Ex-post analysis of two mobile telecom mergers:

T-Mobile/tele.ring in Austria and T-Mobile/Orange in the Netherlands

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Ex-post analysis of two mobile telecom mergers: T-Mobile/tele.ring in Austria and T-Mobile/Orange in the Netherlands

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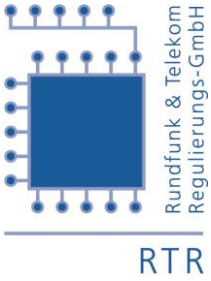

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Contents

Executive Summary

Introduction

Recently increased attention is being paid to ex-post evaluation of competition policy enforcement decisions, and in particular merger decisions. In the United States there is already an established and voluminous body of studies that covers several industries and several types of decisions. In Europe, too, in the last decade a limited, but growing, number of ex-post assessments have contributed to our understanding of the effects of consummated mergers. These studies have traditionally been the outcome of academic research, but more recently are becoming part of the agenda of competition authorities.

This report is the outcome of a joint project of the European Commission (DG Competition), the Netherlands Authority for Consumers and Markets (ACM) and the Austrian Regulatory Authority for Broadcasting and Telecommunications (RTR). The primary aim of the study is twofold: to identify methodological issues and develop insights which can be effectively applied in future ex-post evaluation projects; and to carry out an ex-post evaluation of two consummated mergers in the mobile telecommunications industry.

The mobile telecom industry is an industry of significant interest for merger control, as the European mobile telecom sector has witnessed several recent mergers between independent mobile network operators in a number of different national markets.

The two cases we study are:

- the T-Mobile/tele.ring merger in Austria, approved with remedies in April 2006[1], and
- the T-Mobile/Orange merger in the Netherlands, approved without conditions in August 2007[2].

The mobile telecom industry also presents a number of interesting specificities (complex tariff offers, non-linear prices) that this study tries to address and that might also be relevant to other industries.

Methodology

This study applies econometric methods to estimate the effects of the analysed mergers on retail prices. In the ex-post evaluation literature, the effect on prices of a consummated merger is identified by comparing the actual outcome after the merger to the hypothetical outcome which would have occurred in the absence of the merger (the counterfactual scenario). Hence, the identification challenge is to correctly model how the variable of

[1] The Commission's case reference is M.3916. For further information: http://ec.europa.eu/competition/elojade/isef/case_details.cfm?proc_code=2_M_3916.

[2] The Commission's case reference is M.4748. For further information: http://ec.europa.eu/competition/elojade/isef/case_details.cfm?proc_code=2_M_4748.

interest (prices in this case) would have evolved absent the examined market concentration. Simply assuming that the pre-merger price would have prevailed also post-merger is likely to bias our estimate if post-merger prices would have changed also absent the merger. This is likely the case in the mobile telecom industry, as we find evidence of a long-term path of price decrease shared by almost all countries considered in the report which are unaffected by mergers. Hence, the comparison of the prices "before-and-after" the merger is not appropriate in this setting. To estimate an appropriate counterfactual this study applies reduced-form econometric methods typically used in the so-called treatment evaluation literature, which are commonly applied also to the ex-post assessment of competition policy. These methods rely on the comparison, both before and after the merger, of the country in which the analysed merger took place ("affected country") with a number of countries in which no structural change takes place over the same period ("control countries"). This permits an estimation of the change in price that would have been observed in the country of interest absent the merger.

We first apply a standard difference-in-differences (DiD) approach which is widely used in the policy evaluation literature and for ex-post evaluation of mergers. For this method we test two specifications. The first specification (the “Base specification”) assumes that all countries share the same common trend in prices (once we control for other time varying control variables as well as time- and country-specific fixed effects). However, in both case studies the prices of the affected countries in the pre-merger period do not always follow the same trend as the average price development of the control countries[3]. Some of the price effects identified in the Base specification may therefore be biased. The second DiD specification (the “Trend specification”) therefore allows for different countries to follow long-term differential trends and it estimates the counterfactual change in prices also on the basis of these trends.

The second estimation approach that we apply is known as the synthetic control method, whereby the counterfactual price is constructed by weighting the prices of a selected sub-sample of control countries. The sub-sample of countries and the weights are selected so as to best approximate the pre-merger evolution of prices (and other predictors) in a given affected country. The merger effect is then identified as the difference between the post-merger price of the affected country and that of the synthetic control.

For both methods we also evaluate the statistical significance of the estimates, which is challenging in our study for two main reasons. We observe only a single affected country, and overall we have a small sample (in statistical terms) of control countries. These factors raise methodological issues (discussed in the report) that should be considered when assessing the significance of results. Depending on the applied approach, there is a risk that the precision of the estimated effects will tend to be overestimated.

A specific challenge of estimating merger effects in the mobile telecom industry relates to the fact that consumers generally purchase a *bundle* of mobile telecommunications services (voice calls to mobile and fixed numbers, text messages, and data services). A

[3] There are also no control countries after the exclusion of which the pre-merger trends of Austria and the Netherlands, respectively, would be significantly more similar to the average trend of the remaining control countries.

mobile tariff is usually characterized by a monthly fee that includes a certain quantity of services, plus a set of unit prices that specify the cost of "out of bundle" mobile services (as well as other fees like the one-off set-up/connection fees). The total expenditure of a subscriber for mobile services is then determined based on usage and the chosen tariff. Given these specificities, one of the challenges in analysing the mobile telecom market is to derive a convenient index summarizing the price level of each mobile tariff. In this study we define consumption profiles and refer to price of a given tariff as the hypothetical monthly expenditure required for purchasing a pre-defined consumption profile on the basis of that tariff.

To account for possible heterogeneous preferences of customers we consider three consumption profiles (i.e. consumers with low, mid and high usage), hence three expenditure levels, and estimate the effects of the mergers for each of these profiles. Further, to isolate price effects from usage effects we consider a constant usage pattern which remains fixed over the period under investigation (for each consumer type).

Analysis of the T-Mobile/tele.ring merger in Austria

The first merger case that we study is the acquisition of the Austrian mobile operator tele.ring by its competitor T-Mobile. This transaction was cleared in April 2006 after an in-depth investigation by the European Commission (EC) subject to structural remedies.

At the time of the merger there were five mobile network operators (MNOs) active on the Austrian market: Mobilkom Austria (the incumbent with a market share of around 40%); T-Mobile (24%); Orange (20%); tele.ring (12%) and Hutchison 3G (or H3G, with a market share of 3%, having just entered the market in 2003).

T-Mobile and tele.ring were, respectively, the second and fourth largest operators. In terms of broad market developments, by looking at the market share evolution, the years immediately before the merger were characterized by Mobilkom and T-Mobile losing market share to the advantage of the rival operators. The EC's investigation concluded that tele.ring was the most aggressive player in the mobile market and exerted competitive pressure especially on T-Mobile and Mobilkom. The proposed transaction raised serious competition concerns and was only approved after T-Mobile offered a package of commitments which consisted of the transfer of parts of tele.ring's spectrum and of mobile telecommunication sites to H3G and Orange.

As the T-Mobile/tele.ring merger was modified by commitments, our ex-post evaluation does not allow properly separating the effects of the unmodified merger and of the commitments, although it took more than one year until the commitments were fully implemented. Therefore, we study exclusively the effects of the merger including the commitments.

The objective of our econometric analysis is to estimate the market-wide price effect of the merger including the remedies. We also complement these econometric results with some descriptive analysis of the evolution of the market shares and of the relative price positioning of the different operators. In particular, we look at both short-term (one year after the merger) and medium-term (the second year after) effects of the merger to allow for the fact that the effects might change over time (also in relation to the remedies implementation).

In the econometric analysis, we apply three main approaches to estimate the effect of the merger, which rely upon slightly different identification assumptions (concerning the hypotheses on the evolution of the counterfactual price and the selection of countries in the control group). Then we also run a series of alternative analyses in which we test the robustness of our estimates to variations in the underlying data (type of tariffs considered, estimation of the basket of consumption, pre-merger period). For all specifications we mostly estimate negative price effects from the remedied merger. The estimates that we consider more credible range from -2% up to -20%, both in the short term and in the medium term. In light of these results we can exclude a possible (significant) price increase resulting from the merger relative to the control countries. However, given the differences across the specifications, it is difficult to draw conclusions on the magnitude of the negative estimated effects and we cannot firmly conclude that the merger (as modified by the commitments) was associated with a significant relative price reduction.

The relatively low precision of the estimated price effects is not surprising, as we have a relatively small sample of control countries that we compare to only a single affected country. Hence, we cannot exclude that idiosyncratic price developments in some of the control countries are affecting the results and we are also not able to separate the merger effects from idiosyncratic post-merger price dynamics in Austria.

The finding that the merger was not associated with a price increase can be explained by some factors. In particular, the structural commitments offered by the merging parties are likely to have strengthened the smallest two operators (Orange and especially Hutchinson), as market developments after the merger appear to show.

Analysis of the T-Mobile/Orange merger in the Netherlands

The second event analysed in this report is the T-Mobile/Orange merger in the Netherlands. This merger was cleared without commitments by the EC in August 2007.

Prior to the T-Mobile/Orange merger, KPN was the market leader with a retail market share in terms of subscribers of roughly 39%[4]. Other MNOs active in the mobile telecommunications market of the Netherlands were Vodafone, with 21% subscriber market share, T-Mobile (14% subscriber market share), and Orange (12%). With the acquisition of Orange, T-Mobile became the second largest MNO in the Netherlands with a market share exceeding 25%.

Compared to many mobile telecommunication markets in Europe, one distinguishing feature of the Dutch mobile telecom market was the fast-growing presence of the mobile virtual network operators (MVNO) segment. By the time of the T-Mobile/Orange merger in 2007, the combined MVNOs market share was around 15% of the retail mobile telecom market. This feature is reflected in the clearance decision of the T-Mobile/Orange merger that points to the strong presence of the MVNOs as one of the factors countervailing the possible loss of competition from the reduction in the number of MNOs in the Netherlands' mobile telecom market.

[4] Due to confidentiality reasons, the market share figures mentioned in this section are provided by Telecompaper and are not the figures on which the decision is based. This excludes subscribers of MVNOs hosted by MNOs.

One important specificity of the Dutch case study is that the T-Mobile/Orange merger was preceded by another merger between KPN and the by then fifth-largest MNO Telfort, which was unconditionally cleared in August 2005 by the Dutch competition authority.

For this case study, one of the challenges of the analysis is to properly account for the earlier KPN/Telfort merger when quantifying the price effects associated with the T-Mobile/Orange merger. The earlier concentration may have affected the retail prices in the period prior to the T-Mobile/Orange merger and, consequently, may affect the identification of the price effects of the concentration under study. We attempt to limit the confounding effect of the KPN/Telfort merger by shortening the pre-merger period. This, however, may still not fully eliminate possible spillover effects of the previous concentration, and in the interpretation of the results we discuss possible biases stemming from the KPN/Telfort merger.

As in the Austrian analysis, we apply three main approaches to estimate the price effects associated with the T-Mobile/Orange merger, as well as several variations to test the robustness of the results. Whilst after the T-Mobile/Orange merger prices in Netherlands did not increase in absolute terms, the model estimates that prices increased relative to the control countries. The price increases appear to be more pronounced for heavier users of mobile services, with estimated price increases in the range between 10% and 15%.

However, it is difficult to attribute firmly these price increases to the T-Mobile/Orange merger in light of possible confounding effects of the earlier KPN/Telfort merger as well as further specificities of the Dutch analysis. Nevertheless, the analysis provides evidence that the T-Mobile/Orange merger, possibly together with the KPN/Telfort merger, may have led to price increases. As in the Austrian case, however, the small sample of countries limits the precision of our estimates.

Conclusions

The quantitative results suggest that the Austrian T-Mobile/tele.ring merger as modified by the offered commitments did not lead to price increases in Austria. In contrast, mobile telecom prices in the Netherlands increased after the T-Mobile/Orange merger compared to the control countries. It cannot be firmly established that the T-Mobile/Orange merger exclusively caused the observed price increases, and some of the observed price increases may be associated with late effects of the KPN/Telfort merger for the reasons discussed in this report.

The observed price changes after the Austrian T-Mobile/tele.ring merger and the Dutch T-Mobile/Orange merger differ significantly, indicating that the effects of mergers in this sector likely depend on the specificities of each case (such as the intensity of competition between merging parties, the number of operators remaining after the merger, whether remedies were implemented after the merger, the nature of any remedies that were implemented, etc.).

There are four primary reasons that make challenging identifying the effect of the analysed mergers on prices. First, the effects of the analysed mergers exclusively materialize in a single country. This implies that it is very difficult to separate unobservable effects (not

related to the merger) which affect prices in the country where the merger took place from the effects of the merger[5]. This issue is particularly relevant when analysing mergers in the mobile telecoms industry as pricing is often set at national level, so that the merger effects materialize often uniformly in the country where the merger took place[6]. Under such circumstances, merger effects can be only identified to the extent they are much larger than other confounding effects in a given country. Second, there may be structural differences across countries which affect the price level and which are difficult to control. Third, prices in all countries appear to be substantially affected over time by idiosyncratic effects which generally reduce the precision of the econometric model. Fourth, the analysis of the T-Mobile/Orange merger in the Netherlands illustrates that it is very difficult to separate the effects of an earlier important event (such as another preceding merger) from those of the merger of interest.

Implications for future retrospective studies

This report clearly shows the importance of having access to reliable data in order to carry out a proper ex-post evaluation. Often, the data must cover not only those markets in which the relevant merger took place but also suitable control markets (from a geographic or also product perspective) in which no intervention took place. For instance, basing the analysis of this study on data which includes all MNOs of the control countries and in particular the handset subsidies linked to each tariff would have significantly improved the reliability of the estimated price effects[7].

The quality of data which can be used for ex-post evaluation depends on the information available to competition authorities. Data which can be gathered in the context of merger control proceedings often does not suffice to meaningfully evaluate mergers ex-post. Allowing competition authorities to request suitable data from market participants specifically for ex-post evaluations may be necessary in situations where information which is publicly available or can be acquired from private information providers is insufficient.

One important consideration for the interpretation of ex-post evaluations of mergers is the role of merger control. As illustrated by the analysis of the Austrian T-Mobile/tele.ring merger, often only the effect of the merger as modified by submitted commitments can be estimated[8]. Moreover, commitments will be likely imposed whenever the involved

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5 The imbalance between only one country in which the tariffs were affected by a given merger and many other countries which were not affected by that merger also raises econometric difficulties in correctly estimating the precision of the estimation as set out in Section 4.1.

6 In other industries (e.g. retailing or gasoline stations), competition takes place at local level and the effects of a merger differ across local markets. This can be exploited in order to separate the merger effect from other confounding effects in a given country.

7 If SIM-only tariffs (which by definition do not include subsidized handsets) are properly identified in the data and are sufficiently prevalent, focusing the analysis on SIM-only tariffs may be a promising alternative to collecting handset subsidy data.

8 Often, it cannot be excluded that remedies have an effect on the observed prices directly after a merger has been consummated. One would thus have to estimate the hypothetical prices in the absence of any remedies, which in practice may be difficult.

competition authority expects that the unmodified merger would cause significant anti-competitive effects. Therefore, if no significant anti-competitive effects are found for a merger which was conditionally cleared, this indicates that the remedies were sufficient for that case. Still, on this basis, it could not be concluded that the merger would have had no significant anti-competitive effects even if no commitments had been imposed[9]. On the other hand, if a remedied merger still entails significant anti-competitive effects, this indicates that the remedies were insufficient.

This study was assessed by two independent academic experts with expertise in ex-post evaluation. The assessment was done at two stages: the experts first received a preliminary version of the study on which they provided feedback. This feedback was addressed by the authors in the present report. The experts then provided a final assessment which is published alongside this report. The academic experts' expertise in particular as regards methods which are not yet commonly applied in practice proved to be very valuable. Based on this experience, close cooperation with academic experts appears advisable for retrospective studies carried out by competition authorities.

[9] Typically it cannot be evaluated whether the unmodified merger would have caused anti-competitive effects and thus whether imposing commitments was necessary in the first place, or whether the commitments were disproportionate.

1 Introduction

Merger control ensures that notified mergers are only cleared if they are not expected to entail significant anti-competitive effects (possibly after being amended by commitments). Merger control analysis is usually conducted prospectively and typically does not deal with the actual competitive development that followed the authority's decision.

Recently, in Europe there has been increased attention paid to the ex-post evaluation of competition policy decisions and in particular merger decisions. In the United States there is already an established and voluminous body of studies that covers several industries and several types of decisions. Also, in Europe in the last decade a limited, but growing, number of ex-post assessments have contributed to our understanding of the effects of consummated mergers. These studies have traditionally been the outcome of academic research, but more recently have become part of the agenda of competition authorities[10].

Insights of retrospective merger evaluations can contribute to improving the enforcement practice of competition authorities in various ways. Retrospective merger analyses allow testing the merits of arguments commonly brought forward in past cases. In addition, ex-post evaluations improve competition authorities' understanding of parameters which are particularly important to assess likely effects of mergers. Moreover, ex-post evaluations can provide useful information as regards market definition, for example if price effects of past mergers differ across regions or products[11]. Ex-post evaluation can also help competition authorities to calibrate the merger policy by identifying potential systematic biases in merger decisions[12].

This report is the outcome of a joint project of the European Commission (DG Competition), the Netherlands Authority for Consumers and Markets (ACM) and the Austrian Regulatory Authority for Broadcasting and Telecommunications (RTR). The primary aim of the study is to build on the available experience in ex-post evaluation of the participating institutions and to develop insights which can be effectively applied to future ex-post evaluation projects. Besides studying the effects of two past mergers, this report also sheds light on a number of methodological issues relevant to ex-post evaluation. Specifically, the report illustrates the merits and the limitations of recent approaches proposed to conduct econometric ex-post evaluation of competition policy interventions such as mergers. Moreover, the report gives policy recommendations aiming to facilitate a more systematic approach to ex-post evaluation of merger decisions in the future.

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[10] For a recent literature review and meta-analysis of the available literature on ex-post evaluation of European merger decisions see Ormosi, Mariuzzo, Havell (2015). For a review of the US ex-post evaluation studies see Kwoka (2013).

[11] See for example case M.6905 Ineos/Solvay/JV, where in the in-depth assessment an ex-post evaluation of the preceding Ineos/Kerling and Ineos/Tessenderlo mergers which was carried out, based on which, *inter alia*, conclusions on market definition were drawn.

[12] For example, in a recent survey, Kwoka (2013) finds that mergers which are conditionally cleared in the US often still had significant anti-competitive effects.

This report presents an analysis of the competitive effects of two merger decisions in the mobile telecommunications industry. This industry is of particular interest as the European Mobile Telecom sector has been lately characterized by an increasing level of concentration, as mergers between independent mobile network operators have taken place in a number of different national markets. Moreover, this industry also presents a number of interesting specificities (complex tariff offers, non-linear prices) that this study tries to address and that might also be relevant to other industries.

The two cases we study are:

- The T-Mobile-tele.ring merger in Austria, approved with remedies in April 2006[13]
- The T-Mobile-Orange merger in the Netherlands, approved without conditions in August 2007[14]

One aim of the study is to evaluate the impact of these two acquisitions on the market competition in the respective mobile telecom markets. The ex-ante competitive assessment of mergers typically considers several parameters that might be affected by a lessening of market competition (like price, quality, innovation, variety). However, because of data limitations, we concentrate the main analysis on the effects on retail prices and we account for this limitation when we interpret the results.

The typical challenge encountered in conducting quantitative ex-post evaluations is to model correctly how the variable of interest (prices in this case) would have evolved absent the market concentration. Simply comparing the price levels before and after the merger would often result in a biased estimate of the merger effect if, in the meantime, other factors not related to the merger also affected price developments (e.g. technological change or other changes in costs or demand). This is particularly relevant for the mobile telecom industry, where prices were generally falling in the relevant period. Similarly, comparing post-merger price levels between the affected country and non-affected countries might be misleading, because price level differences between these two groups could be independent of the merger and could have existed before the merger as well.

To address these issues, this study uses econometric methods to estimate the effect of the merger by comparing the affected market to other appropriate control markets, both before and after the merger.

Beyond the econometric analysis on prices we further analyse qualitatively other relevant indicators like relative price positioning of the different operators and their market share developments, as well as the development of mobile virtual network operators (MVNOs[15]). Although information on these indicators across countries is not available, and hence it is not possible to use other countries' indicators as counterfactuals, the analysis of these factors across time, together with the econometric analysis on prices, delivers further

[13] The Commission's case reference is M.3916. Further information is available under http://ec.europa.eu/competition/elojade/isef/case_details.cfm?proc_code=2_M_3916.

[14] The Commission's case reference is M.4748. Further information is available under http://ec.europa.eu/competition/elojade/isef/case_details.cfm?proc_code=2_M_4748.

[15] MVNOs do not own a mobile network and therefore rely on wholesale access to a host network.

insights about competitive developments after the merger. Moreover, the qualitative evidence resulting from this analysis, together with some other qualitative information on the markets, can be used to explain and rationalize the estimated price effects.

Empirical studies on the effects of mergers in the telecommunications industry have been limited so far. To our knowledge, these include working papers by Csorba, Pápai (2013) and Nitsche, Affeldt (2014), as well as recent studies by Genakos, Valletti, Verboven (2015) and Frontier Economics (2015)[16]. While these studies use a number of entries and mergers to identify the effect of a change in the market structure in the mobile telecom industry (e.g. five-to-four mergers, four-to-three mergers, etc.), we analyse two mergers separately and independently, in the attempt to identify and to take into account aspects that may be specific to these particular mergers (for instance the original market structure and the remedies imposed in the Austrian case) or to the mobile telecom markets in which they took place.

