0867	0.0943
i.i.d. SE	[0.0259]*	[0.0287]**	[0.0252]***	[0.0236]***	[0.0262]*	[0.0293]*	[0.0246]***	[0.0234]***
Robust SE	(0.0177)***	(0.0197)***	(0.0196)***	(0.0181)***	(0.0178)***	(0.0197)***	(0.0194)***	(0.0179)***
Cluster robust SE	{0.0893}	{0.0776}	{0.0318}*	{0.0179}**	{0.0893}	{0.0793}	{0.0322}*	{0.0203}**
Feasible GLS:								
1st-year Effect	0.0937	0.0985	0.0905	0.0859	0.0810	0.0836	0.0735	0.0717
Cluster robust SE	{0.0227}**	{0.0263}**	{0.0118}***	{0.0148}**	{0.0265}*	{0.0293}*	{0.0156}**	{0.0198}**
2nd-year Effect	0.1037	0.1107	0.1056	0.1020	0.0956	0.1010	0.0981	0.0979
Cluster robust SE	{0.0305}**	{0.0406}*	{0.0123}***	{0.0175}**	{0.0328}*	{0.0408}*	{0.0149}***	{0.0200}**
Control variables	no	yes	no	yes	no	yes	no	yes
Country specific trends	no	no	yes	yes	no	no	yes	yes

Robust standard errors in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications control for country and month fixed effects.

Finally, Table 13 repeats the analysis for the additional results for all brands. We include specifications with and without control variables. This confirms our discussion of different standard errors and overall confirms our main finding of no robust evidence for price effects in either direction. Thus the merger likely had no significant impact on overall prices.

Table 13: Alternative standard errors and Feasible GLS estimation for All brands (aggregated TeliaSonera plus Tele2)

	Main sample				Excluding Summer 2015			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
OLS: 1st-year Effect	0.0121	0.0154	0.0454	0.0471	-0.0013	0.0048	0.0310	0.0366
i.i.d. SE	[0.0258]	[0.0265]	[0.0175]**	[0.0159]***	[0.0279]	[0.0296]	[0.0170]*	[0.0162]**
Robust SE	(0.0163)	(0.0150)	(0.0170)***	(0.0129)***	(0.0153)	(0.0171)	(0.0142)**	(0.0128)***
Cluster robust SE	{0.0686}	{0.0614}	{0.0129}**	{0.0155}*	{0.0705}	{0.0637}	{0.0166}	{0.0197}
2nd-year Effect	-0.0095	-0.0003	0.0431	0.0493	-0.0095	-0.0032	0.0411	0.0452
i.i.d. SE	[0.0258]	[0.0266]	[0.0245]*	[0.0222]**	[0.0260]	[0.0271]	[0.0232]*	[0.0217]**
Robust SE	(0.0174)	(0.0174)	(0.0188)**	(0.0166)***	(0.0176)	(0.0172)	(0.0184)**	(0.0164)***
Cluster robust SE	{0.0893}	{0.0817}	{0.0318}	{0.0152}**	{0.0893}	{0.0821}	{0.0322}	{0.0184}
Feasible GLS:								
1st-year Effect	0.0432	0.0495	0.0652	0.0607	0.0274	0.0371	0.0413	0.0431
Cluster robust SE	{0.0260}	{0.0195}*	{0.0123}**	{0.0132}**	{0.0278}	{0.0238}	{0.0159}*	{0.0172}*
2nd-year Effect	0.0485	0.0548	0.0711	0.0660	0.0383	0.0471	0.0610	0.0608
Cluster robust SE	{0.0331}	{0.0332}	{0.0130}**	{0.0164}**	{0.0337}	{0.0351}	{0.0152}**	{0.0189}**
Control variables	no	yes	no	yes	no	yes	no	yes
Country specific trends	no	no	yes	yes	no	no	yes	yes

Robust standard errors in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications control for country and month fixed effects.