This report is structured as follows: in Section 2, we briefly discuss potential effects (in particular on prices) of horizontal mergers. Section 3 describes our dataset and the methodology to calculate prices for mobile telecommunications services for different user groups. Section 4 discusses in detail the estimation methodology we apply. Section 5 analyses the T-Mobile/tele.ring merger in Austria. Section 6 analyses the T-Mobile/Orange merger in the Netherlands. Section 7 concludes.

2 The effects of mergers

In antitrust analysis the incentives to increase prices following mergers are typically framed into the two different paradigms of non-coordinated effects and coordinated effects. Non-coordinated effects are related to anti-competitive effects that result from the merger without any need of coordination of the merged entity with its competitors. Coordinated effects may result if the market characteristics are such that the remaining firms can jointly raise their prices above the competitive level.

If competitors merge ("horizontal mergers") the most direct effect is the loss of competition between the merging firms. This normally creates an incentive for the merging parties to raise prices post-merger[17]. Despite the absence of coordination, unilateral price increases by the merging party may be followed by price increases by the non-merging firms[18]. The

[16] Frontier Economics (2015) is a study for the GSMA, an organization representing the interests of mobile operators worldwide.

[17] In the absence of the merger, as a consequence of a unilateral price increase of products offered by one merging party, a number of customers would normally switch to products offered by competitors (including the other merging party). Pre-merger, from the viewpoint of one merging party, customers that switch to products of the other merging party are lost after a price increase. Post-merger, the threat of losing consumers to competitors is reduced since some of the alternative products that were pre-merger owned by a competitor are offered post-merger by the merged entity itself (or are not available any more if they are discontinued). Some of the demand that would be lost following a price increase pre-merger will thus be recaptured by the merged entity post-merger.

[18] A price increase of the merging firms may induce some additional switching to the non-merging firms. This increase in demand for the products of the non-merging firms may lead to a price increase. See Ivaldi et al. (2003a).

so-called Bertrand-Nash differentiated products framework, which was applied by the Commission in recent mobile telecom cases to analyse the magnitude of non-coordinated effects, typically predicts more pronounced price increases by merging firms compared to those of competitors[19]. As both the merging firms and the competitors would have an incentive to increase prices, this model predicts a price increase also at the market level.

Coordinated effects may arise if the likelihood or the magnitude of coordination between competitors increases as a result of the merger[20]. A market structure particularly conducive to explicit or tacit collusion is one in which symmetric firms interact repeatedly, barriers to entry are high, the market outcome (e.g. prices, quantities) is transparent and there is potential for retaliation in case of deviation.

A merger can also entail (consumer) welfare-enhancing effects. This may be the case if the merger leads to increased efficiency and lower costs (or better quality), which are passed through to consumers. In the case of mobile telecommunications, efficiency gains due to a merger can mainly be realised by increased economies of scale (e.g. by more efficient use of the network equipment or the spectrum) but merging parties do not necessarily have an incentive to pass them through to subscribers (e.g. by lowering prices).

The total effect of a merger depends on the magnitude of anti-competitive effects and efficiency gains. If the merging firms can realise sufficient efficiency gains and the remaining competition is strong enough, a merger may improve the outcome for consumers. If instead the anti-competitive effects are more pronounced than the efficiency gains, the outcome for consumers deteriorates. Often this will lead to higher prices, compared to the scenario without the merger.

The overall effects of a merger may be further affected by commitments which are submitted by the notifying party. Indeed, such commitments aim at compensating possible negative effects on competition which are likely to occur otherwise.

The market price is probably the most prevalent dimension that affects consumer welfare and that is likely to be affected by a merger. However, there are also other important dimensions that may be affected, such as quality and variety. As explained in more detail in Section 4, due to data limitations this report focuses on the price effects of the analysed mergers.

3 Data

This section introduces the data sources employed in the econometric analyses, and explains how we construct a price index which aggregates the different dimensions of a mobile tariff plan.

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[19] See e.g. cases M.6497 *Hutchison 3G Austria/Orange Austria*, M.6992 *Hutchison 3G UK/Telefónica Ireland*, or M.7018 *Telefónica Deutschland/E-Plus*. The Bertrand-Nash differentiated products framework assumes that MNOs compete by setting prices in a differentiated products market to maximise their own profits.

[20] See Ivaldi et al (2003b).

A specific challenge of estimating merger effects in the mobile telecom industry relates to the fact that consumers generally purchase a *bundle* of mobile telecommunications services. Subscribers may *inter alia* place mobile calls, send text messages (SMS) and may also use mobile data services. A mobile tariff is usually characterized by the amount of mobile services (voice calls, SMS, mobile data) included in the monthly fee, the unit prices for the different "out of bundle" mobile services, as well as further fees such as for set-up/connection. The total expenditure of a subscriber for mobile services is then determined based on the usage and the chosen tariff. Given these specificities, one of the challenges in analysing the mobile telecommunications market is to derive a one-dimensional price index for a given mobile tariff. In this study we consider the monthly expenditure of representative consumer types for which we collected a representative usage pattern, and we estimate the effect of the merger on this monthly expenditure. In this report we refer to this measure as price. This approach is also followed by other econometric studies of the mobile telecom sector such as Genakos, Valletti, Verboven (2015) and Csorba, Pápai (2013).

Another price measure that could be used is the Average Revenues per User (ARPU)[21]. One of its main drawbacks is that the underlying usage changes over time[22]. Therefore, the analysis may falsely attribute price effects to a merger whereas they are actually caused by changes in the usage patterns. The price index that we construct is invariant to changes in the usage over time, and hence it is not affected by this shortcoming.

Another feature of the mobile telecom industry is price discrimination through the offer of nonlinear tariff plans. That is, operators offer quantity discounts (e.g. bundles with more included minutes, SMS and mobile data have a higher absolute price but a lower unit price for the different components than bundles with fewer included units of the same services) and consumers with different usage characteristics self-select into their preferred tariff plan.

To account for possible heterogeneous effects we consider three consumer types (i.e. consumers with low, mid and high usage), hence three expenditure levels. To isolate price effects from usage effects we consider a constant usage pattern which remains fixed over the period under investigation (for each consumer type).

In order to build a price time series for mobile telecommunications services, we collected detailed tariff data at the country level for the periods both before and after the merger. Additionally, we collected information on the average mobile telecommunications usage in each country as well as a set of further control variables which may explain changes in demand and supply of mobile telecom services over time.

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[21] Another measure used by Frontier Economics (2015) and Nitsche, Affeldt (2014) is the Average Revenue Per Minute, which is derived by dividing the voice ARPU by the number of average voice minutes per subscriber. Whereas this measure accounts for mobile voice usage changes over time, it appears to isolate the voice ARPU out of the total ARPU and we are not aware of a methodology which is uniformly applied across operators to that end.

[22] See also Genakos, Valletti, Verboven (2015).

To summarize, the following three sets of data are used in the econometric analysis:

- Data on mobile tariffs offered before and after the merger;
- Data on the average mobile telecommunications usage;
- A set of country-specific control variables which may influence the mobile telecom price level.

In the following sections, we discuss the data sources we use and how we calculate the price time series used in the quantitative analysis. In Section 3.1, we describe the tariff data, which is the basis for our price time series. In Section 3.2 we present the usage data and in Section 3.3, we show our method of calculating price baskets based on these data. Finally, in Section 3.4 we describe the further data sources we used for our estimations.

3.1 Tariff data

3.1.1 Tariff data sources

We use three different sources for tariff data:

- Data obtained from the data provider Teligen[23] that cover the tariffs of the largest two operators in fourteen European countries (including Austria and the Netherlands) between 2004 and 2010;
- Data obtained from the provider Telecompaper that cover tariffs of all operators in the Netherlands between 2004 and 2010;
- Data from the Austrian chamber of labour (*Arbeiterkammer* or AK) that cover the tariffs of all Austrian operators between 2004 and 2010.

In all cases, the tariff dataset covers the full range of retail tariffs available to new customers at a particular point in time and contains all the tariff elements which are needed to calculate a price per quarter (or month for some datasets) given a certain usage pattern (number of voice minutes and SMS). These tariff elements are:

- Activation charge/connection fee
- Monthly rental/fixed fee
- Minimum rental per month
- Number of minutes/SMS included in the fixed fee - by target network (i.e. on-network, off-network, national fixed network)
- Price per minute/SMS - by target network and peak/off-peak time

All datasets cover pre-paid as well as post-paid tariffs. Handset subsidies, if part of the tariff, are not separately identified in the available datasets. MNOs often offer very low and subsidized handset prices and expect to recoup the initial handset subsidies via the monthly payments of the subscribers. Table 1 gives an overview of the different tariff data sets available.

[23] See http://www.strategyanalytics.com/default.aspx?mod=saservice&a0=25#0

Table 1: Overview of tariff data used in the DiD analysis

	Teligen	Telecompaper	AK
Countries covered	AT, BE, CH, CZ, DE, DK, FI, FR, HU, IT, NL, SE, PT, UK	NL	AT
Operators covered	two largest per country	all	all
Frequency	quarterly	Monthly*	monthly
Period*	2004-2010	2004-2010	2004-present
Sub-brands	partly included	included	included

* start- and end-dates of tariffs available

The selected pool of control countries in the Teligen data includes all Western and Central European countries (see Table 1) for which sufficient data were available and in which no merger and no market entry or exit occurred during the period 2005-2009[24].

3.1.2 Tariff data issues

Unfortunately, there is no available dataset that covers all tariffs for all operators in all the countries we are interested in. Whereas Teligen is the best uniform data source we could find, it only covers the tariffs of the two largest operators, e.g., Mobilkom and T-Mobile for Austria and KPN and Vodafone for the Netherlands. We believe however that the prices of the largest two operators, which have a combined market share usually exceeding 60% in the respective markets, can be considered as a valid proxy for the overall market price level (see also Sections 5.2.2 and 6.2.3 where the prices of each MNO in Austria and the Netherlands are shown). Despite the data limitations, tariff data were not requested directly from the MNO, as data collection for the purpose of ex-post evaluation is currently not provided for in the relevant regulations of the European Commission.

The tariffs of one of the merging parties in Austria (tele.ring) and of both of the merging parties in the Netherlands (T-Mobile and Orange) are not included in the Teligen tariff data. In order to analyse meaningfully the effects of the two mergers we thus use in our main specification the AK tariff data for Austria and the Telecompaper tariff data for the Netherlands, respectively.

Missing handset subsidies may have an impact on the price effects that we estimate, especially if handset subsidies are also affected by the mergers we study. To control for this possibility we estimate our model also on the sub-sample of pre-paid tariffs, those tariff less affected by handset subsidies.

Sub-brands are not considered since it appears that they were not systematically included across the entire timeframe in the Teligen data. Business tariffs are generally not considered since business customers often obtain large discounts, meaning that business tariffs are less representative. We thus focus on the residential segment, which usually accounts for more than 70% of the retail market in terms of subscribers.

In order to check the quality of the data, we compared the Austrian Teligen data to the AK data and the Dutch Teligen data to the Telecompaper data. These comparisons are shown

[24] This is to ensure that there were no major structural changes in the market in the analysed period (see also Section 4.1).

in Sections A.1 and B.1 in the Annex, respectively, for the two countries. In the Austrian case, we find that the data matches fairly well, whereas for the Netherlands we find some more significant differences. Nevertheless, for both countries we conclude that the evolution of prices is similar across the two data sources. Further, in our econometric analysis we test whether the use of the Teligen data also for the affected countries might change the results.

An additional limitation of the data concerns the post-paid SIM-only tariffs. Teligen recorded these tariffs from Q2/2006 onwards. However, post-paid SIM-only tariffs were introduced earlier in some countries, for example since Q4/2004 in the Netherlands. To minimize the bias potentially introduced by this measurement error we excluded all SIM-only tariff plans from all the analyses, both for Austria and the Netherlands.[25]

Further minor data issues are presented in Annex C.

3.2 Usage data and definition of price baskets

To compute the monthly price associated with a certain tariff, we defined three usage baskets which cover:

- the number of minutes to fixed line (national);
- the number of minutes to mobile on-net (national);
- the number of minutes to mobile off-net (national); and
- SMS (national).

The baskets do not include international calls, calls to voicemail, MMS and data services[26]. Data services were not included since the usage in the period considered (from Q2/2004 to Q2/2008 for Austria and from Q3/2005 to Q3/2009 for the Netherlands) was still relatively low, especially in the first part of the period.

Information on average voice and SMS usage for the fourteen countries used in the analysis for the relevant years were obtained from publicly available sources (e.g. websites of the relevant national regulatory authorities). The average voice and SMS usage for the fourteen countries is depicted in Table 2.

The countries' average usage baskets (minutes and SMS) was kept constant over the period considered in the analysis to prevent changes in the consumption pattern from influencing the tariffs' price series. For the analysis of the Austrian merger we keep constant the 2006 consumption levels (also for all countries) and for the Dutch merger we do the same using 2007 as base year. Although we use fixed consumption baskets we still use country-specific consumption bundles in order to better reflect the countries' specificities and the significant differences across consumption preferences and resulting price patterns (indeed

[25] In the Teligen dataset the SIM-only classification refers to the post-paid SIM only tariffs. Pre-paid SIM-only tariffs are recorded as pre-paid and are included in the analysis.

[26] With regard to international calls, the relevant information (per minute tariffs to different destinations and usage) is not available in most cases. Furthermore, the share of international calls is rather low compared to national usage and it can be assumed that a particular tariff is usually not chosen based on international call prices. Similar arguments apply for calls to voicemail and MMS.

the tariffs offered in one country are likely to reflect the characteristics of consumption specific to that country).[27]

Table 2: Average usage in the fourteen countries in 2006 and 2007 per month[28]

		AT	BE	CH	CZ	DE	DK	FI	FR	HU	IT	NL	PT	SE	UK
2006	min to fixed	19	12	25	9	18	27	29	31	8	20	20	6	28	31
	min on-net	65	51	26	93	22	53	57	81	61	14	25	60	54	30
	min off-net	33	22	14	52	10	25	27	36	32	48	26	18	26	25
	SMS	18	60	41	93	20	145	15	24	16	35	22	88	26	55
2007	min to fixed	22	12	23	9	22	27	26	28	7	21	21	6	30	32
	min on-net	75	56	34	97	29	56	54	79	67	13	24	61	64	37
	min off-net	38	21	13	49	9	28	27	38	32	52	28	18	32	31
	SMS	29	60	39	84	21	157	48	29	15	42	26	121	51	71

To analyse the effects in different market segments and also to cover a larger range of tariffs, we construct a High and a Low usage basket based on the average usage of Table 2. The factors applied to the average (Mid) usage basket are taken from the OECD's study on mobile tariffs[29] and are depicted in Table 3.

Table 3: Factors for Low and High usage basket based on OECD Baskets

Basket	Minutes factor	SMS factor
Low	0.46	0.66
Mid	1	1
High	2.15	1.1

3.3 Calculation of price indexes

For a given usage basket, we computed the monthly tariff price index using the tariff data and the following assumptions:

- The average call duration is 2 minutes. Besides that, billing intervals are not taken into account.
- The off-net calls are split equally among the other MNOs active in the country.
- The shares of peak and off-peak (i.e. evenings and weekends) calls are 50%.
- One-time fees (e.g. activation fee) are spread over 24 months, which is often the minimum contract duration for post-paid tariffs with subsidized handsets.

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[27] For a robustness check on the analyses of the Austrian and Dutch mergers, we also use a common average OECD usage pattern with 62 minutes (which are split in 14 minutes to fixed, 32 on-net, and 16 off-net) and 50 SMS across all countries. See OECD (2006).

[28] Sources: Information on national regulatory authorities' webpages or via direct contacts; SE, FI, DK: "Telecommunication Markets in the Nordic Counties" (https://www.viestintavirasto.fi/en/aboutthesector/studiesandsurveys/telecommunicationmarketsinthenordiccountries-julkaisu.html).

[29] See OECD (2006), p. 6.

To improve the comparison across countries, the following adjustments have been applied to the tariff price series:

- Applicable value added taxes have been deducted from the tariff price series because in some countries the VAT changed during the period of the analysis[30].
- We incorporated inflation by computing real prices using the Harmonised Indices of Consumer Prices (HIPC)[31].
- For non-Euro countries (Czech Republic, Denmark, Hungary, Sweden and the UK) we converted the price from local currencies into EUR. To limit the impact that fluctuations of the exchange rate may have on the countries' price series, we used a constant nominal average exchange rate over the years 2004-2009[32].

We intend to capture the evolution of the prices of those tariffs that are likely to be purchased by an average consumer whose consumption pattern resembles the usage baskets described above. To this end, for each usage basket we include in the analysis only the prices of the four cheapest tariffs per operator. We could have considered a smaller number of tariffs (i.e. the cheapest tariff available given the consumption pattern). However, we believe that including the four cheapest tariffs has some advantages. First, it is a shortcut to reflect heterogeneity across the users for each average usage basket[33]. Second, users may not know their exact behaviour in advance and may more generally not be rational, so that they do not choose the tariff which is cheapest from an ex-post perspective. Third, it averages out smaller measurement errors of tariffs and further data issues as discussed above in Section 3.1.2[34]. Nevertheless, as a robustness check, we also focus on the two cheapest tariffs only.

Figure 1 shows the price series for the Mid basket in the affected countries (Austria and the Netherlands) and in the twelve countries which potentially serve as control group. All countries experience a downward trend in the mobile telecom price for the Mid consumption basket[35]. Nevertheless, there is significant variation in the development over time with some countries experiencing a faster reduction in prices than others. In the estimation of the counterfactual price for Austria and the Netherlands we consider these possible differences and their impact on our estimation.

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[30] For example, in the relevant period, the VAT rate in Czech Republic changed from 22% to 19% in Q3 2004.

[31] Source: Eurostat, 2005=100.

[32] Source: Eurostat.

[33] Tariffs which are cheap but not cheapest for the specified usage baskets may become the cheapest tariffs if the usage basket is slightly modified.

[34] In particular, tariffs that include a lower monthly fee often also include lower handset subsidies. Given that we do not observe the handset subsidies in our available data, we cannot exclude that tariffs with a higher monthly fixed fee may even be more attractive for some consumers if they at the same time offer higher handset subsidies.

[35] Also for the other baskets (low and high) we observe a similar decreasing trend in the tariff prices.

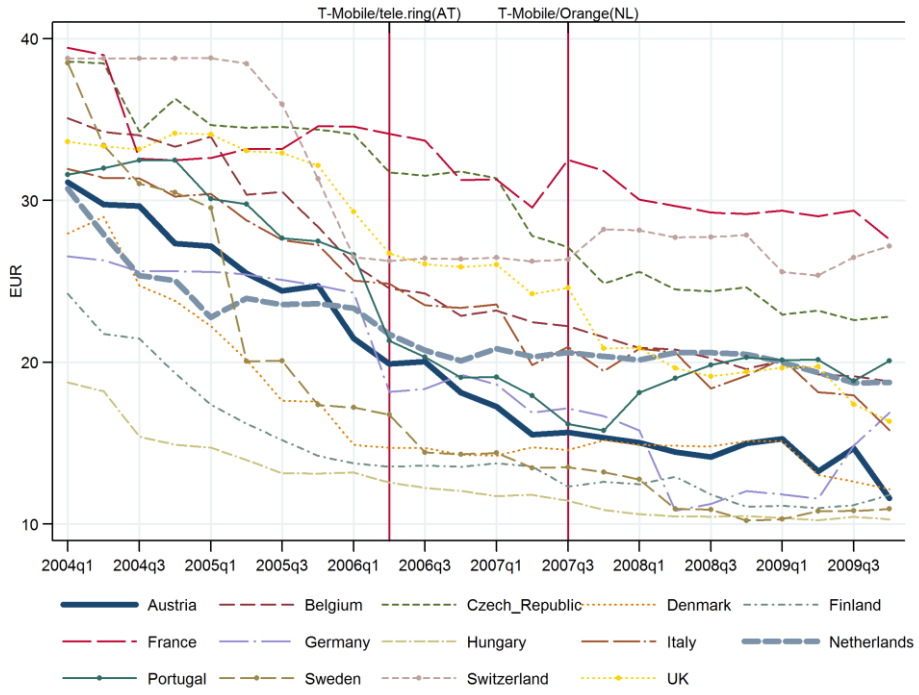

Figure 1: Countries' price series from 2004 to 2009 (Mid basket)[36]

3.4 Other data

Changes in price levels or trends observed in the period under analysis may be caused by market developments not associated with the mergers. In particular, changes in supply and demand conditions may well have an impact on prices.[37] In order to capture such changes, the following variables are included in the analysis:

- Mobile termination rates (MTRs) which can be considered as a proxy for marginal costs of off-net calls to other mobile networks[38].
- Growth of gross domestic product per capita (GDP), as a proxy for changes in demand conditions[39].

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[36] For Austria and the Netherlands we plot the average country expenditure on the basis of the national databases (AK and Telecompaper); for the control countries we use the Teligen data.

[37] The inclusion of control variables in the model may also control for confounding trends and reduce the variance of the errors that in turn might reduce the standard errors of the estimate of interest (see Pischke (2007)).

[38] Operators need to pay MTRs to MNOs for calls which terminate on the latters' networks in order to compensate them for the costs of incoming calls. The MTRs are often regulated and cost-oriented. Expenses due to mobile termination increase in the number of mobile voice minutes which are terminated on other networks. Source: IRG/BEREC reports. See IRG/BEREC, MTR snapshots Jan 04 – Jul 10: http://www.irg.eu/template20.jsp?categoryId=260345&contentId=544607

[39] Source: Eurostat. GDP growth is stationary and therefore preferred to GDP in levels.

Summary statistics of the price variables and these control variables are reported in the Annexes (Table 14 and Table 27 for Austria and the Netherlands, respectively).

4 Econometric Approach

The effect of a consummated merger is identified by comparing the actual outcome after the merger to the hypothetical outcome which would have occurred in the absence of the merger. Since for the treated country (i.e. the country in which the merger takes place) only the actual outcome with the merger can be observed, the hypothetical outcome without the merger (the counterfactual) has to be estimated.

This study uses reduced form econometric methods to estimate the effects of the analysed mergers. First, we follow the difference-in-differences (DiD) approach, which is widely used in the policy evaluation literature. This approach compares in a standard regression framework the price changes in Austria and the Netherlands before and after the merger to the price changes observed in a control group of countries where no merger took place. With respect to the mobile telecom industry, the effects of the analysed merger were presumably confined to the respective affected countries, as competition takes place on the national level and as the mergers have not changed the competitive structure in the control countries. Second, we also implement another estimation methodology, known as synthetic control group approach, whereby a synthetic control is constructed by weighting the prices of selected control countries. The merger effect is then identified as the difference between the post-merger price of the treated country and that of the synthetic control.

Under both approaches the main focus of our analysis is to estimate the market-wide effect of the mergers under study. This average effect is estimated on the basis of an average market price that is equivalent to an unweighted average price across all MNO in the country of interest[40].

Whereas the econometric framework presented in this section could be also applied to estimate merger effects on network quality, this is beyond the scope of this study mainly due to severe data limitations. It appears very difficult to obtain data on suitable indicators of network quality which would be available for all countries included in the analysis. An indirect indicator of network quality which is used by Genakos, Valetti, Verboven (2015) is the level of capital expenditures[41]. However, estimating effects of mergers on capital expenditures leaves open the important issue of whether larger operators can invest more efficiently into network quality; that is, whether after the merger with the same level of investment per subscriber a higher network quality can be achieved. In that context, a further challenge is that the impact of mergers on network quality probably materializes

[40] We could have also weighted the contribution of the different MNOs according to the share of newly started contracts, but we do not have access to this information. Moreover the volume of actually sold tariffs may rather reflect choices on the basis of the actually chosen consumption bundles as opposed to choices based on the hypothetical bundles we use. We hence adopted a symmetric weighting.

[41] Genakos, Valetti and Verboven (2015) in their main specification estimate the effects of concentration on the capital expenditures per operator. This indicator does not allow separating an increase in investments necessary to serve an increased number of hosted subscribers per operator (which would not increase network quality) from an increase in investments which indeed improves the network quality.

much slower than price effects. Therefore, a longer period would need to be analysed, which in turn would increase the scope for confounding effects unrelated to a given merger.

4.1 Difference-in-differences methodology

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

In its simplest application, the DiD approach is based on the assumption that the price change over time observed in the control group approximates the price change that would have occurred in Austria and the Netherlands (treated countries) absent the respective mergers. The underlying rationale of this approach is that unobserved effects have a similar impact both on the control group and on the treatment group. The DiD approach can therefore be applied if the control group satisfies two requirements: first, it is affected by similar shocks as the treated country[42] and second, it is not affected by the studied merger (no spillover effects).

Within a difference-in-differences framework, to identify the treatment effect, the treated group is compared to a control group which is not subject to treatment but otherwise similar in terms of observable characteristics. In our case we compare prices in Austria and the Netherlands, respectively, to a group of European countries where no merger and no MNO entry/exit occurred in the relevant time period[43]. Under the assumption of common (price) trends, the merger effect is identified by comparing the average (across group) differences in prices before and after the merger. In its simplest form, the DiD can be calculated as

$$(1) \qquad DiD = (p_i^{post} - p_i^{pre}) - (p_{i'}^{post} - p_{i'}^{pre})$$

where p_i are the prices of tariffs in the treatment country (Austria or the Netherlands) averaged across the post- or pre-merger period (indicated by the superscripts *post* and *pre*) and $p_{i'j}$ are the respective prices of the control group. A positive merger effect, for example, would mean that prices of the treatment group increased on average relative to the control group after the merger, indicating a negative effect on competition[44].

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[42] This requirement can be somewhat relaxed by accounting for linear trends as will be explained below.

[43] Table 1 lists the control countries. For the reasons explained in Footnote 55, Denmark is excluded from the analysis of the Austrian T-Mobile/tele.ring merger.

[44] The DiD framework correctly identifies the merger effect only to the extent the timing and the occurrence of a merger is not endogenous. However, this requirement may not be met since the timing and occurrence of mergers may well be related to the competitive conditions which also affect prices. Hosken (2012) argues that the synthetic control approach to some extent addresses this issue.

As shown in Figure 1 above, the average prices of those countries do not necessarily share the same pre-merger trend as the prices in Austria or the Netherlands, respectively. Further explanatory variables may explain these differences to some extent. We therefore include in our regression MTRs and the GDP growth rate, two time varying control variables that might affect the price of mobile services and explain the different evolutions over time.

In this setting, we estimate the following fixed effects model (Base specification):

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

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

For our analysis the coefficients of interest are γ_{short}, γ_{medium}, which can be interpreted as the merger effect in the first and second years, respectively, following the merger.

The hypothesis that the control group and the treated country are subject to similar unobservable effects after the merger is not testable. However, in line with the literature, if two countries have a similar pre-merger trend this indicates that similar unobserved factors might affect both countries equally. A similar pre-merger trend may thus bolster the reliability of the estimated price effects[45]. As done in Hastings (2004), we present a visual comparison of the development of the price series both pre- and post-merger as a graphical check of the common trend hypothesis (Section 5.2.3 and 6.2.4 for Austria and the Netherlands respectively).

Beyond the graphical analysis we then carry out a formal test of the common trend hypothesis. To perform this test we first estimate the deviation of the treated country's price from the average price of the control countries in each quarter. Then, the test assesses whether the deviations of the treated country's price in the pre-merger period follow a different trend than the average price of the control countries[46].

In some cases, we see that the time varying control variables (MTRs and GDP) do not fully explain the observed differences in the price trends across countries, as we have evidence

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[45] See the discussion in Angrist, Pischke (2008).

[46] Formally, we substitute the short-term and medium-term effect dummies in equation (1) with one dummy variable for each quarter that assumes the value of 1 only for the treated country in the relevant quarter. We then compute the slope of a linear trend of the coefficients of these dummies in the pre-merger period and test whether the estimated slope is statistically different from zero using the *lincom* command in Stata. Our test is similar to the one proposed by Ashenfelter, Hosken, Weinberg (2013) and to the one discussed by Angrist , Pischke (2008).

that country prices might be affected by a number of other (non-random) unobserved factors that we cannot fully control for.

We try to address this issue with a twofold strategy. First, within the regression framework we modify the model specification of Equation (2) by allowing for the possibility that unobservable factors introduce different (linear) price trends across countries[47]. Second, we implement the synthetic control group methodology (see Section 4.2).

In the DiD specification with country-specific trends we follow an approach similar to Wolfers (2006), where it is shown that the simple inclusion of country-specific trends as controls in the standard difference-in-difference framework may lead to biased estimates, as the effect of the merger might be partially confounded with the estimated trend (especially when there are dynamic effects, as there might be in our case). Hence, in our approach the merger effect is identified by assuming that for the treated countries the country-specific (linear) price-trends in the pre-merger period remain unchanged post-merger. Formally, we estimate the following specification ("Trend specification"):

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

Here, $\sum_i \partial_i t$ represents the country-specific linear trends. We estimate the effect of the merger using the dummies $D_{i,t}$ for each quarter after the merger (where t^M is the date of merger)[48]. In our analyses these are eight dummies and $D_{i,t}$ takes the value of one only for the treated country in quarter t. The coefficients γ_t capture for each quarter the estimated effect of the merger relative to the counterfactual. We then compute the average effect of the merger in the short term and in the medium term; that is, in the first and second years after the merger, by taking the average of, respectively, the estimated coefficients of the first four dummies and the last four dummies[49].

Whereas the identification of the merger effect under our basic DiD approach relies on the assumption that unobserved effects have a similar impact on the treated and control countries absent the merger, the identification of the effect of the merger under this modified model relies on a different assumption. When including country-specific trends as in Equation (3), the identification of the effect relies on the assumption that absent the merger the (log) price in the treated country would have followed the same pre-existing trend that characterized the pre-merger period (after controlling for the other time varying explanatory variables and for the common time effect).

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[47] This modelling is now commonly applied in the DiD literature, see e.g. Angrist, Pischke (2008), section 5.2.1.

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

[49] To make inference, we compute the standard error of the averages.

Which of the two assumptions is more appropriate depends on the specific context. Although we provide some graphical and statistical indication to discuss the suitability of either assumption, this can only be done by studying the pre-merger period. In particular, patterns observed in the pre-merger period may not have necessarily also held in the post-merger period in the absence of the merger, especially in a dynamic market like the one under study. Moreover, we have only a few pre-merger observations, four quarters for the Netherlands and eight quarters for Austria, which may not be sufficient reliably to identify long-term trend differences between countries[50].

The main objective of our analysis is to estimate the market-wide effect of the mergers under study. As regards the regression analysis within the difference-in-differences framework, we estimate the effect of the merger at the country level, capturing the overall merger effect on the treated country. However, our tariff data also includes the name of the MNO which offers a given tariff. Hence, we could also estimate the effect of the merger at the MNO level, by separating the merger effects across the MNOs operating in the given treated country[51]. In the Annexes, for the respective countries, we also briefly comment on this analysis. This more detailed analysis effectively decomposes the average market-wide effect into the price changes by MNO. As will be clear in the following sections, already the cross country comparison poses challenges in terms of satisfying the basic assumption of the DiD framework. These challenges are likely to be further exacerbated when trying to estimate the merger effect by MNO. Hence, we believe that the estimated MNO-specific effects should not be interpreted as being necessarily caused by the analysed mergers.

To properly estimate the MNO-specific effects we would need to estimate MNO-specific counterfactuals that take into account both common country developments and heterogeneous movements within the same country. Such analysis would probably require far more detailed and more comprehensive data at the operator level for both the treated and control countries, and it is out of the scope of this analysis.

Inference and computation of standard errors

In both regression specifications (Base and Trend), we account for autocorrelation and heteroscedasticity in the residuals by using a cluster-robust estimator with clustering at the country level[52]. This allows the error terms to be correlated within a country and over time,

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[50] For example, there may be episodes of more intense competition giving rise to price drops which are then followed by episodes of less intense competition. If we do not observe a long enough time series we may not be able to separate the effect of short-term developments from medium-term trends. This is an issue also raised in Wolfers (2006), where he suggests using long pre-intervention periods.

Moreover, given the short pre-merger periods we can only model a simple linear trend as any other more sophisticated functional form (like a quadratic trend) would require many more data points for a correct identification.

[51] In the synthetic control group approach we only consider aggregate country level outcomes as this technique is mostly suited for the comparison of aggregate outcomes.

[52] Not taking into account existing autocorrelation can lead to too low standard errors and therefore the erroneous finding of statistically significant results (see Bertrand et al, 2003). We use the option *vce(cluster)* which clusters standard errors by country and corrects for autocorrelation in Stata. Another way to deal with the autocorrelation issue would be to estimate the model in first differences (see

but not across countries. However, the small sample of available countries (and, therefore, clusters) likely introduces a downward bias in the standard errors, and, in turn, spuriously increases the statistical significance of the merger effects estimated by the models[53].

One way to correct for this bias is to increase the number of clusters by, for example, clustering at MNO-country level. This, however, assumes that the error terms are not correlated across the MNOs of the same country, which we believe is an unreasonable assumption. Another way suggested by the literature to correct for the bias of low number of clusters is to compute standard errors using the *wild bootstrap* method introduced by Cameron, Gelbach, Miller (2008)[54]. However, the findings of the wild bootstrap tend to underestimate the significance level of the estimates in case of a strong imbalance in the number of treated units relative to the number of control units, and particularly in case of only one treated unit and few control units, as in our setting (see Brewer, Crossley, Joyce (2013) and MacKinnon, Webb (2014)). This suggests that the true significance level is likely to be somewhere in between the cluster-robust and the wild bootstrap corrections.

In the following, we report the significance of our point estimates based on cluster-robust standard errors, as this is a standard approach which is commonly used in the applied literature (and we will only provide a brief summary of the wild bootstrap standard error). However, one should bear in mind that the reported p-values are likely to be underestimated (and hence the significance of our estimates overestimated).

4.2 The synthetic control group approach

As mentioned above, the second approach we implement to control for possible differences of the treated and control countries is the synthetic control group method that was developed by Abadie, Gardeazabal (2003) and later refined by Abadie, Diamond, Hainmueller (2010 and 2015). In the context of ex-post merger evaluation the same approach, together with a standard DiD analysis, is also used by Hosken (2012).

The main innovation of the synthetic control group approach is to offer a data-driven procedure to select the control group units that are used to estimate the counterfactual. This method may be particularly compelling for instances when certain untreated units do not provide a good comparison for the unit affected by the treatment or event of interest. This is often the case when the treatment affects large aggregates like regions or countries, so that only a limited number of untreated units are available. Based on the proposed systematic way to select comparison units we also propose a framework to conduct statistical inference. The synthetic control method exploits the pre-merger period information so as to produce a weighted average of the available control units. Specifically, the relative importance of each control unit is the outcome of an algorithm that, given some "predictor" variables, minimizes the distance between the realizations of the

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Csorba/Papai, 2013). This method might be more useful with yearly data (as in Csorba/Papai, 2013) compared to quarterly data.

53 See Wooldridge (2003) for an overview.

54 Donald and Lang (2007) and Conley and Taber (2011) suggest further methods to account for a small number of clusters when deriving standard errors.

predictors in the treated countries and the (weighted) average of the predictors in the control countries. Given this procedure it is then possible to verify the relative weight of each unit to the estimation of the counterfactual and the pre-intervention similarities between the actual series and the estimated "synthetic" one.

We exclude treated countries from the synthetic control. Specifically, when analysing the T-Mobile/tele.ring merger in Austria, the Netherlands as well as Denmark are excluded because of mergers in the relevant time period, while for the analysis of the T-Mobile/Orange merger in Netherlands, Austria is excluded[55]. To construct the synthetic control group we use the following predictor variables: the mean of GDP growth and (log) MTRs over the pre-merger period, and the pre-merger (log) prices in three different quarters, Q2/2004, Q2/2005 and Q1/2006 for Austria and Q2/2006, Q3/2006 and Q1/2007 for the Netherlands[56].

The synthetic control method computes the weights that minimize the difference between the predictors in the treated countries and the weighted average of the predictors in the control countries. Once the weights are estimated in the pre-merger period we can compute the price development of the synthetic control in the post-merger period. This series represents the counterfactual price development of the treated country absent the merger.

The effect of the merger can then be calculated as the difference between the actual and synthetic price series in the post-merger period.

To assess the statistical significance of the measured effect, we then follow the "falsification" approach proposed by Abadie, Diamond, Hainmueller (2010 and 2015). We conduct a series of "placebo" studies by applying the synthetic control group approach to each non-treated country (with the remaining countries as control), as if each country experienced a merger in the same period as Austria and the Netherlands, respectively. Hence, we create 11 "placebo mergers" for the Austrian analysis[57], and 12 "placebo mergers" in the Netherlands, and we compare the merger effect of the placebos to the estimated effect of the actual merger.

Comparing the effect of the "true" merger to the effects of the placebo mergers allows us to assess whether the effect estimated for Austria or the Netherlands is large compared to the effects estimated for the countries not subject to a merger. To assess this we follow Abadie, Diamond, Hainmueller (2015), and calculate the ratio between the post-merger

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[55] Likewise in Denmark, a merger between TeliaSonera AB and Orange A/S occurred in September 2004, which may have affected the retail prices in the aftermath of that merger. We therefore do not use Denmark as a control country when analysing the T-Mobile/tele.ring merger. Denmark is not excluded for the analysis of the T-Mobile/Orange merger in Netherlands, since the Danish merger occurred almost three years before the Dutch merger was closed.

In the UK a merger occurred in 2010 (Orange and T-Mobile). This does not affect our analysis since we restrict our observation period to Q3/2009 (2 years after the Dutch merger).

[56] We use as predictors three distinct datapoints for the price so as to select countries that shared a similar path of price development in the pre-merger period.

[57] There are 12 placebo mergers for the Netherlands as we also include Denmark in the control group pool.

Root Mean Squared Prediction Error (RMSPE) and the pre-merger RMSPE for Austria, the Netherlands, and their respective placebos. The RMSPE is the root of the average of the squared difference between prices in the treatment country and prices of the synthetic control group in the pre-merger or post-merger period. The RMSPE ratio hence weights the post-merger effect (the difference between actual series and its synthetic series in the post-merger period) by the "fit" of the synthetic control in the pre-merger period. For a given pre-merger RMSPE, a higher RMSPE ratio indicates a larger merger price effect (either positive or negative).

If the placebo mergers have a smaller RMSPE ratio than Austria (or the Netherlands), it can be argued that the effect measured for Austria (or the Netherlands) is unlikely to be driven by random factors. We therefore rank the RMSPE ratios measures obtained by analysing the merger in Austria (or the Netherlands) and the respective placebo tests. The rank of the treated country can be directly translated into the probability of finding a RMSPE ratio which is not below the RMSPE ratio observed in the treated country in the sample of RMSPE ratios. Similar to inference based on asymptotic distributions, the smaller the probability of finding a RMSPE ratio which is larger than the RMSPE ratio of the treated country, the more likely is that there was an effect of the merger.

However, this non-parametric inferential method relies on the size of the sample of control countries, as the distribution of RMSPE ratios can be better traced out if more observations are available. In our case we only have 11 or 12 potential control countries, respectively for Austria and the Netherlands. Hence, even if the RSMPE ratio of a treated country is the highest of all observed RSMPE ratios, the probability of randomly obtaining an estimate of at least the estimated effect in the sample cannot be lower than 1/13=0.077[58]. The formal maximum probability of finding an effect at least as large as the one of the treated country is thus limited by the number of control countries. Nevertheless, if the RSMPE ratio of a treated country is above the RSMPE ratios of the placebo tests, this indicates that the merger has likely had a significant effect on prices. In what follows, we refer to the effect of a merger being significant if the associated RSMPE ratio is higher than the RSMPE ratios of all placebos; that is, if it is ranked first.

5 Analysis of the merger T-Mobile/tele.ring in Austria

In this chapter, we discuss the analysis of the merger between T-Mobile and tele.ring in Austria. Section 5.1 puts the case in perspective by describing the main facts of the merger proceeding. Section 5.2 presents a descriptive analysis of the market developments before and after the merger. Section 5.3 discusses the results of the econometric analysis. Section 5.4 presents the conclusions based on the quantitative and qualitative analyses.

5.1 The T-Mobile/tele.ring merger proceeding

T-Mobile acquired the rival mobile operator tele.ring in April 2006, after antitrust approval. At the time of the merger there were five mobile network operators (MNOs) active on the Austrian market: Mobilkom Austria (with the brand A1) owned by the Austrian fixed network

[58] We refrain from conducting more placebo mergers by exploiting the time dimension since we have autocorrelation in the price so that the measured placebo effects would not be independent.

incumbent Telekom Austria; T-Mobile; Orange (named "One" until September 2008); tele.ring and Hutchison 3G (H3G), which was the last MNO to enter the Austrian market in late 2003.

The five operators were licensed sequentially and their market shares prior to the T-Mobile/tele.ring merger were highly asymmetric (Table 4), reflecting the different timing of entry. Mobilkom had the highest market share by far (around 40%) followed by T-Mobile (24%), Orange (20%), tele.ring (12%) and H3G (3%).

Table 4: MNO market entry and subscriber market shares (Q1/2006)

	Mobilkom	T-Mobile	Orange	tele.ring	H3G
Year of market entry	1993	1997	1998	2000	2003
Market share before merger (Q1/2006)	39.5%	24.4%	20.7%	12.0%	3.3%

In August 2005 T-Mobile Austria announced its plan to acquire the rival operator tele.ring. This transaction was subject to the approval of both the Austrian telecommunications regulator (Telekom Control Kommission, TKK) and the European Commission (EC or the Commission).

The transaction was notified to the EC in September 2005. The preliminary investigation (Phase I) led the Commission to initiate an in-depth investigation (Phase II) in November 2005. The Commission's analysis concluded that tele.ring was the most aggressive player in the mobile market, and exerted competitive pressure especially on T-Mobile and Mobilkom, the two main MNOs. Hence, the proposed transaction was likely to have a tangible effect on prices (although prices were not expected to rise in the short term, the falling price trend would have likely been curbed). This conclusion was based on the analysis of market shares, switching rates, price developments, and incentive structures[59]. To overcome the Commission's competition concerns, T-Mobile offered a package of commitments that were assessed and finally accepted by the Commission, which authorised this acquisition on 26 April 2006, subject to the implementation of the offered commitments described below[60].

[59] In the period from 2002 to mid-2005 tele.ring doubled its market share in terms of revenue and almost tripled its market share in terms of customers. Over the same period T-Mobile's and Mobilkom's shares decreased significantly and Orange's subscriber share remained stable. The analysis of switching data indicated that tele.ring exerted the strongest competitive pressure in the market, in particular on Mobilkom and T-Mobile. The price analysis showed that tele.ring was the provider offering the cheapest tariff most frequently, followed by H3G. T-Mobile, Mobilkom and Orange offered the lowest prices in considerably fewer cases. The Commission also concluded it was unlikely that H3G or Orange/Yesss! would replace tele.ring's position and discipline the competitive behaviour of the other two MNOs. H3G limited coverage and dependency on the national roaming agreement limited H3G's pricing behaviour. Orange was not considered as competitive as tele.ring in terms of prices (also Orange's low cost brand Yesss! was purely pre-paid, targeting low volume customers, so its services were not comparable to tele.ring or H3G).

[60] See Commission decision of 26 April 2006 declaring a concentration to be compatible with the common market and the EEA Agreement (Case No COMP/M.3916 – T-MOBILE AUSTRIA/TELE.RING), http://ec.europa.eu/competition/mergers/cases/decisions/m3916_20060426_20600_en.pdf.

In addition to the Commission's assessment, the Austrian TKK analysed the effects resulting from the spectrum transfer from tele.ring to T-Mobile. On 26 April 2006, the TKK also approved the transaction subject to conditions. These conditions obliged the merging parties to sell spectrum to the remaining smaller operators (Orange and Hutchison) within nine months and were compatible with the commitments accepted by the European Commission.

Commitments

The commitments offered by T-Mobile provided for the transfer of parts of tele.ring's spectrum and of mobile telecommunication sites to competitors (H3G, Orange and possibly a new entrant). The Commission considered that these commitments were capable of eliminating the competitive risks identified in the assessment of the transaction. In particular, the remedies were expected to enable H3G, which before the merger had only limited coverage and relied to a large extent on national roaming, to achieve a nationwide mobile communications network, and thus to create competitive pressure in the mobile telecommunications market comparable to that previously exerted by tele.ring.

The implementation of the commitments involved several stages. In December 2006, Orange and Hutchison notified the spectrum transition, later approved (in January 2007) by the TKK. From January to October 2007, about 1800 sites were transferred to H3G in several steps. During the same period around 100 sites were purchased and transferred to Orange. Finally, T-Mobile also complied with further commitments and *inter alia* established preferred collocation rights for Orange on 530 sites and concluded a contract with H3G on access to its fibre backbone infrastructure.

Since the T-Mobile/tele.ring merger was modified by commitments, our ex-post evaluation of the merger does not allow separating the effects of the unmodified merger and of the commitments. The implementation of the commitments started soon after the conditional clearance of the merger and we cannot exclude that the MNO's pricing decisions were influenced by the anticipated remedies after these had been made public by the conditional clearance decision[61]. Hence, we observe only the price developments of the modified merger and estimate the price changes in the absence of the transaction. We do not construct the price changes that would have resulted from the unmodified merger as originally notified since this would have required imposing very strong assumptions[62]. Therefore, in what follows, we analyse exclusively the effects of the merger including the submitted commitments.

5.2 The Austrian mobile telecom market

5.2.1 Evolution of retail market shares

At the time of the merger the four main Austrian MNOs each had nationwide coverage with their proprietary network. Only H3G's coverage was still limited (around 50%) as it entered

[61] Similar considerations as discussed in Footnote 122 may apply.

[62] Indeed, since the (magnitude of the) effects of mergers may be very different, even across mergers that take place in the same industry, it appears to be very difficult to construct price changes of hypothetical unmodified mergers. Moreover, only very few other mergers took place in the relevant period.

the market as a pure 3G operator. To retail a nationwide offer H3G had a national (unregulated) roaming agreement with Mobilkom for 2G traffic.

Following the merger, tele.ring was kept by T-Mobile as a separate brand. The merged entity had a combined market share of 35%, a level just below the market share of the incumbent Mobilkom. However, in the following years T-Mobile/ tele.ring's market shares decreased over time while Mobilkom's increased. By the end of 2009, the difference in terms of market shares between the two largest operators of the Austrian mobile telecom industry had grown from around 5% to around 13% (see Figure 2).

The market share of the incumbent Mobilkom experienced only minimal variations over the relevant period. In 2004 its market share was about 43% and declined to a minimum of around 39% at the end of 2006. From then on Mobilkom constantly increased its market share to reach a level of about 43% again by the end of year 2009[63].

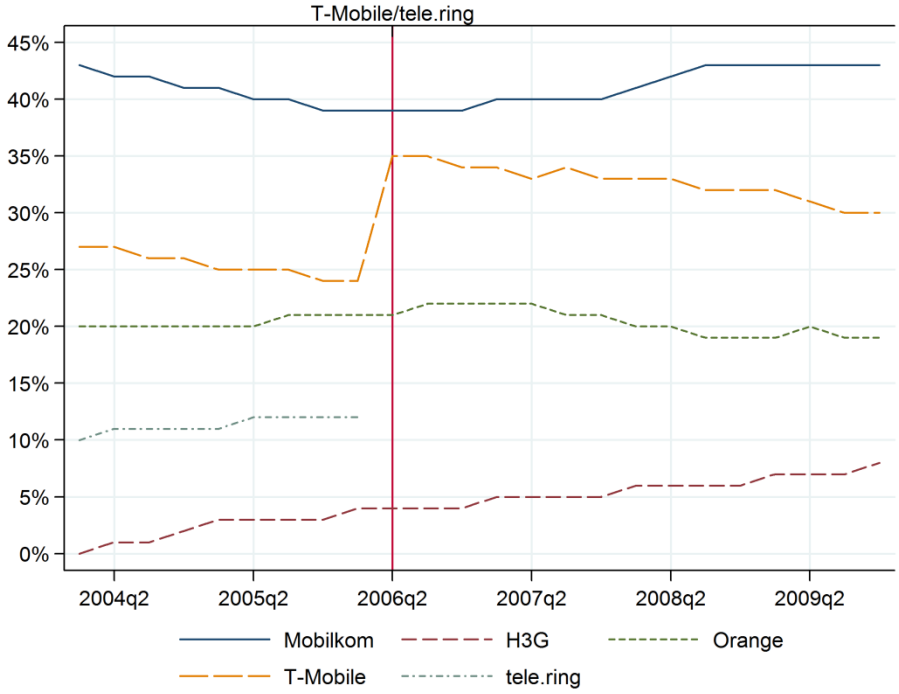

Figure 2: MNOs market shares (subscribers) in Austria 2004-2009[64]

The market share of Orange, the third operator by subscribers, remained fairly constant over the relevant period with a slight market share increase in the period 2006-2007 and then a slight decline afterwards[65].

[63] The market share figures for Mobilkom include also the customers of the second brand bob, launched in year 2007. As Mobilkom does not report the dis-aggregated figures at brand level we cannot separate the two.

[64] Market shares include sub-brands and MVNO hosted by the respective MNO.

The MNO that grew constantly over the entire period was H3G. Several factors might explain this constant growth path. First, H3G was the last MNO to enter a relatively concentrated market in late 2003 and it took time to build a reputation and to attract customers both from other operators and from the pool of new customers. Second, H3G started with only limited coverage on its proprietary network (based on 3G technology) and coverage was expanded over time. Network expansion (together with increased demand for 3G services) might explain the continuous growth of H3G over the relevant period with no sign of reaching equilibrium.

In Austria during the period of interest, the importance of MVNOs was limited. The only significant MVNO entry was Tele2, an alternative fixed network operator that entered the market on the Orange network in 2003. Tele2 then left the market in 2007, when it sold its mobile business to Mobilkom. Throughout this time period, its market share remained below 2%.

Although virtual operators played only a marginal role, in the period 2005-2008 most MNOs introduced sub-brands as a mean to differentiate their products further, especially to target price-sensitive customers better. Orange was the first to introduce its sub-brand "Yesss!" in April 2005, and Mobilkom followed by introducing the sub-brand "bob" in July 2007. Both focused on the "no-frills" segment (no subsidised handsets, no shops) and significantly undercut the prices of the mother company. In addition, T-Mobile also launched its sub-brand "S-Budget" in the no-frills segment in Q4/2008.

5.2.2 Retail prices within Austria

This section presents some qualitative evidence on the developments of the average prices of the different MNOs (and of their second brands) active on the Austrian mobile market both pre- and post-merger. We consider the price measure described in Section 3.3. In particular we discuss the development of the average prices computed for the hypothetical consumption profile Mid (Figure 3). Nevertheless, the conclusions drawn for this basket apply similarly to the other baskets of consumption (Low and High baskets).

[65] The market share figures for Orange also include the market share of the second brand Yesss! (but exclude the market share of the MVNO Tele2 that operated on the Orange network). The main brand Orange actually lost market share over the relevant period whereas the sub-brand Yesss! gained market share. Overall the two effects evened out and imply an almost constant market share at the operator level.

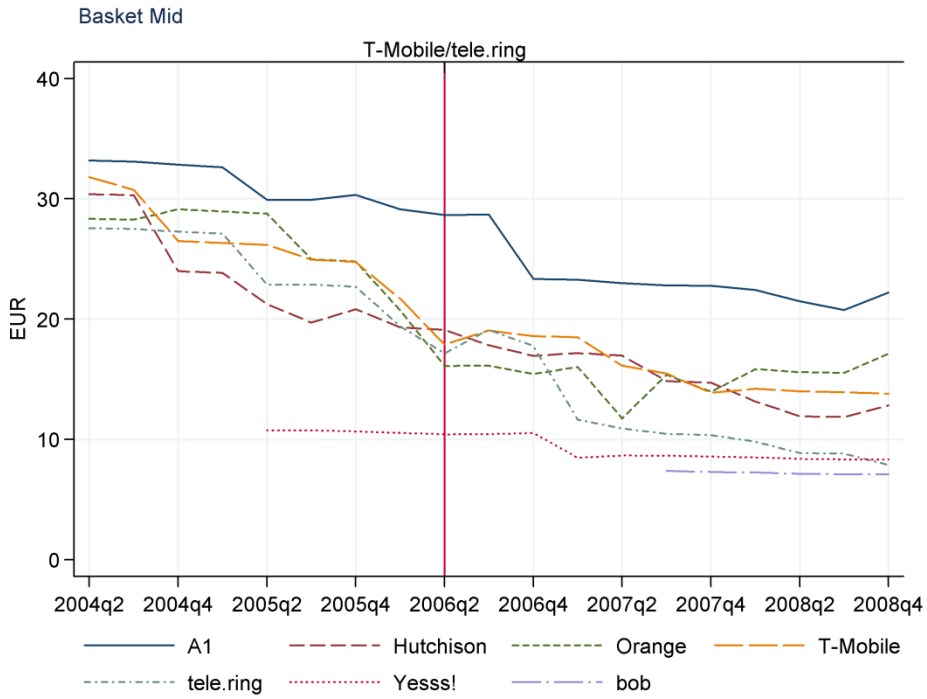

Figure 3: Price developments in Austria 2004-2008, Mid basket

Looking at Figure 3, the first fact that emerges is related to the incumbent operator Mobilkom, which offers the A1 brand. Both pre- and post-merger the (cheapest four) tariffs of the A1 brand are the most expensive on the market. Moreover, the gap between its price and the price of the other competitors seems to increase post-merger, and with the exception of a sharp drop in prices toward the end of 2006, A1's prices are relatively flat until the end of 2008. In Q3/2007 Mobilkom also introduces the sub-brand bob. Since then it offers both the most expensive and the cheapest price given the considered bundle of consumption, respectively with the main A1 brand and with the low cost brand bob.[66]

The price positioning of the MNOs other than Mobilkom appears to be more similar. Moreover, by comparing the relative positioning of the other MNOs we can observe some interesting relative changes over time.

With regard to the merging parties, T-Mobile and tele.ring, it can be observed that in the years prior to the merger, tele.ring in particular acted aggressively, as it offered attractive prices undercutting its three main established competitors[67]. Only H3G and later Orange's sub-brand Yesss! sometimes had lower prices. However, these were only marginal

[66] It should be noted, however, that the prices shown include the handset subsidies. This artificially increases the prices of Mobilkom, T-Mobile, Orange and to some extent also tele.ring compared to Yesss! and bob, which usually do not offer subsidized handsets.

[67] These results are broadly consistent with the tariff analysis presented in the M.3916 *T-Mobile Austria / Tele.ring* decision. Both analyses find that tele.ring is among the cheapest MNOs, together with H3G. The applied methods are not fully comparable, as we average over the four cheapest tariffs whereas the tariff analysis of the M.3916 *T-Mobile Austria / Tele.ring* decision mostly focuses on the cheapest tariffs for a large number of consumption bundles, respectively.

operators at that time. During the pre-merger period T-Mobile's price was mostly between the price of Orange and the price of tele.ring. After the merger, the prices of tele.ring remained relatively constant in 2006. However, starting from Q1 2007, tele.ring decreased prices significantly, undercutting both Orange and H3G that by the time had introduced some relatively cheaper prices. After 2007, the tele.ring price level was closer to that of the "no-frills" brands than to the other established brands, and it seems that tele.ring kept reducing its price level to compete with Yesss! and bob for price-sensitive users. The relative price position of T-Mobile does not seem to change after the merger, as T-Mobile is usually the second or the third most expensive brand in the market for most of the post-merger period considered in Figure 3.

Orange, the third MNO in terms of customers at the time of the merger, adopted a relatively high price strategy during the pre-merger period, as it offered the second highest prices after A1. However, Orange was the first to introduce the sub-brand Yesss! in Q2/2005, which catered, with its "no-frills" products, to particularly price-sensitive customers. Yesss! had the cheapest offering in the market from its introduction until the entry of Mobilkom's sub-brand bob. Soon after the merger Orange adopted a rather competitive pricing strategy, undercutting many of its competitors[68]. Also, in 2007, Orange initiated the mass diffusion of mobile broadband services by introducing new tariffs which included much larger data volumes than before at attractive prices. This was presumably possible because the quality and coverage of its 3G network was high. In early 2008, Orange was the first operator in Austria to offer iPhone tariffs (together with T-Mobile, as the two operators had exclusive rights to sell the iPhone).

During the pre-merger period H3G often undercut the four largest operators and offered a very competitive price in the market. In the period soon after the merger it seems that H3G did not follow the price reductions of both Orange (especially in the period soon after the merger) and tele.ring (starting from 2007). In July 2007, H3G started to launch tariffs with significantly reduced fixed and per minute fees, and from the end of 2007 H3G's price was below the prices of the other main brands (A1, T-Mobile and Orange)[69]. The relative price reductions of H3G at the end of 2007 coincide with the end of the phase of remedy implementation (especially the transfer of the transmission sites). The sites obtained as part of the commitment from T-Mobile allowed H3G to increase its coverage and become more independent from national roaming. H3G further rolled out its 3G network and reached >90% population coverage in 2009, which not only strengthened its position in the bundle segment (voice/SMS/data) but also in the mobile broadband market[70]. At the same

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[68] Orange, for example, launched new tariffs with unlimited on-net calls and calls to the fixed network as well as tariffs with a higher number of included minutes to other mobile networks in the second half of 2006.

[69] A unique feature of these tariffs was that the user received a credit of 6 euro cents for each call received ("Six Back"-tariffs). This was possible as a result of the asymmetric mobile termination rates (H3G was allowed to charge higher rates compared to the other MNOs), from which H3G benefited until the end of 2008.

[70] In 2011, according to a network test from *Connect* (a renowned magazine in the Telecom sector), H3G became the quality leader and reaffirmed this position in 2012. Until 2010 Mobilkom was undisputed quality leader and used this as a key marketing message (http://www.connect.de/ratgeber/mobilfunk-netztest-oesterreich-2012-1368672.html).

time H3G also introduced attractive offers to the market. This was likely facilitated by the spectrum and mobile sites acquisitions related to the remedies, which decreased H3G's reliance on national roaming and thus reduced the marginal costs of hosting additional subscribers. Then, in 2008 and 2009, it launched new tariffs with larger amounts of included minutes/SMS/MB and attractive subsidised handsets[71].

Overall, these price developments suggest that the market did not show sudden changes in the relative prices across operators after the T-Mobile/tele.ring merger. However, this comparison only looks at the Austrian market in isolation and does not reflect how prices would have evolved absent the merger.

Discussion of price and market share developments

It is instructive to try to reconcile the evolution of the market shares with the observed relative price developments at the MNO level.

The incumbent Mobilkom increased its market share in particular after Q4/2007 in spite of offering the highest price in the market (in absolute terms), and being one of the MNO for which we do not find consistent evidence of relative price reductions. This observation may be explained by some other factors not directly related to the observed A1 prices. For example, Mobilkom may have expanded its business market share and business tariffs are excluded from the price analysis. The market share of Mobilkom slightly declined in the period 2004-mid 2006 (from around 43% to 39%). It is only after the second half of 2006 that the market share of the incumbent starts to increase again. This trend reversal appears to be associated first with the sharp drop in prices observed around the end of 2006 (for the A1 brand) but mostly with the later acquisition of Tele2 (1.2% of market share) and the introduction of the sub-brand bob, both at the end of 2007. In this respect the relatively high prices of A1 might simply suggest a repositioning strategy of the brand after the introduction of cheaper tariffs through the new sub-brand.

Tele.ring is the mobile brand that apparently reduced its prices the most after the merger. At the same time, T-Mobile's pricing also does not increase relative to other brands, like A1. However, after the merger, the market share gap between T-Mobile and the market leader Mobilkom widened from 4% in Q2/2006 to more than 10% at the end of 2009. The merged entity T-Mobile/tele.ring continuously lost market share over the whole period following the merger[72]. Perhaps factors other than prices drove this development. For instance, it might be partly explained by possible problems in the integration of the two networks, with a consequent reduction in the quality and loss of customers despite the relatively competitive offer[73].

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[71] At this time, competition shifted from competition for pure voice/SMS customers to voice/SMS/data customers (smartphone users) and H3G with a high 3G coverage was in a very good position to compete in this segment.

[72] Notably, T-Mobile also introduced its own sub-brand S-Budget in Q4 2008, not depicted in Figure 3. However, the introduction of this new brand does not seem to increase T-Mobile's total market share in terms of customers (see Figure 2).

[73] According to the conciliation body of the Austrian regulator RTR, the number of complaints regarding T-Mobile including tele.ring more than doubled from 576 cases in 2005 to 1244 cases in 2008. The 2006

From a simple graphical comparison of prices, Orange is also seen to have reduced its prices following the merger, at least in the short term. However, despite the more aggressive pricing and service offering and also the introduction of the sub-brand Yesss!, Orange's market share remained rather constant over the whole period[74].

On the other hand, H3G constantly gained market share throughout the analysed period. Before the merger, H3G had relatively low prices (as partly shown in Figure 3) which apparently attracted a steady inflow of new subscribers. After the merger, it apparently decreased its prices by less than the country average in the short term, whereas in the medium term we also find some evidence that H3G reduced prices relative to other competitors. It is therefore somewhat surprising that H3G continued to steadily increase in the first year after the merger. An explanation could be that H3G offered better data deals which are not reflected in this analysis and that this latter component, together with some other quality dimension, might have driven customer acquisition rather than the price measure we capture. It is also remarkable that the post-merger improvement in coverage related to the merger remedies (especially in terms of 3G) does not seem to impact significantly the H3G's rate of growth, which kept growing (in terms of customer market share) at an almost constant rate over the period 2005-2008 (see Figure 2) with no significant effects around the date of the merger.

In summary it appears somewhat challenging to reconcile the relative price developments between competitors in Austria and the market share development in the relevant period. The development of market shares appears to be affected to some extent by non-price parameters.

5.2.3 Retail prices compared to control countries

The previous section shows that the price of a fixed bundle of mobile services broadly declined in Austria over the period 2004-2008. Indeed, although there is heterogeneity in the MNO price reduction, it is possible to identify a general decrease in prices common to the entire market. This is a typical feature of telecom markets (especially mobile markets) where prices have been generally declining over time. It is then clear that in the market there are underlying factors, unrelated to the merger, that are affecting prices.

Given these price developments the simple comparison of prices before and after the merger in Austria would not provide a meaningful measure of the effect of the merger. As explained in the methodological section, to measure the effect of the merger on the mobile prices in Austria we exploit the price development in other countries so as to estimate the counterfactual prices that would have prevailed in Austria absent the merger.

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report of RTR's conciliation body mentions "an increased number of requests [...], according to which consumers claim that the merging of the networks of T-Mobile and tele.ring have [sic] led to declined network provision" (translation from RTR, 2007, p. 32). Moreover, the deactivation of tele.ring's UMTS network raised issues for consumers. In 2007, problems regarding the consolidation of billing procedures were mentioned in another RTR conciliation report (RTR, 2008, p. 28). Overall, these observations seem to point at problems regarding the integration of tele.ring into the T-Mobile network after the merger, which might have led to an increased number of customers switching to other operators in the following years.

[74] Note that the Orange brand actually lost market share over the period and it is only thanks to the subscriber gains made by Yesss! that Orange as a group kept a constant market share.

For Austria we have selected a total of 11 countries that we use as the control group to estimate the counterfactual prices[75]. These are European countries in which we do not observe structural changes (entry or exit, or mergers) during the period of interest for our study.

In the following we compare the evolution over time of our price measure for Austria and for the control group, for the three levels of consumption.

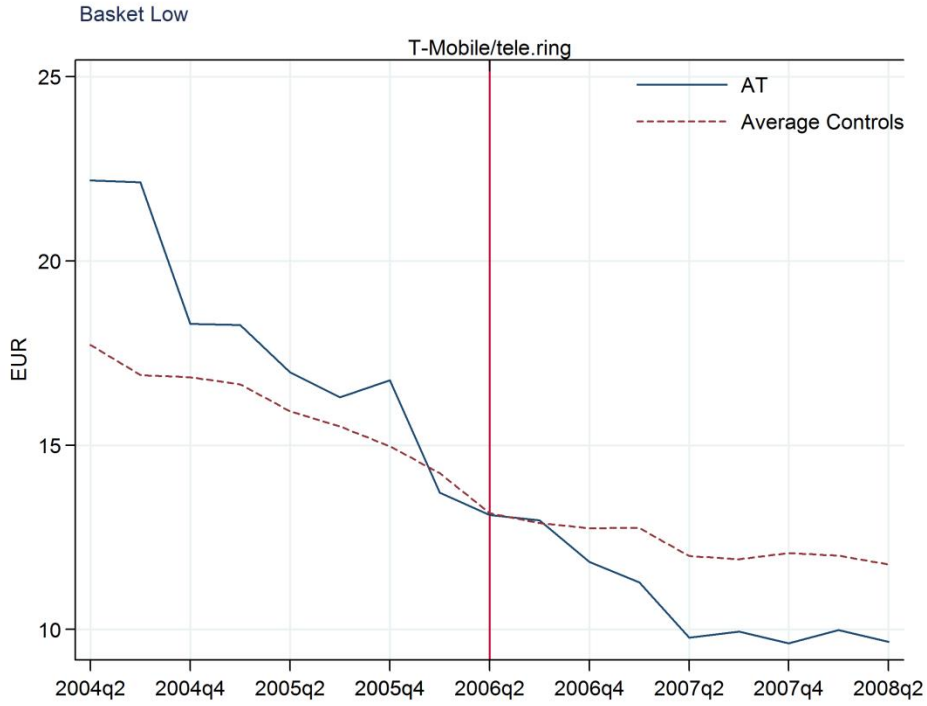

Figure 4: Average price comparison Austria vs Control countries –Low basket

For the Low consumption basket (Figure 4), in Austria, the price dropped from around EUR 22 to less than EUR 10 over the three-year period from Q2/2004 to Q2/2007, then stabilised around the EUR 10 level until the end of the relevant period. At the same time, the unweighted average price in the control countries also dropped over time from around EUR 18 in Q2/2004 to around EUR 12 in Q2/2007, then remained roughly constant at this level until Q2/2008. Hence, for both series we find a constant reduction over the first three years, although with different patterns of price reduction, and a broadly constant evolution during the last year. Notably, the average price for Austria is higher than the average price for the control countries for the entire period preceding the merger (until Q2/2006) and is lower during the period that follows the merger.

For the Mid basket (Figure 5), in Austria, the price dropped from around EUR 30 to less than EUR 15 over the four-year period from Q2/2004 to Q2/2008. In the control countries the average price at the beginning of the period is about EUR 30 (comparable to the Austrian price) and, overtime, the price decreases to about EUR 18. Despite some short-term

[75] Belgium, Czech Republic, Finland, France, Germany, Hungary, Italy, Portugal, Sweden, Switzerland and UK.

development, for both price series we find a constant price decrease over the relevant period. Also, differently from the Low basket, the prices do not seem to stabilise over this period. However, the two series (Austria and control countries) seem to follow different patterns over time as the gap between the two widens over time, especially in the period after the merger. With the exclusion of the first two quarters, the average price in Austria is lower than the average price in the control countries.

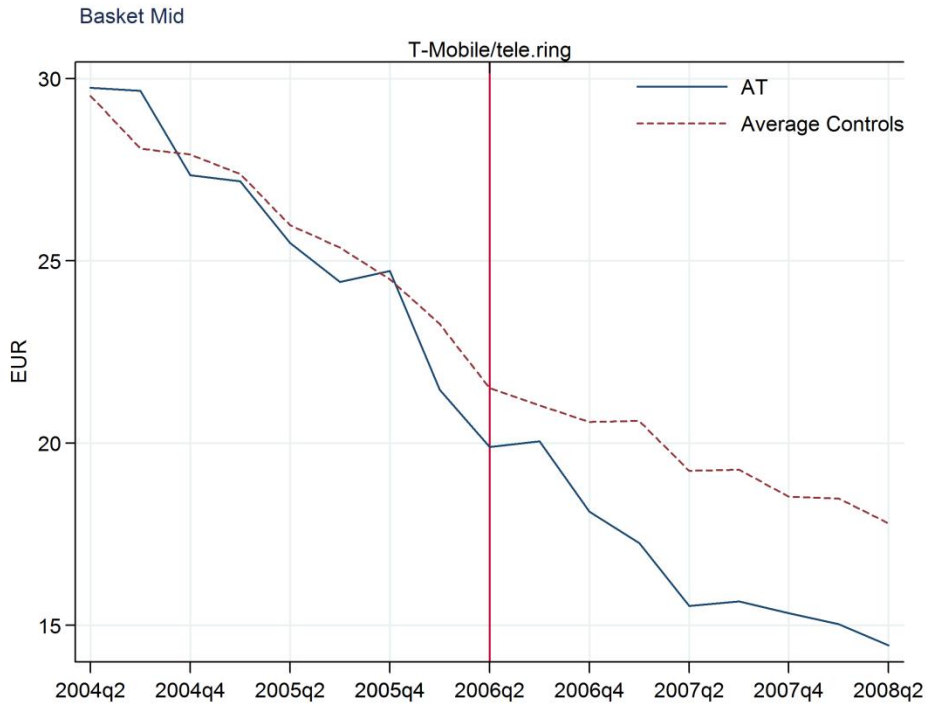

Figure 5: Average price comparison Austria vs Control countries –Mid basket

For the High basket (Figure 6) we also observe a constant fall in prices over the four-year period, with no price stabilisation as we find for the Low basket. For Austria, the average price for the high bundle of consumption falls from around EUR 43 in Q2/2004 to EUR 22 in the second quarter of 2008. For the control countries, the price drops from about EUR 50 at the beginning of the period to around EUR 30 in Q2/2008. For the High basket the two price series seems to follow the same pattern of price reduction over time, as the two lines are broadly parallel. However, the gap between the two lines widens in the period after the merger. Over all periods, the average price in Austria is lower than the average price in the control countries.

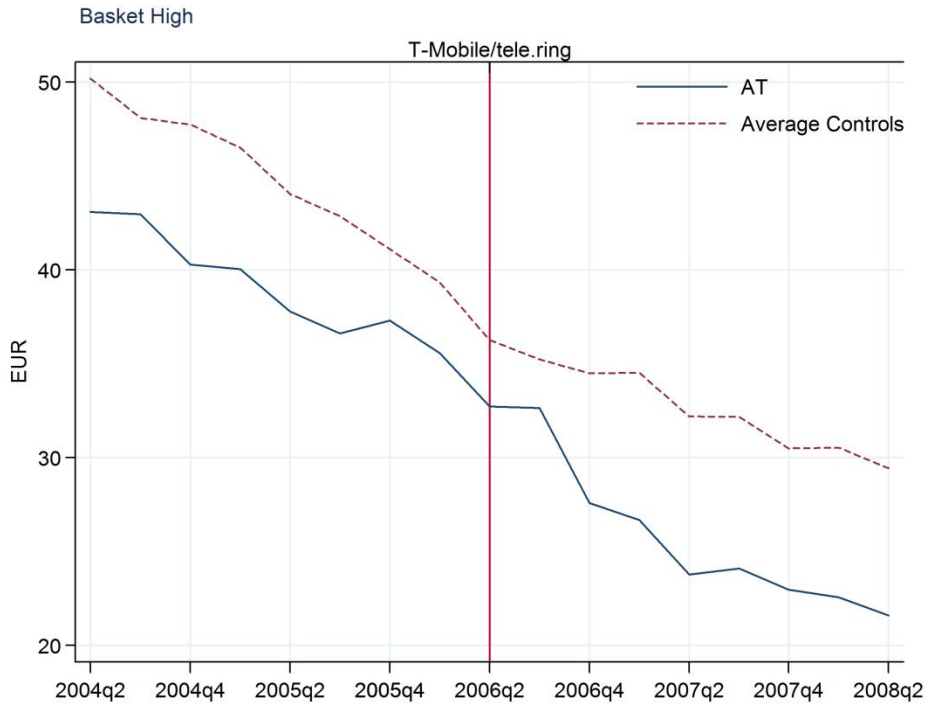

Figure 6: Average price comparison Austria vs Control countries –High basket

Overall, the graphical comparison of price trends indicates that after the merger the prices in Austria decreased faster than the average of the control countries' prices. This analysis, however, does not take into account the influence of other factors that may drive price changes and that may vary from country to country. The econometric analysis in the next section tries to control for these factors.

5.3 Econometric analysis

This section presents the results of the econometric analysis carried out to estimate the price effect of the merger. As set out in the methodological part (Section 4.1) we first fit Equation (2) to the data and discuss the Base model results (Section 5.3.1). Then we test whether the common trend assumption (one of the main identifying assumptions of the difference-in-differences approach) is met, and add country-specific trends, as in Equation (3), to account for possible differential trends between treatment and control groups (Section 5.3.2). As an alternative to control for common trends we then turn to the synthetic control group approach (Section 5.3.3).

When evaluating the effect of the merger we look at the effect in the short term (one year after the merger) and in the medium term (the second year after the merger). This allows for possible dynamic effects of the merger on prices. It is also particularly interesting to look at these two intervals as it took roughly one year to implement the remedies following the merger approval.

Within the regression framework we also decompose the country-level effect of the merger at the MNO level. As suggested in Section 4.1, these estimates should be interpreted with caution as they rely on further assumptions beyond the ones implied for the identification of the country-wide effect. These results are presented in Section A.5 of Annex A.

Our main analysis adopts the following specification. The analysis considers a period of 16 quarters, eight before the merger (Q2/2004 – Q1/2006) and eight after the merger (Q3/2006 – Q2/2008); the merger period (Q2/2006) is excluded[76]. Analysing the merger effects over a longer time period after the merger occurred would have the drawback of picking up more confounding effects from unobservable factors that influence prices. Within eight quarters after the merger all the MNOs introduced several new tariffs in the market and discontinued many others, so that in the second year after the merger the merger effect on prices should be largely reflected in the offered tariffs.

For Austria, to estimate our price measure, we use the data obtained from the Austrian chamber of labour (AK data), as this data source covers all the MNOs active in Austria in the period of interest. For the control countries, we use the data obtained from the data provider Teligen[77]. Our dependent variable is the log monthly price that a hypothetical consumer would have to pay to consume a fixed bundle of mobile services as defined in Section 3.2. For the main analysis, in accordance with our price measure, in each quarter and for each MNO, we consider only the four cheapest tariffs (either pre-paid or post-paid) given the selected bundle of consumption[78]. Moreover, in the main analysis we consider both pre-paid and post-paid tariffs[79]. Given that we consider log prices, the estimated effects can be (approximately) interpreted as percentage changes. Then, in Annex A we also present some robustness checks in which we vary some of the above specifications.

5.3.1 Difference-in-differences approach: Base specification

Within the difference-in-differences framework, we estimate the price change in Austria before and after the merger, relative to the control countries. By controlling for country and provider fixed effects, for common time effects and for a set of time varying control variables, we interpret the parameter of interest as the change in prices in Austria relative to the counterfactual scenario of no merger.

Table 5 presents the results of our Base model corresponding to Equation (2), for the Low, Mid and High baskets, respectively in columns (1), (2) and (3). For all baskets we have evidence that the merger is associated with a drop in prices compared to the counterfactual of no merger. Moreover, the price reductions seem to grow over time, as the medium-term effects are usually larger (more negative) than the short-term effects. In the Low basket we estimate a price reduction of 23% in the short term and of 34% in the medium term. Both estimates are statistically significant when we use the cluster robust standard errors with clusters at the country level[80]. For the Mid basket we estimate a price reduction of

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[76] We exclude the quarter in which the merger decision falls to avoid the inclusion of this period either in the pre-merger or post-merger period biasing the results.

[77] Teligen only covers the first two MNOs in each country. See Section 3.1 for a detailed description of the data sources.

[78] This means that for Austria, in each quarter we have 20 price observations (5 MNOs X 4 prices) and for the control countries we have 88 observations (11 countries X 2 MNOs X 4 prices).

[79] We exclude post-paid SIM-only tariffs as Teligen only recorded them starting from 2006.

[80] However, as suggested in section 4.1, the cluster-robust standard errors are biased downward and are likely to inflate the significance of our estimates; this aspect should always be considered when

13% in the short term and of 18% in the medium term (both statistically significant). The estimated price reduction for the High basket is 7% in the short term and 13% in the medium term (not statistically significant). Both the coefficients associated to MTR and GDP are always positive, suggesting (as expected) a positive relation between mobile prices and these measures[81].

Table 5: Estimation of country-wide effect of the merger – Base specification

	(1)	(2)	(3)
Dep. Variable	log Price	log Price	log Price
Basket	Low	Mid	High
Short-term effect	-0.231***	-0.134***	-0.074
	(0.000)	(0.008)	(0.131)
Medium-term effect	-0.340***	-0.180**	-0.128
	(0.000)	(0.028)	(0.111)
GDP growth	1.562	0.906	1.114
	(0.254)	(0.558)	(0.468)
log MTR	0.007	0.098	0.130
	(0.958)	(0.570)	(0.463)
Constant	3.263***	3.847***	4.327***
	(0.000)	(0.000)	(0.000)
Observations	1,727	1,727	1,727
R-squared	0.737	0.815	0.832
Country-spec. trend	NO	NO	NO
Common trend test	Failed	Passed	Passed

Cluster-robust pval below coefficients (s.e. clustered at country level)[82]
Time fixed effects and country-provider fixed-effects
Excluded quarter (merger) Q2/2006; pre-period 8 quarters; post-period 8 quarters; cheapest 4 tariffs
Common trend test if: "Failed" we reject the null hypothesis of common trend at 10% level
*Significance level: *** 1%, ** 5%, * 10%*

When we decompose the country-level effect (Table 23 of Annex A), we find that most of the price reduction in Austria is driven by the price development of tele.ring and T-Mobile (the two merging parties) and Orange (especially in the short term). H3G appears to contribute to the fall in price more for the Low and Mid baskets and less for the High basket. A1, as suggested also by the graphical comparison of prices (Figure 3), does not seem to contribute to the overall fall in prices[83].

evaluating the significance of our estimates. See also Footnote 82. In the main text, we refer to cluster-robust standard errors unless explicitly mentioned otherwise.

[81] We use MTR as a measure of mobile network cost and GDP as a proxy for demand.

[82] For the Low basket, short and medium term, the wild bootstrap standards errors would imply p-values respectively of 0.18 and 0.11. For the estimates of the Mid and High baskets we instead estimate wild bootstrap p-values in the range 0.3-0.4.

[83] As suggested in the methodological part (Section 4.1) we do not interpret the coefficients of the MNO-specific analysis as the effect of the merger on the individual operators. Indeed, these estimates rely on

When modifying some of the assumptions made in the model specification presented in Table 5 we obtain broadly similar results[84]. The first robustness test excludes from our tariffs data, for both Austria and the control countries, all post-paid tariffs and runs the analysis only on the pre-paid tariffs. This somewhat addresses the issue of handset subsidies, which are not recorded separately in any of the datasets we have and therefore may bias our results (for instance if handset subsidies changed in Austria as a result of the merger but not in the control group countries). Pre-paid tariff plans usually do not include a valuable subsidised handset. By looking at price development for this category of tariffs we then aim to avoid the possible bias related to the size of the handset subsidy. Under this scenario, we estimate similar or even stronger price reduction for all baskets[85]. As further robustness checks, we reduce the estimation period to only the four quarters before the merger (so as to attenuate the impact of the earlier observations)[86]; we estimate our price measure only on the basis of the two cheapest tariffs; and we estimate our model assuming a constant OECD basket for all countries. In all these cases we obtain results that are largely comparable to the main estimates.

Overall, under the assumption that absent the merger the price trend in Austria would have followed the trend of the control countries (after accounting for MTRs and GDP-growth), these results suggest relative strong price reductions associated with the merger, meaning that relative to the control countries Austrian prices post-merger decreased much more.

As discussed in Section 4.1, the correct identification of the effects of the merger using a difference-in-differences approach relies on the correct specification of our model. A key assumption is that the trend of the outcome variable would have been the same for treated and control countries in the absence of the merger. To check this hypothesis we exploit the available periods in the pre-merger period and conduct a statistical test to examine whether the prices for Austria and the control countries trend similarly in the pre-merger period. The results of this test are reported in Table 5 ("Common trend test")[87]. The null hypothesis of no trend differences between Austria and the control countries is rejected for the Low basket and it is not rejected for the Mid and High baskets.

The strong indication of a differential trend for the Low basket is also evident from the simple graphic comparison of the price development depicted in Figure 4. That figure clearly shows that the price reduction in Austria for the Low usage basket followed a steeper path than the price reduction of the control countries (the two lines cross around the merger date). The formal econometric test of the pre-merger trends suggests that this

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the assumption that all MNOs would follow the same price trend absent the merger. However, as shown in Figure 3 there are some within-country differences between the different operators and we would need to account for those to estimate the effect of the merger at the operator level.

84 See Annex A, Table 15 to Table 18 (columns (1), (2) and (3)) for a series of robustness tests.

85 The similar estimates across baskets might be explained by the lower number of pre-paid tariffs, meaning that the same tariffs are used to estimate our measure of price for the different baskets.

86 If we were to instead exclude the periods of the merger investigation (Q3/2005-Q2/2006) we would find similar results.

87 See Section 4.1 and footnote 46 for further details.

difference in trends is not explained by the considered time varying control variables (MTR and GDP). Ignoring this differential trend implies that the counterfactual price estimated for Austria would be estimated on the basis of the price development of the control countries, a price development that might not have been shared by Austria absent the merger, in particular as far as the Low basket is concerned.

To the extent the prices for low-usage tariffs indeed dropped faster in Austria compared to the control countries, not accounting for this difference in trends would lead to the estimation of an excessively high counterfactual price and, consequently, the estimation of an undue strong reduction in prices.

5.3.2 Difference-in-differences approach: Trend specification

One approach to control for the differential trend pre-merger is to estimate the model allowing for country-specific trends as described in Equation (3). These results are reported in Table 6, respectively in columns (1), (2) and (3) for the Low, Mid and High baskets. In this setting, the estimated counterfactual development of prices not only takes into account time invariant differences between Austria and the control countries and common time varying price development, but also accounts for the estimated different trends in prices. As expected, this new specification has a significant impact on the estimated coefficients of interest for the Low basket, the basket for which the common trend test is failed. Compared to the Base specification, the estimated effect of the merger on prices is less negative and both the short- and medium-term coefficients are close to zero (respectively -2% and 0.5%) and not statistically significant. Although for the Mid and High baskets we do not find evidence of differential trends in the pre-merger period, we nevertheless estimate the model with country-specific trends.

Also in these two cases we do observe some differences relative to our Base DiD estimates, although of a lower magnitude compared to those observed regarding the Low basket. For the Mid basket the size of the price effect is reduced from -13% and -18% to -6% for the short- and medium-term coefficients, respectively, and although the estimated effects remain negative they are no longer statistically significant. If we consider these results in light of the graphical analysis (Figure 5) we see that the gap between the Austrian and control group prices started to widen already before the merger (with the Austrian price falling faster). Hence, if we do not account for these slightly diverging trends we might overstate the counterfactual post-merger price and in turn the price reduction associated with the merger. For the High basket when we account for country-specific trends we find slightly more negative coefficients (from -7% to -10% for the short-term effect and from -13% to -18% for the medium-term effect). However, the results of both regressions are reasonably comparable, given the relatively low precision of our estimates.

Table 6: Estimation of country-wide effect of the merger – Trend specification

	(1)	(2)	(3)
Dep. Variable	log Price	log Price	log Price
Basket	Low	Mid	High
Short-term effect	-0.019	-0.056	-0.104*
	(0.733)	(0.35)	(0.1)
Medium-term effect	0.005	-0.057	-0.177*
	(0.962)	(0.588)	(0.091)
GDP growth	1.351	1.282	1.433
	(0.248)	(0.309)	(0.297)
log MTR	0.128	0.120	0.125
	(0.298)	(0.181)	(0.151)
Constant	5.673***	4.759**	3.458**
	(0.004)	(0.013)	(0.043)
Observations	1,727	1,727	1,727
R-squared	0.754	0.841	0.865
Country-spec. trend	YES	YES	YES

Cluster-robust pval below coefficients (s.e. clustered at country level)
Time fixed effects and country-provider fixed-effects
Excluded quarter (merger) Q2/2006; pre-period 8 quarters; post-period 8 quarters; cheapest 4 tariffs
*Significance level: *** 1%, ** 5%, * 10%*

As we do for the Base specification, we also decompose the country-level effect at the MNO level (Table 24 in Annex A). Again we find that most of the price reduction in Austria is driven by the price development of tele.ring. Orange also appears to contribute significantly to the drop in prices and to a lesser extent also T-Mobile. Differently, H3G (in the short term) and A1 appear to reduce their prices by less than the country average and do not follow the country-wide trend of price decrease. However, both the pricing of A1 and (to a lesser extent) H3G were already characterized pre-merger by a flatter trend in prices[88]. Indeed, when we account for these intra-country trend differences we obtain estimates which differ considerably from those of the Base specification. In light of these considerable differences we conclude that the available data does not allow clear identification of differences in the effect of the T-Mobile/tele.ring merger across MNOs.

To assess the robustness of our estimates, we modify some of the assumptions made in the regression presented above also for the Trend model specification[89]. When we include only the pre-paid tariffs we find evidence of some relative price reduction for the Low basket (only in the short term) and no effects for the Mid and High baskets. We also replicate the model reducing the estimation period to only one year before the merger, and we estimate very similar results with no effect for the Low and Mid baskets, and a relative price reduction in the range of 10-20% for the High basket. Additionally, we estimate the Trend model on the price measure defined only on the basis of the two cheapest tariffs. In

[88] A1 and H3G differed in the relative price positioning: A1 was the most expensive brand and H3G was among the cheaper brands, if not the one with the cheapest offer.

[89] See Annex A Table 15 to Table 18 (columns (3), (4) and (5)) for a series of robustness tests.

this case, we estimate positive relative price change for the Low and Mid baskets; however these are not statistically significant. For the High basket we find estimates similar to those presented in Table 6. When we consider the same basket of consumption for all countries (the common OECD basket) we obtain somewhat different results with positive coefficients for the Low and Mid baskets and negative coefficient for the High basket. However, all these estimates are non-statistically significant and do not change our conclusions.

Overall, we mostly estimate negative parameters under the Trend specification also. Hence, we exclude that the merger might have been associated with possible (significant) relative price increases.

However, contrary to the Base specification, the analysis of this section suggests that there is only limited evidence that the merger might be associated with significant relative price reductions.

5.3.3 Synthetic control approach

The synthetic control group approach compares aggregate outcomes at country level. Therefore, for each country we compute an average country price series for each of the three baskets of consumption that we consider. For our main estimation for each country we define a price measure by averaging across the expenditure of the four cheapest tariffs for each of the MNOs that we observe[90]. For the regression analysis, we use the data obtained from the Austrian chamber of labour (AK data) for Austria and for the control countries we use the Teligen data. For each basket, we then perform our synthetic control group analysis on 12 countries (log) price series.

For the period of analysis, similarly to the regression analysis, we consider a period of 16 quarters, eight before the merger (Q2/2004 – Q1/2006) and eight after the merger (Q3/2006 – Q2/2008); the merger period (Q2/2006) is excluded.

For the estimation of the counterfactual price (the "synthetic control") we follow the model outlined in the methodological section (Section 4.2) whereby such measure is estimated as a weighted linear combination of the price series of some selected countries (the "synthetic control group"). The weights and the countries are selected so as to approximate best a number of predictor parameters during the pre-merger period, for instance the pre-merger evolution of mobile prices in Austria[91].

The effect of the merger is then estimated as the post-merger difference between the Austrian actual price series and the counterfactual synthetic price.

Table 7 presents the results of the synthetic control group estimation[92]. The column "Effect" presents the estimated relative price change associated with the merger and the column

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[90] For the regression approach, we consider both pre-paid and post-paid tariffs; however, we exclude post-paid SIM-only tariffs as Teligen only recorded them starting from 2006.

[91] Other predictors are log MTR and GDP growth.

[92] Given that we consider log prices the estimated effects can be (approximately) interpreted as percentage changes.

"Rank" presents the results of the permutation test that evaluates the significance of our estimates[93]. For the difference-in-differences analysis we estimate both a short-term and a medium-term effect. For each basket we also list the countries (column "Selected controls") that have been selected by the synthetic control algorithm to estimate the counterfactual price in Austria (the weights are reported in Annex A, Table 19).

Table 7: Results of synthetic control group estimation

Basket	Period	Effect	Rank	Selected controls
Low	short	-0.191	4/12	CH; SE; FR;
Low	medium	-0.404	1/12	
Mid	short	-0.085	4/12	ALL- UK, CH, SE, highest weight
Mid	medium	-0.148	5/12	
High	short	-0.005	5/12	DE; FI; HU; FR, CZ
High	medium	-0.036	8/12	

Excluded quarter (merger) Q2/2006; pre-period 8 quarters; post-period 8 quarters; cheapest 4 tariffs

As we find in the regression analysis, also the synthetic control group approach estimates a price reduction for Austria following the merger, relative to the selected control countries. For the Low basket we estimate a strong price reduction of 20% in the short term and 40% in the medium term. For the Mid basket we estimate a price drop of 8% and 15% over the same periods, and for the High basket we find negligible effects.

Looking at the significance of these estimates we find that most of our estimated effects, when weighted for the pre-merger fit, are not larger than the effects we find in a number of placebo studies that we ran in the control countries. This is reflected in the ranks of our estimates that are usually above or equal to four (meaning that in the placebo tests for at least three other control countries the synthetic controls method finds weighted effects as large, or larger, than the ones found for Austria).

Only for the Low basket, the medium-term effect seems to stand out in the permutation test (rank 1/12) whereas the short-term price effect is not larger than the price differential estimated in other three placebo studies (rank 4/12).

[93] As set out in Section 4.2 a high rank of 1/12 means that a given estimated effect stands out from the other placebo studies.

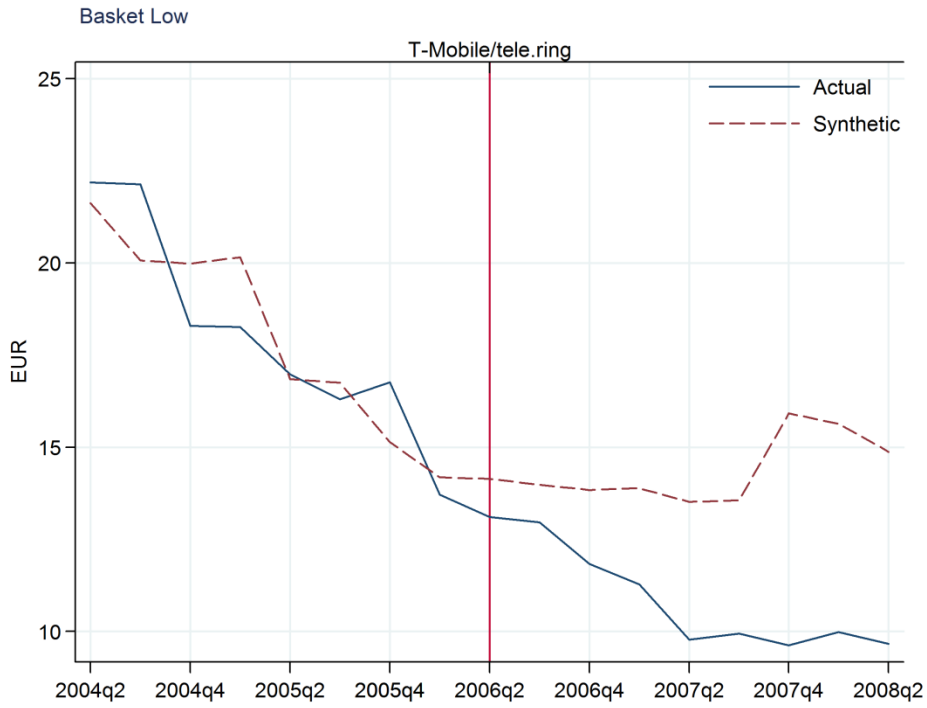

Figure 7: Price development Austria and Synthetic control – Low basket

For the Low basket, the synthetic price (the counterfactual price) is estimated as a linear combination of the prices of France, Sweden and Switzerland. The resulting price series is depicted in Figure 7. In the pre-merger period the synthetic price has a similar development to the Austrian price, although there are short-term differences. Following the merger the two series diverge significantly and we estimate that in the short term (one year after the merger) the Austrian price is 19% cheaper than the synthetic price. This difference gets larger in the second year where the price reduction is equal to 40%.

Figure 8 compares the estimated gap between the actual and synthetic control series for Austria to the gap found in the other 11 placebo studies. This comparison shows that the gap for Austria stands out from the other placebo studies[94].

[94] The estimated synthetic control and placebo studies for Mid and High baskets are presented in Figure 16, Figure 17, Figure 18, and Figure 19 in Annex A.

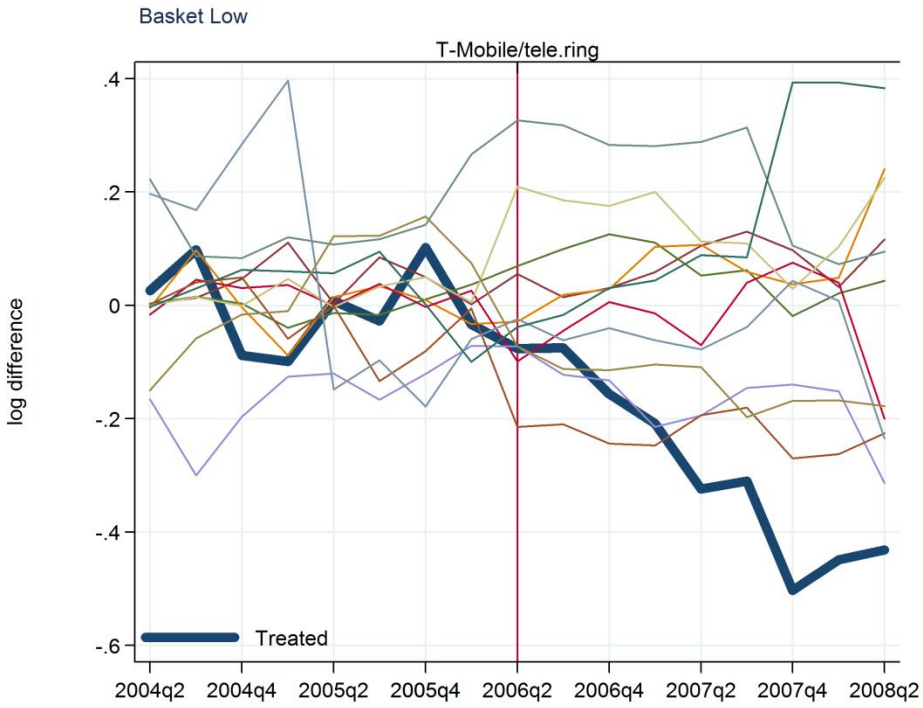

Figure 8: Log price gap in Austria and in placebo for control countries – Low basket

However, a closer look at the country prices used to estimate the synthetic control might raise some concerns about the magnitude of the estimated medium-term effect. Indeed the widening of the gap between the actual and synthetic Austrian prices following Q3/2007 is mostly due to a sharp increase in the synthetic price (in particular such rise is explained by a price increase for the Low basket in Switzerland).

As a robustness check, we repeat the synthetic control estimation excluding from the country sample the country that received the highest weight in the first application of this approach. For the Low basket we exclude Switzerland, for the Mid basket we exclude the UK and for the High basket we exclude Germany. These results (Annex A - Table 20) show that some synthetic control estimates are quite sensitive to the selection of control countries. Once we exclude Switzerland the estimated medium-term effect for the Low basket is reduced to -28%, whereas the short-term effect is consistent with the main estimate. Also for the High basket, when we exclude Germany we find a much more pronounced drop in prices (respectively -7% and -16% for short-term and medium-term effects, with rank 1/11 for both).

In a further robustness check, we repeat the synthetic estimation on a sample in which we estimate the country price series on the basis of the two cheapest tariffs (instead of the four cheapest tariffs considered in the first analysis). The estimated effects under this specification (Annex A - Table 21) seem to be in line with the robustness check in which we exclude the country that receives the highest weight, as they suggest relative price reduction of similar magnitude for all baskets both in the short and medium term.

Finally, as done also for the regression analysis, we estimate the synthetic control group on the expenditure obtained, assuming a common OECD basket of consumption across all

countries. Table 22 (in Annex A) reports the results of this robustness check. These results are largely consistent with the main estimates discussed above.

Overall, the results of the synthetic control group approach suggest that, following the merger, the prices in Austria decreased faster than the estimated counterfactual prices. This result holds for the three baskets of consumption considered. We should however interpret these estimates with some caution. Indeed, despite the sizeable effects that we estimate for Austria, these are usually not larger than the effects estimated for a number of placebo mergers (when we conduct the placebo studies and weight the effects for the pre-merger fit).

This evidence warns us about the significance of our estimates and suggests that the synthetic control group methodology applied to our data might not provide precise and sufficiently robust results. This may be due to the relatively few pre-merger periods used in the estimation of the synthetic price and is also reflected in the relatively poor fit that we achieve in the pre-merger period[95].

On the other hand, despite the issues that concern the point estimates, by looking at the evolution of the Austrian prices against the estimated counterfactuals also from the synthetic control analysis, we exclude that the merger might be associated with a significant relative price increase in Austria.

5.4 Conclusions on the T-Mobile/tele.ring merger

The graphical and econometric analyses presented above show that after T-Mobile's acquisition of tele.ring (with the associated remedies), prices in Austria did not increase relative to the considered control countries. Indeed, the Austrian market remained competitive after the merger, with some significant changes in the relative pricing of the different MNOs.

In the above discussion we present the results of three main approaches, highlighting the assumptions on which the different identification strategies rely. For all specifications we mostly estimate negative coefficients, at times of relatively large magnitude. However, in light of the differences across the specifications, it is difficult to draw conclusions on the magnitude of the estimated effects.

As is evident from the analysis, the magnitude of the estimated price effects depends considerably on the chosen model specification and estimation methodology. Of the different specifications, the estimates that we consider more credible range from -2% up to -20%[96]. Still, our estimates lack precision and despite the sometimes large estimated

[95] Other studies that apply the same methodology find a synthetic control estimation that tracks much more closely the actual series (for instance see Abadie, Diamond, Hainmueller 2010 and 2015).

[96] For the Low basket we observe that the parallel trend hypothesis is likely not satisfied and that the Base specification yields higher price reductions that the specification with country-specific trends. For the Mid and High baskets we consider that the Base and trend estimations provide largely comparable results, especially given the implied large interval of confidence that we estimate. The synthetic control estimates are less robust.

effects we often cannot conclude that the estimates would be statistically significant[97]. Also, the placebo tests conducted in the context of the synthetic control approach suggest that the estimated magnitude of the price effects of Austria do not generally stand out compared to the price changes we find in our "placebo" study. For these reasons, despite the observation that in Austria prices decreased post-merger relative to the control countries, this generally cannot be causally attributed to the T-Mobile tele.ring merger.

There are a number of possible reasons for the relatively low precision of the estimated price effects. First, we have only a relatively small sample of control countries. Second, even when accounting for the effect of further explanatory variables, a large part of unexplained variation of prices remains. Moreover, as we observe only a single treated country we might not be able to separate the merger-specific effects from idiosyncratic post-merger price dynamics in Austria.

Some factors might explain this concentration not being associated with a price increase. First, the structural commitments offered by the merging parties are likely to have strengthened the smallest two operators (Orange and especially Hutchinson), as the market developments after the merger seems to show. In particular, this may have significantly improved H3G's offer, as it received assets to achieve nationwide coverage thereby reducing its reliance on national roaming. Second, the post-merger market structure was characterized by the presence of four competing operators with asymmetric market shares, which may have limited the loss of competition from the merger, so that it could be offset by strengthening weaker MNOs. Third, efficiencies due to larger scale might have materialized for the merging parties. However, despite some evidence of significant price reductions for tele.ring, the market share of T-Mobile (as a group) decreased post-merger, which may indicate that the value of the merged entity has not improved relative to the competing MNOs. It is thus not clear to what extent possible efficiencies have been passed through to consumers or have been offset by network quality issues.

In particular, the first effect seems to appear in the data (from the graphical analysis of Figure 3 or the MNO analysis in Section A.5 of Annex A) where Orange acted as price-aggressive operator, especially in the first year after the merger, beyond having already introduced a no-frills brand that offered the cheapest tariffs in the market. However, for the operator that benefited most from the remedies (Hutchinson) we see price decreases occurring in particular in the medium term. Additional positive effects which the remedies may have had on H3G's network quality cannot be assessed based on the price analysis. Generally, it is challenging to interpret the relative price development of the different MNOs after the merger and reconcile them with the evolution of the market shares.

Although not captured by our econometric analysis, the market was also characterized by the introduction of several no-frills sub-brands with attractive prices that contributed to a competitive offer especially for the pre-paid segment.

[97] As pointed out in Section 4.1, the presented standard errors are likely underestimated.

6 Analysis of the T-Mobile/Orange merger (Netherlands)

This Section presents and discusses the analysis of the merger between T-Mobile and Orange in the Netherlands.

Following a spectrum auction that led to the entry of three new operators in the market in 1997, there were five mobile operators in the Dutch mobile telecom market: KPN, Vodafone (previously known as Libertel), T-Mobile (previously known as Ben), Orange (previously known as Dutchtone) and Telfort. By 2007, the market was also characterised by the presence of a large number of MVNOs, which accounted for approximately 15% of the subscriptions.

In the years 2005-2007, two mergers took place. In August 2005 KPN acquired Telfort and in August 2007 T-Mobile took over Orange. The KPN/Telfort merger was cleared without conditions by the Dutch Competition Authority and falls outside the scope of this study[101]. However, as discussed below, the effects of this merger may influence the T-Mobile/Orange pre-merger period, in particular prices, and so may have some impact on our results.

Section 6.1 describes the T-Mobile/Orange merger proceeding. Section 6.2 gives an overview of the Dutch mobile telecom market. The econometric analysis and its results are discussed in Section 6.3. Finally, Section 6.4 draws the conclusion on the price effects of the T-Mobile/Orange merger.

6.1 The T-Mobile/Orange merger proceeding

On 13 July 2007, the T-Mobile/Orange merger was notified to the European Commission[102]. The Commission unconditionally cleared the merger on 20 August 2007.

In the competitive assessment of the merger the Commission primarily investigated the effects of the transaction on the retail market for mobile telecommunication services in the Netherlands and on the wholesale market for access and call origination on public mobile telecommunications networks in the Netherlands[103]. On the latter market, the MVNOs buy access services from MNOs. The Commission focused the competitive assessment primarily on non-coordinated effects, since for a number of reasons coordination would remain unlikely also after the merger[104].

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101 https://www.acm.nl/en/publications/publication/6056/NMa-KPN-May-Acquire-Telfort/

102 http://ec.europa.eu/competition/mergers/cases/decisions/m4748_20070820_20310_en.pdf

103 The wholesale markets for international roaming and mobile voice termination services were not or just minimally affected by the transaction.

104 In particular, the Commission found that there was not sufficient pricing transparency, which made it difficult to reach a common understanding between the MNOs, that the remaining operators would have asymmetric market positions and that they would have significant spare capacity.

As regards the market for mobile telecommunication services, the retail market share of the merged entity would be 25% in terms of subscribers[105], which would be the second largest after KPN with 39%. In terms of revenues, the market share of the new entity would be the third largest (after KPN and Vodafone). On the basis of an analysis of pricing behaviour and customer switching, the Commission concluded that Orange could not be considered a particularly aggressive player in the market and that T-Mobile and Orange were not the closest competitors[106]. Finally the Commission noted that a large number of MVNOs and Service Providers[107] would remain present on the retail market and constrain the merged entity. On this basis, the Commission concluded that the merger would not give rise to competition concerns on the retail market as a result of non-coordinated effects.

Regarding the wholesale market, the Commission found that the access of MVNOs to the network was unlikely to be hindered by the merger, as there was a high number of MVNOs and SPs active in the market; all operators granted wholesale access; T-Mobile's and Orange's combined wholesale market share based on subscribers was around 16% and thus limited; and there was under-utilized spectrum available and no indications that incentives to grant access would change after the merger. Hence the merger would not give rise to competition concerns on that market.

6.2 The Dutch mobile telecom market

6.2.1 Evolution of retail market shares

The market share distribution prior to these mergers approximately reflected the sequential entry dates of the five MNOs: KPN, which entered first in 1994, was the market leader, followed by Vodafone, which entered two years later. T-Mobile, Orange and Telfort entered simultaneously in 1997 and had similar market shares prior to the two mergers. (see Figure 9).

[105] Due to confidentiality reasons, the market share figures mentioned in this section are provided by Telecompaper and are not the figures on which the decision is based. The retail market shares exclude subscribers of MVNOs hosted by MNOs.

[106] Orange's business strategy focused on pre-paid customers as opposed to the other MNOs, which were stronger in the more profitable post-paid segment. However, the analysis of pricing behaviour (on the basis of a certain usage pattern) indicated that Orange was not the cheapest provider, neither for pre-paid nor for post-paid tariffs. The analysis of customer switching revealed that Orange was not particularly successful in acquiring customers from T-Mobile, and T-Mobile's share of customer switching from Orange was not particularly high compared to its market share.

[107] Service Providers do not own a mobile network and (in contrast to MVNOs) do not own a core network.

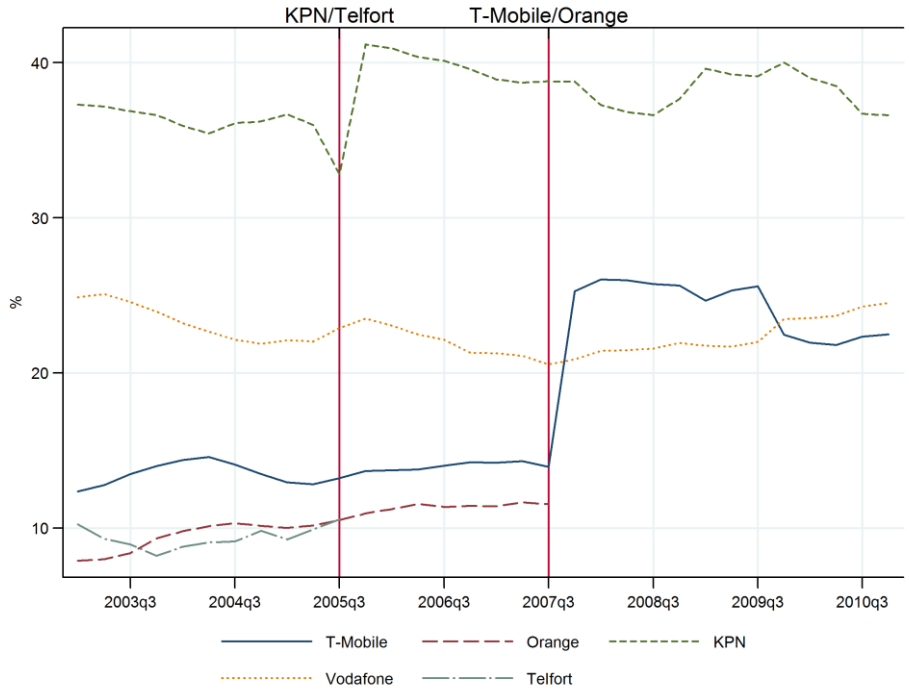

Figure 9: Retail level market shares based on subscribers of the MNOs in the Netherlands 2003 - 2010[108]

As a consequence of the KPN/Telfort merger in Q3/2005, KPN increased its market share to approximately 40%. This was almost twice the market share of the second-largest competitor Vodafone. The remaining two competitors, T-Mobile and Orange, followed with market shares between 10 and 15%.

The market share of KPN, which was already following a downward trend before the acquisition of Telfort, declined over time also after the KPN/Telfort merger took place. In Q3/2008 KPN acquired the MVNO Debitel, one of the most successful MVNOs in the Netherlands. This acquisition slightly increased its market share, but it did otherwise not interrupt its declining path.

After the T-Mobile/Orange merger, T-Mobile maintained a market share around 25% until late 2009. In Q4/2009 T-Mobile experienced a strong decrease in its subscriber base, which led Vodafone to become the second largest operator in the Netherlands[109]. As will be explained in the subsequent sections, the period covered by our analysis ends in Q3/2009. Therefore, the sudden decrease in T-Mobile subscriber base does not affect the quantitative results.

Vodafone closely followed T-Mobile with a share slightly above 20%.

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[108] Source: Telecompaper, Dutch Mobile Operators, Q1/2003 – Q4/2010.

[109] According to the data on subscriber numbers provided by Telecompaper, the Netherlands mobile telecommunication market lost from Q3/2009 to Q4/2009 approximately one million subscribers, the vast majority of which belonged to T-Mobile. Possibly, T-Mobile removed non-active subscribers during this period.

6.2.2 The MVNO segment

In contrast to many other European countries, the presence of MVNOs was significant in the Netherlands during the period under study. Figure 10 shows the market shares of the MVNOs in the Netherlands aggregated by their host network provider, as well as the combined market share of all MVNOs. In the years prior to the KPN/Telfort merger, numerous MVNOs entered the market reaching a joint MVNO market share of 10%. The MVNO market share increased after the KPN/Telfort merger, and they reached a joint market share of roughly 15% by the time of the T-Mobile/Orange merger. After 2007, the MVNO market share remained stable around 15% until 2008. Later, it appears that the MVNO market share temporarily declined after the large MVNO Debitel was acquired by KPN in Q3/2008. From late 2009 the growth of the MVNOs in the Netherlands increased again, pulled by a strong increase in the market share of Lebara (hosted by KPN) and Lycamobile (hosted by Vodafone).

KPN and Telfort were the first network operators to offer MVNO access. With the acquisition of Telfort, KPN positioned itself firmly as the largest supplier of MVNO access, with the MVNOs on KPN's network reaching a joint market share of 10% - almost reaching the totality of the MVNO market share. Orange and T-Mobile entered the segment in late 2005/early 2006. The last to enter the market with a significant MVNO offering was Vodafone. In 2007, the MVNOs on T-Mobile's and Orange's networks accounted for a retail market share of 1% each. After the T-Mobile/Orange merger, T-Mobile continued the MVNO activities of Orange and grew market share to 3-4% in Q1/2009, as shown in Figure 10. KPN remained by far the most important supplier of MVNO access after the T-Mobile/Orange merger but slightly lost wholesale market share.

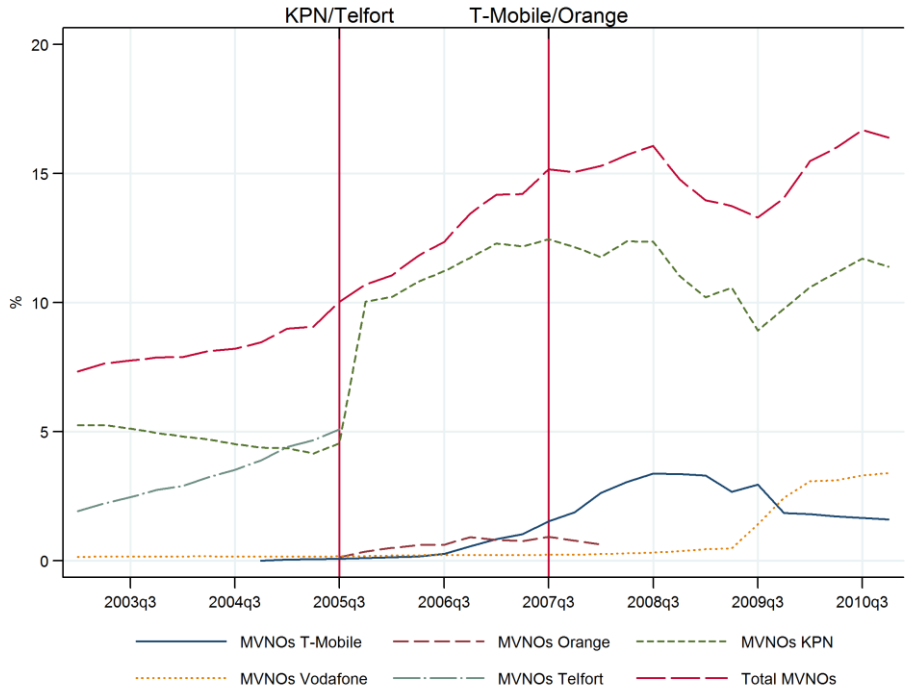

Figure 10: Retail market share of MVNOs by their network provider[110]

In the post-merger period some of the larger MVNOs switched host operator: Rabo Mobiel from Orange to KPN in 2008, Lycamobile from T-Mobile to Vodafone in 2009 (which explains the sudden increase in the wholesale market share of Vodafone at the end of 2009) and Tele2 from KPN to T-Mobile in 2009.

The number of MVNOs increased over the period of review, as depicted in Table 8[111]. The table also shows that the MVNO segment is characterised by exit and entry. The number of MVNOs in the Dutch market was relatively high during the relevant period but the MVNO segment itself was dominated by the five largest MVNOs Lycamobile, Tele2, Lebara, Ortel and Albert Heijn who together serviced over 70% of all MVNO subscribers in 2009[112]. In terms of mobile offer, the MVNOs focused mostly on pre-paid connections and some large MVNOs such as Lebara, Lycamobile and Ortel focused on offering international communications services ("Ethnic MVNOs").

[110] Source: Telecompaper, Dutch Mobile Operators, Q1/2003 – Q4/2010.

[111] However different data sources report different numbers of MVNOs. For example Telecompaper reports 47 in 2009 while UPNext only counts 29.

[112] Source: Telecompaper, Dutch Mobile Virtual Operators Market overview, first quarter 2009. Debitel was also a large MVNO but was taken over by KPN in November 2008.

Table 8: Number of MVNOs and entry/exit 2005 – 2010[113]

	2005	2006	2007	2008	2009	2010
Number of MVNOs	14	20	23	28	29	37
Newly launched independent MVNOs	5	5	3	4	3	6
Exit through acquisition by MNO or closing	2	0	1	2	3	0

6.2.3 Retail prices within the Netherlands

The available data for the Netherlands include all MNOs, their sub-brands and several MVNOs, which allows us to compare the development in the price level across the competitors in the market (although only the MNOs will be included in the econometric price analysis). Figure 11 presents the development of the average of the monthly prices of the four cheapest tariffs across the Dutch providers for the Mid basket[114]. Overall, the monthly price of MNOs and MVNOs decreased slightly over the period considered.

Figure 11: Price development of MNOs, their sub-brands and the largest MVNOs for the Mid basket[115]

[113] Source: UPNext Research, European MVNO survey, January 2012.

[114] Ethnic MVNOs (Lycamobile, Lebara, Ortel) and small MVNOs are not included. The MVNO Debitel is excluded due to lack of data.

[115] Although Orange was discontinued in Q3/2008, we also drop its Q2/2008 prices due to a significant decrease of its tariff plans offering. See Section 6.3.1 for further explanations.

Among the MNOs and MVNOs in the Netherlands there are different positioning strategies, which are reflected in the price levels shown in Figure 11.

The market leader KPN seems to adopt a multi-brand strategy. Its KPN brand is positioned as one of the most expensive providers for the whole period. The sub-brand Hi focuses on younger post-paid customers, and has a price position closer to the country's average. After the KPN/Telfort merger, Telfort became the budget brand of KPN, with pre-paid and post-paid tariff plans.

Of the merging parties, T-Mobile is positioned below the country average price, and is one of the cheapest providers pre-merger, whereas Orange was for several quarters one of the most expensive operators. However, Orange introduced some very competitive (less expensive) post-paid tariff plans in Q3/2006, which drastically reduced its price level. After the merger, the Orange brand was still on the market until Q3/2008. T-Mobile introduced its second brand Ben only in 2010[116].

Vodafone is positioned approximately at the country average price, and it offered a single brand until 2010, when it created the second brand hollands nieuwe.

The MVNO Tele2, hosted by Telfort and KPN, positioned itself at the lower end of the price range in the Dutch mobile telecommunications market, and was the cheapest provider throughout the period, with a very aggressive strategy. However, Figure 11 shows that Tele2's price over time converged with the other providers' prices. Recently, Tele2 became an MNO in the Netherlands' mobile telecommunications market and expects to have a 4G network with national coverage by 2016.

From Figure 11 it appears that the price series of the different MNOs and MVNOs did not react strongly in the aftermath of the two mergers.

All in all, the average tariffs of the four MNOs in the Dutch market cover different parts of the monthly price range in the Netherlands. Hence, not only they are by far the biggest players, but they offer a reasonable approximation of the average price level of the country.

Discussion of price and market share developments

Similarly to the Austrian analysis, it is challenging to reconcile the development of the MNOs' market shares in the Netherlands in the post-merger period with the relative changes in price levels.

We observe that T-Mobile's prices stayed below the prices of Vodafone and KPN and dropped after the merger by slightly more than those of Vodafone. Figure 9 shows that the market share of T-Mobile remained approximately constant in the post-merger period until Q4/2009 when it suddenly dropped. Possibly, this is related to the termination of the Orange brand (and the discontinuation of former Orange tariffs). Of the remaining MNOs, the market share of Vodafone increased, although we observe a considerable increase in prices post-merger relative to the other two MNOs. When abstracting from extraordinary

[116] See http://www.elephanttalk.com/news/t-mobile-netherlands-launches-ben-prepaid-news-13117913223

effects such as the acquisition of Debitel, KPN steadily lost market share, which may be linked to the relatively high prices of its main brand.

6.2.4 Retail prices compared to the control countries

Figure 12 compares the evolution of the average of the mobile prices of the four cheapest tariffs of each of the MNOs in the Netherlands (the blue solid line) and the average mobile price (based on the four cheapest tariffs) in all the control countries (the red dashed line) for the three baskets in the period from Q1/2005 to Q3/2009[117,118]. The two vertical lines indicate the quarters of the two mergers in the Netherlands' mobile telecom market during the period considered: the KPN/Telfort merger in Q3/2005, and the T-Mobile/Orange in Q3/2007.

[117] The average price of the Netherlands has been computed including only the tariffs of the MNOs (T-Mobile, Orange, KPN and Vodafone).

[118] For the Dutch merger analysis, the control countries also include Denmark, which was excluded from the Austrian merger analysis due to an MNO entry event in Denmark in early 2004.

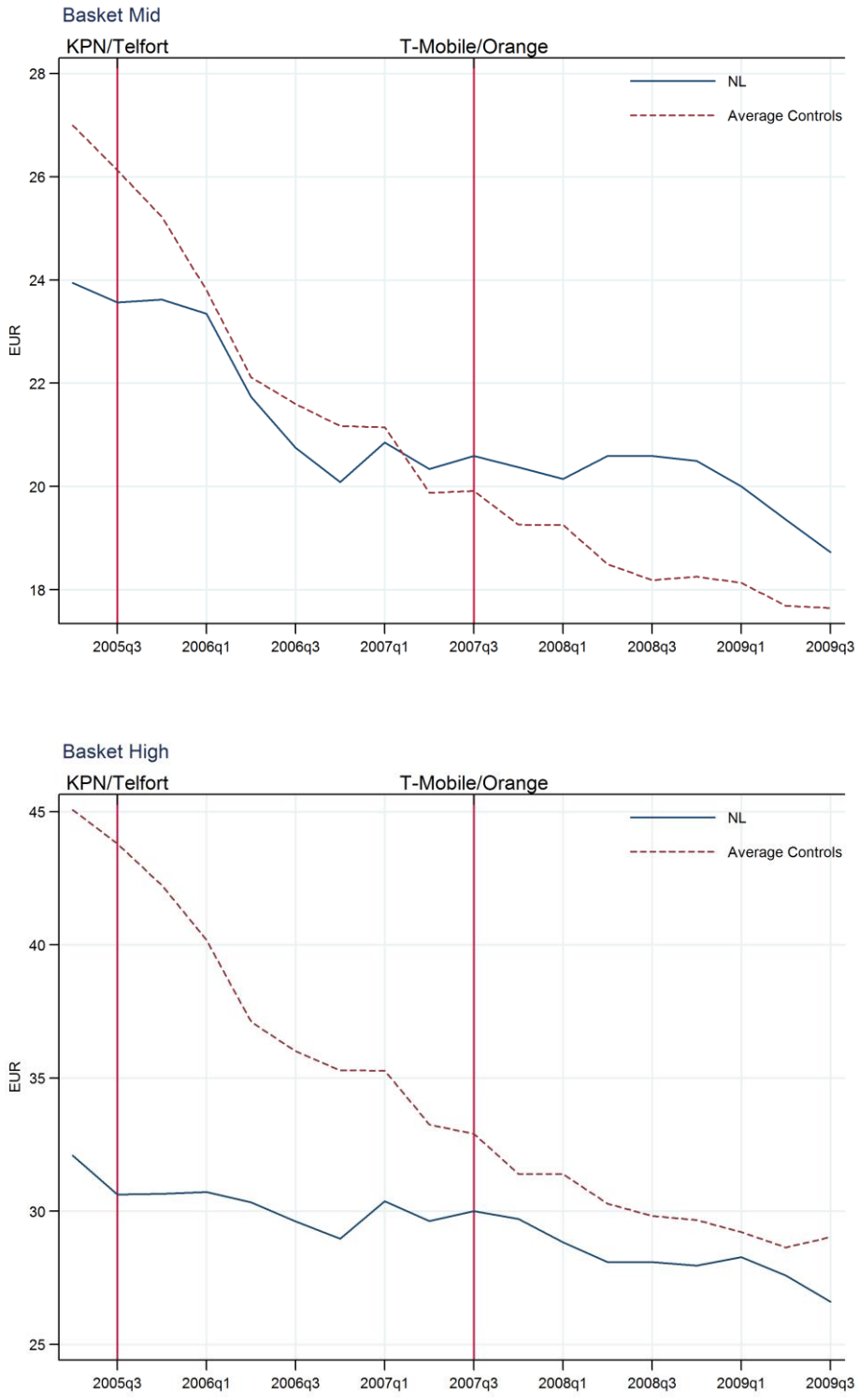

Figure 12: Average MNO price development in the Netherlands and in the control countries (Low, Mid and High baskets)

The average price across the control countries appears to follow a downward pattern for all three baskets. In particular, in the two quarters following the KPN/Telfort merger (Q4/2005 and Q1/2006) and for all three baskets, there is a strong price decrease in the average price of the control countries, but a minor price decrease in the Netherlands. The relative

price increases with respect to the control countries in these two quarters may possibly be linked to the preceding KPN/Telfort merger.

After Q2/2006, the development of the prices depends on the basket. The price level in the Netherlands appears to follow a less steep downward trend compared to the control countries for the High basket over the entire analysed period. For the Mid and Low baskets the price movement is similar to the average in the control countries until Q1/2007, when it becomes flatter relative to the control countries.

Although it is not possible to identify clearly the effect of the T-Mobile/Orange merger based on visual inspection of the development of prices, from Figure 12 it appears that the price for mobile services in the Netherlands for the Mid and Low baskets followed a similar trend to the average price in the control countries during the pre-merger period and then diverged to a less steep downward trend in the post-merger period. However, it appears that the divergence started before Q3/2007, the quarter in which the merger deal was cleared. For the High basket, instead, it appears that the pre-merger trend of the price in the Netherlands did not follow the same trend as the price in the control countries. The control countries average price converges to the lower level of the Netherlands over time.

6.3 Econometric analysis

This section introduces the econometric analysis for the estimation of the effect associated with the merger between T-Mobile and Orange in the Netherlands. In Section 6.3.1, we discuss the model adjustments which were required to carry out the analysis in the Netherlands. Sections 6.3.2 and 6.3.3 report and discuss the results of the difference-in-differences estimation of the Base specification (Equation 1) and of the Trend specification (Equation 2), respectively. The results of the synthetic control group approach are reported in Section 6.3.4. Finally, Section 6.4 draws the overall conclusion and lessons learnt from the Dutch analysis.

As in the Austrian analysis, we decomposed the country-wise effect estimated by the difference-in-differences to MNO level. This analysis, however, presents serious challenges for identifying the effect associated with the merger at the level of each MNO, as detailed in Section 4.1. The results of the analysis at MNO level are therefore included in Annex B.

6.3.1 Specificities of the econometric analysis

The econometric specifications applied in this section are adapted to a number of specificities of the T-Mobile/Orange merger.

First, we cannot exclude that some effects linked to the T-Mobile/Orange merger may have already materialized before the merger was cleared in Q3/2007. By February 2007 it became public knowledge that France Telecom, which owned Orange Netherlands, was considering the sale of its Dutch subsidiary[119]. Also in February, it was reported that Orange Netherlands had attracted interest from several potential bidders, among which T-Mobile

[119] See e.g. https://www.telegeography.com/products/commsupdate/articles/2007/02/13/ft-considering-sale-of-orange-netherlands/.

and Vodafone were mentioned[120]. In May 2007, Deutsche Telekom, the mother company of T-Mobile, was reported to have effectively agreed to acquire Orange Netherlands[121].

Figure 12 shows that from Q1/2007 to Q2/2007 the average prices in the control countries decreased by more than in the Netherlands. A deeper investigation of the data gives further indication of the possibility of an early effect of the merger (see Annex B). The MNOs in the Netherlands may have already anticipated the merger in Q2/2007. It is conceivable that once a deal is expected to be struck, this may be reflected in the pricing of the marked participants, even if the merger is not yet formally cleared or closed[122]. For these reasons, we took a conservative approach and excluded from the analysis Q2/2007 and Q3/2007 in our main specification and report in the Annex how the results change if Q2/2007 quarter were to be included.

Second, the T-Mobile/Orange merger took place roughly two years after the KPN/Telfort merger, which was cleared in August 2005. The KPN/Telfort merger may have affected in particular the pre-merger trend of the T-Mobile/Orange merger. Indeed, we observe that there was a divergence in the trend in the Netherlands and the trend of the control countries in particular in the two quarters following the KPN/Telfort merger (see Section 6.2.4). This led us to restrict the pre-merger period when assessing the T-Mobile/Orange merger to four quarters, from Q2/2006 to Q1/2007[123]. As in the Austrian analysis, we kept the length of the post-merger period to eight quarters, from Q4/2007 to Q3/2009. Shortening the pre-merger period avoids confounding effects due to changes in the price level caused by the KPN/Telfort merger which materialized within seven months after that merger. In contrast, as set out below in more detail, it may not be excluded that the KPN/Telfort merger led to further price changes after Q2/2007, which needs to be taken into account when interpreting the results. The shorter pre-merger period might also affect the precision of our estimates, as we have a lower number of observations to disentangle the effect of the merger from the impact of other explanatory variables.

Third, the Orange brand was discontinued in Q3/2008 and already in Q2/2008 many of the post-paid tariffs were no longer available. For this reason, we drop Orange from Q2/2008 onwards in the econometric analysis. Therefore, the medium-term effect of the T-Mobile/Orange merger on the Orange brand cannot be estimated.

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120 See e.g. https://www.telegeography.com/products/commsupdate/articles/2007/02/27/sale-of-orange-netherlands-seen-attracting-five-bidders-paper-says/.

121 See https://www.telegeography.com/products/commsupdate/articles/2007/05/23/dt-linked-with-move-for-orange-netherlands/.

122 Being aware of the facts based on which the merger was eventually cleared, the MNOs in the Netherlands may already have expected that the merger would likely be cleared. For example, in anticipation of the merger, Orange may decide not to engage in aggressive pricing and competitors may similarly refrain from aggressive pricing in anticipation of reduced competitive pressure post-merger. Alternatively, MNOs may be hesitant to make any significant change in their pricing strategy in light of the upcoming merger, which may imply a price increase in relation to the control countries, where prices keep falling.

123 An alternative would have been to estimate the joint effect of both mergers. However, the available data proved to be incomplete before 2005, which would have undermined the quality of the results.

Fourth, MVNOs play a significant role in the mobile telecommunications market. However, we lack price data of relatively important MVNOs (such as Debitel) and in the control countries we observe only the tariff of the two largest MNOs. In addition, the MVNOs tend to offer predominantly SIM-only tariffs and pre-paid which are less comparable to the tariffs of the MNOs; and, as explained above, some MVNOs target specific groups of customers which are not the focus of the analysis. For those reasons MVNOs are excluded from the econometric analysis.

Fifth, KPN used a multi-brand strategy throughout the analyzed period. However, second brands were not included in the Teligen dataset (which is used for the control countries) until 2006 and the timing as of when sub-brands were included differs across countries (see Section 3.1.2). Therefore second brands (including the Telfort brand of KPN) were excluded from the analysis.

To summarize, in the main specification the pre-merger period lasts four quarters, from Q2/2006 to Q1/2007, while the post-merger period includes eight quarters, from Q4/2007 to Q3/2009. Q2/2007 and Q3/2007 are excluded from the analysis. The analysis is carried out for the three usage baskets separately. The dependent variable is the (log) price of a given tariff for each basket, while the control variables are (log) MTR and GDP growth. The tariff dataset combines Telecompaper data for the Netherlands, which include all the operators there (excluding tariffs of MVNOs and second brands), and Teligen data, which includes only the two largest operators, for all other countries[124]. The analysis includes country-provider fixed effects and time-fixed effects. Finally, the standard errors are clustered at the country level.

6.3.2 Difference-in-differences approach: Base specification

This subsection presents the estimated effects that the merger T-Mobile/Orange had on the price level in the Netherlands when comparing the price development in the Netherlands to the price development in all the available countries.

[124] For the Base specification, changing the source of data from Teligen to Telecompaper for the Netherlands only marginally affects the results. For the Trend specification, however, changing the source of data has a greater effect on the results. However, this may be related to the difficulties in correctly estimating the pre-merger trend in the Netherlands given the short pre-merger period. See Annex B, Section B.1.

Table 9: Estimation of country-wide effect of the merger: Base specification

	(1)	(2)	(3)
Dep. Variable	log Price	log Price	log Price
Basket	Low	Mid	High
Short-term effect	0.062	0.093**	0.133***
	(0.232)	(0.021)	(0.000)
Medium-term effect	0.009	0.099**	0.167***
	(0.864)	(0.038)	(0.001)
GDP growth	2.598**	1.964**	1.825**
	(0.013)	(0.025)	(0.015)
log MTR	0.015	-0.032	-0.083
	(0.906)	(0.723)	(0.226)
Constant	2.591***	3.066***	3.527***
	(0.000)	(0.000)	(0.000)
Observations	1318	1318	1318
R-squared	0.707	0.727	0.785
Country-spec. trend	NO	NO	NO
Common trend test	Failed	Passed	Failed

Cluster-robust pval below coefficients (s.e. clustered at country level)

Time fixed effects and country-provider fixed-effects

Excluded quarters (merger) Q2-Q3/2007; pre-period 4 quarters; post-period 8 quarters; cheapest 4 tariffs

Common trend test "Failed" we reject the null hypothesis of common trend at 10% level

*Significance level: *** 1%, ** 5%, * 10%*

Table 9 summarizes the results of the difference-in-differences estimation at country level. The three columns report the results of the Base specification for the Low, Mid and High baskets, respectively. The analysis focuses on short-term and medium-term effects of the merger, where the short-term effect is defined as the first year (first four quarters) in the post-merger period, while the medium-term effect is the second year (second four quarters) in the post-merger period.

It appears that the Dutch merger was associated with an increase in prices. The estimated percentage price increase appears to be more pronounced the higher the monthly usage. The increase in price is positive but not significant for the Low basket, around 10% for the Mid basket, and attains 13% to 17% for the High basket[125]. In addition, for the High basket it appears that the effect on price increases slightly over time, where the difference between medium-term and short-term effects is roughly 3.3 percentage points.

[125] As discussed in Section 4.1, clustered standard errors may overestimate the significance level of the coefficients in our setting. The p-values of the wild bootstrap (see Section 4.1) for the High basket are 0.17 and 0.29 for short-term and medium-term effects, respectively. For the Mid basket, they are 0.33 and 0.42; and for the Low basket, they are 0.43 and 0.90.

As mentioned in Section 6.3.1, short- and medium-term effects of the KPN/Telfort merger may have had an impact on the price level especially in the two years after that merger. To the extent the prices were increasing in that period due to the KPN/Telfort merger, the estimated effect of the T-Mobile/Orange merger may be biased upwards[126]. Based on Figure 12 as regards the Low and Mid baskets, the prices in the Netherlands do not markedly increase during Q2/2006 to Q1/2007 relative to the control countries, which indicates the absence of significant (persistent) late effects of the KPN/Telfort merger. However, as regards the High basket, the prices in the Netherlands increased during Q2/2006 to Q1/2007 relative to the control countries. For this reason there is some risk, especially for the High basket, that some of the estimated price increase may not be causally linked to the T-Mobile/Orange merger.

Moreover, the results of the Base specification might be driven by differences in the overall trends of the control countries and the overall trend of the Netherlands. The trend test (i.e. the test that we apply to the pre-merger period to identify different trends between the Netherlands and the control countries, see Section 4.1) is indeed failed for the Low and High baskets. In particular, as regards the High basket, the trend test appears to fail because prices were decreasing less in the Netherlands compared to the control countries already in the pre-merger period, as is also visible in Figure 12 above. Whereas this suggests that the prices in the Netherlands for these baskets did not follow the average trend of the control countries, the underlying reasons for this divergence cannot be identified with the available data.

Due to the KPN/Telfort merger which occurred in 2005 in the Netherlands, it is particularly difficult to interpret the implication of a diverging pre-merger trend. In particular, it is unclear to what extent divergences in the pre-merger price trends indicate that prices in the Netherlands and the control countries would have developed differently in the absence of the T-Mobile/Orange merger[127]. Specifically, one conceivable reason for the observed differences in the pre-merger price trends might be the medium-term effects of the earlier KPN/Telfort merger, which materialized during Q2/2006 to Q1/2007. As for the control variables included in the analysis, GDP growth has the expected positive effect on prices, and is statistically significant across all baskets and specifications, while the (log) MTR is mostly negative and never statistically significant. The latter result is somewhat surprising, as one would expect a cost component such as the MTR to affect the tariff prices positively.

In the MNO level analysis included in Annex B, we decompose the price effect at country level of the Base specification by each of the Netherlands' MNOs[128]. We observe that for Low and Mid baskets, KPN and Vodafone are the main contributors to the average effect at

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[126] Specifically, if the KPN/Telfort merger induced a persistent price increase during Q2/2006 to Q3/2009, then some of the difference between the average post-merger price and the pre-merger price (after controlling for other covariates) is due to the KPN/Telfort merger. In the Base specification this late effect of the KPN/Telfort would be fully attributed to the effect of the T-Mobile/Orange merger, implying an upward bias.

[127] For the High basket High, Figure 12 shows a trend difference throughout. However, this trend difference might be associated with effects of the KPN/Telfort merger before Q3/2007 and with effects of the T-Mobile/Orange merger thereafter.

[128] See Table 37 in Annex B.

country level, while for the High basket all the MNOs contribute rather equally to the country average effect. As mentioned in Section 4.1, however, this analysis assumes that the price series of each MNO has the same pre-merger trend as the country average. We believe that this assumption is unlikely to be met for all the MNOs. Indeed, Figure 11 shows that the MNOs present in the Netherlands display differences in the trends of their price series. The violation of this assumption implies that the results of this analysis cannot be regarded as the effect of the merger on each MNO.

We conduct several robustness checks for the analysis at country level. First, we focus the analysis exclusively on pre-paid tariffs. As already discussed for the Austrian analysis (see Section 5.3.1), this robustness check primarily addresses the issue of handset subsidies, which are usually less significant for pre-paid tariffs. Table 28 in Annex B reports the results of this robustness check. Second, we include in the analysis only the two cheapest tariffs instead of the four cheapest per MNO. The full results are shown in Table 29 of Annex B[129]. Third, we include in the analysis Q2/2007, which was excluded from the main analysis because of possible early effects of the merger. Table 30 in Annex B shows the results of this robustness check. Finally, we estimate the model assuming a common (average) OECD usage pattern across countries. The results are reported in Table 32 of Annex B.

Overall, the results of the robustness checks for the Base specification largely confirm the findings in the main analysis above, namely a price increase associated with the T-Mobile/Orange merger, which increases as the usage becomes more intensive.

However, as already mentioned above, the results of the Base specification might be driven by differential trends for example due to structural differences between the Netherlands and the control countries price series. The following two sections address this issue.

6.3.3 Difference-in-differences approach: Trend specification

In the attempt to correct for the possible diverging trends between the control countries and the Netherlands in the pre-merger period, we included country-specific trends in the regression, as discussed in Section 4.1. The results of the Trend specification are reported in Table 10. Once the analysis accounts for country-specific trends, the results change for the Low and High baskets.

The country-specific trend analysis of the Netherlands may be particularly sensitive to price changes in the pre-merger period as it is estimated based only on the four quarters of the pre-merger period from Q2/2006 to Q1/2007[130]. As the identification strategy of the Trend specification extrapolates the estimated trend into the post-merger period, confounding effects in the pre-merger period may severely affect the estimated trend and consequently, the estimate price effects of the merger. In particular, medium-term effects of the KPN/Telfort merger may bias the estimated linear price trend for Netherlands and the predicted price effects of the T-Mobile/Orange.

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[129] See Section 3.3 for a discussion of the advantages of focusing on the lowest four or the lowest two tariffs.

[130] See Section 4.1 where the Trend specification is explained.

Table 10: Estimation of country-wide effect of the merger: Trend specification

	(1)	(2)	(3)
Dep. Variable	log Price	log Price	log Price
Basket	low	mid	high
Short-term effect	0.148**	0.126**	0.05
	(0.015)	(0.036)	(0.194)
Medium-term effect	0.141*	0.149	0.03
	(0.066)	(0.101)	(0.643)
GDP growth	1.315**	0.980*	0.806*
	(0.043)	(0.053)	(0.058)
log MTR	-0.032	-0.036	-0.029
	(0.632)	(0.345)	(0.631)
Constant	0.225**	1.154***	3.672***
	(0.019)	(0.000)	(0.000)
Observations	1,318	1,318	1,318
R-squared	0.806	0.825	0.842
Country-spec. trend	YES	YES	YES

Cluster-robust pval below coefficients (s.e. clustered at country level)

Time fixed effects and country-provider fixed-effects

Excluded quarters (merger) Q2-Q3/2007; pre-period 4 quarters; post-period 8 quarters; cheapest 4 tariffs

*Significance level: *** 1%, ** 5%, * 10%*

For the Low basket, we estimate a price increase of 14%. However, this result may not be reliable, as Figure 12 reveals that the development of the prices in the Netherlands for the Low basket is particularly volatile. Specifically, in Q3/2006 the price in Netherlands increased and then strongly dropped thereafter, whereas in the control countries it decreased in Q3/2006 on average. The estimated price trend of the Netherlands is thus to a large extent driven by the price increase in Q3/2006, which reduces our confidence in the estimated linear trend and thus in the estimated merger effect for the Low basket.

The results for the Mid basket, which passed the trend test in the Base specification, do not change drastically after the inclusion of the country-specific trends. They show price increases of 12% and 15% for the short-term and medium-term effects, respectively, although the latter is slightly outside the standard range of statistical significance of 10%.

For the High basket, though, a positive price trend for the Netherlands is estimated and the estimated price effects of the merger significantly decrease to around 4% and lose statistical significance. Indeed, Figure 12 suggests that prices in the Netherlands were decreasing less compared to the control countries both in the pre-merger period and also throughout the analysed period. Whereas the observed prices in the pre-merger period are less volatile (compared to the Low basket) and indeed suggest that there may be a difference in a linear trend, the above caveat remains: that the observed prices in Q2/2006 to Q1/2007 may be affected by medium-term effects of the KPN/Telfort merger. Put differently, we cannot exclude that in the absence of the KPN/Telfort merger there would have been a steeper price decrease in Q2/2006 to Q1/2007, which would have likely

implied higher estimated price effects of the T-Mobile/Orange merger in the Trend specification.

As we do for the Base specification, we also decompose the country level effect at the MNO level (Table 38 in Annex B). When including country-specific trends, the estimated price effects of each MNO uniformly increase for the Low basket and uniformly decrease for the High basket, similar to the analysis at country level. As in the Base specification at MNO level, we estimate higher price increases for KPN and Vodafone than for T-Mobile and Orange. By including MNO-specific trends (instead of country-specific trends), the estimated price increase of the merging parties becomes substantially higher, while the price effects of Vodafone are reduced and the price effects of KPN are negative. As already mentioned above, however, the entire analysis at MNO level suffers from serious limitations in the identification of the merger effect and is therefore not reliable. A more detailed discussion of the MNO level analysis is presented in Annex B.

For the analysis at country level, we conducted the same robustness checks for the Trend specification as for the Base specification; namely (i) we included in the analysis pre-paid tariffs only, (ii) we included in the analysis only the two cheapest tariffs, (iii) we included in the analysis Q2/2007, and (iv) we used a common OECD usage pattern across countries. The results of the robustness checks are shown in Table 28, Table 29, Table 30, and Table 32 of Annex B, respectively.

The results of the first, second and fourth robustness checks (pre-paid only, two cheapest tariffs, and OECD common basket) confirm the results of the main analysis. We observe a price increase across all baskets, which decreases as the usage becomes more intensive. However, the statistical significance using clustered standard errors is somewhat lost in the first two robustness checks.

In the third robustness check we estimate lower coefficients, and an overall loss in the significance level. The main reason for this change is that the trend for the Netherlands is effectively estimated based exclusively on the four quarters in the pre-merger period, and the inclusion of an outlier such as Q2/2007 can significantly change the estimated coefficient of the trend, and, as a consequence, significantly affect the estimated coefficients of the merger effect. Although this variation changes the results, this does not undermine our confidence in the results of our main specification, as it appears plausible that the Q2/2007 prices were already affected by the upcoming merger. However, this robustness check further demonstrates how the Trend specification in the Netherlands is sensitive due to the small number of periods in the pre-merger period.

Overall, for the above reasons, the results of the Trend specification appear to be more adversely affected by the short pre-merger period than the Base specification. We use a short pre-merger period to limit the influence that the KPN/Telfort merger might have had on our analysis of the T-Mobile/Orange merger. This, in turn, reduces the reliability of the estimated trend in the Trend specification, as also noted by Wolfers (2006), who warns against the estimation of a trend over a short period of time. Therefore, only a very limited weight – if any – should be attached to these results.

6.3.4 Synthetic control approach

This section presents the effect of the T-Mobile/Orange merger when applying the synthetic control group method.

For this approach we aggregate the data at country level by averaging the four cheapest tariffs per MNO in each country. As explained in Section 4.2, this methodology estimates the counterfactual price as a weighted linear combination of the price series of the countries, which linear combination approximates best a number of predictor parameters, such as the pre-merger evolution of prices in the Netherlands, during the pre-merger period. The difference between the actual prices and the price predicted by this "synthetic control" series determines the effect of the merger. Inferences on the estimated merger effect are based on a permutation test whereby the synthetic control group approach is applied to each of the control countries. All countries are then ranked based on the ratio of the difference between actual and synthetic series in the post-merger period and in the pre-merger period (RMSPE ratio)[131]. A detailed discussion of the methodology can be found in Section 4.2 above. Table 11 presents the results of the synthetic control group approach. Similar to the methodology of Section 6.3.4, for each usage basket we disentangle a short-term effect (the first year post-merger) and a medium-term effect (the second year post-merger)[132]. The column "Effect" displays the estimated effect of the merger. The column "Rank" presents the rank of the permutation test used to evaluate the significance of our estimates. The column "Selected Control" shows the countries selected to form the synthetic series of the Netherlands. The selected controls differ across baskets, as the price developments also vary across baskets as shown in Figure 12. The weights assigned to each of those countries are presented in Table 33 of Annex B.

Table 11: Results of synthetic control group estimation

Basket	Period	Effect	Rank	Selected Control
Low	short	0.138	10/13	BE; FR; IT
Low	medium	0.080	9/13	
Mid	short	0.105	6/13	BE; FI; SE
Mid	medium	0.156	6/13	
High	short	0.107	5/13	BE; FI; UK
High	medium	0.147	6/13	

Excluded quarters (merger) Q2-Q3/2007; pre-period 4 quarters; post-period 8 quarters; cheapest 4 tariffs

For all the baskets the merger effects estimated by the synthetic control group approach are relatively high and positive. For the Low basket we observe a decrease in the estimated effect over time (14% and 8% for short-term and medium-term periods, respectively), while for Mid and High baskets the effect increases over time (for the Mid basket 10.5% in the short term and 15.5% in the medium term, for the High basket 10.5% in the short term and 14.5% in the medium term).

Based on the rankings shown in Table 11, none of the estimated effects appears to be significant. The highest ranking is 5/13 for the short-term effect in the High basket. This means that at least four other countries in which no merger occurred had RMSPE ratios

[132] Similarly to the difference-in-differences specifications, in the synthetic control approach we use a pre-merger period from Q2/2006 to Q1/2007, we exclude the quarters Q2/2007 and Q3/2007 from the computation of the merger effect, and use a post-merger period from Q4/2007 to Q3/2009.

higher than the Netherlands, and thus showed more extreme price divergences in the period Q4/2007 to Q3/2009 (relative to the divergences in the pre-merger period) than did the Netherlands. Therefore, we cannot exclude that the effects of the merger in the Netherlands estimated by the synthetic control group approach are due to other unobserved factors.

Figure 13 shows the actual and the synthetic price series of the Netherlands for the High basket. The synthetic series is formed by the linear combination of Belgium, Finland and UK, with weights assigned relatively evenly across the three countries. The synthetic series follows the actual series in the pre-merger period, underlining a good fit of the methodology. In contrast, during the post-merger period the two series diverge substantially. The synthetic series displays a more steep decrease than the actual series, and, as a result, the two series diverge over time, in line with the difference between the estimated short-term and medium-term merger effects.

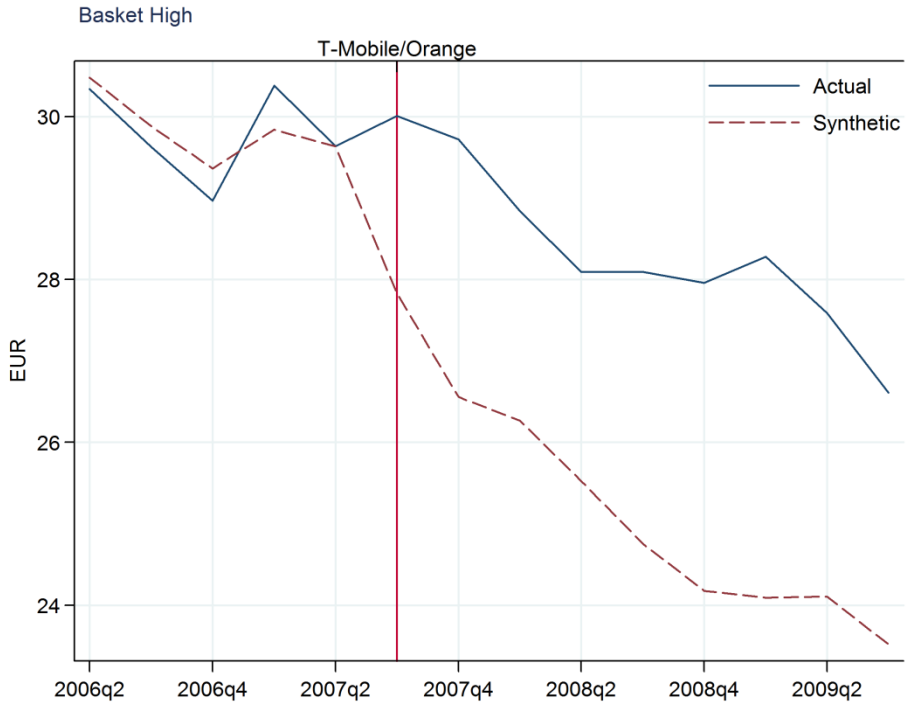

Figure 13: Price development the Netherlands and Synthetic control – High basket

Figure 14 shows the (log) difference between the actual and the synthetic series of the High basket for the Netherlands (the bold line) and for the other control countries used as placebos (the coloured lines). In the post-merger period the (log) difference for the Netherlands does not "stand out" from the other placebos, i.e. in other countries, although no merger took place, the synthetic control group approach estimates a greater effect (in absolute value) than in the Netherlands. This suggests that the RMSPE ratio of the Netherlands for the High basket is relatively low compared to the other countries, questioning, therefore, the significance of the effect estimated in the Netherlands. Similar figures for the Low and Mid baskets can be found in Annex B.

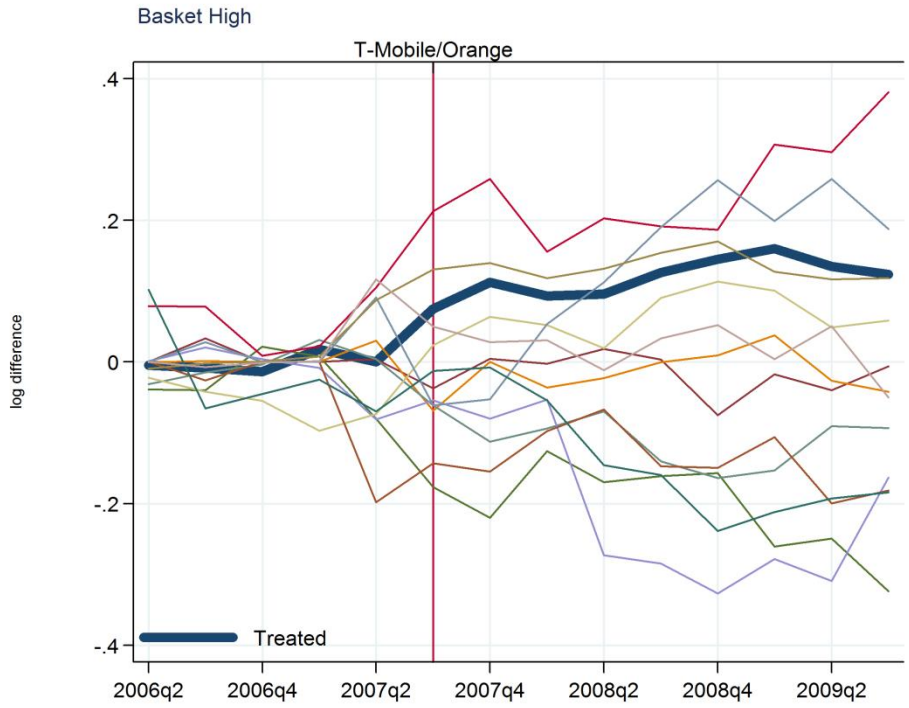

Figure 14: Log price difference in Netherlands and in placebo for control countries – High basket

To test the robustness of the synthetic control group approach, we excluded from the pool of countries potentially selected to form the synthetic series of the Netherlands the country with the highest weight in the main specification. For the High basket, for example, we excluded Finland. Table 34 in Annex B shows the results of the robustness check and the country that was excluded from the analysis. For the Mid and High baskets we find consistent results with the main specification, with positive merger effects above 9%. In contrast, for the Low basket the exclusion of Italy from the pool of control countries turns the merger effects negative (-3% in the short term, and -7.5% in the medium term). Hence, this robustness check shows that in particular for the Mid and High baskets the results of the main specification are not significantly affected by the exclusion of the country that received the highest weight.

As a second robustness check, we included in the analysis only the two cheapest tariffs. The results are shown in Table 35 of Annex B. Compared to the main specification of Table 11, the analysis of the two cheapest tariffs delivers somewhat more significant results for the High basket, with a ranking of 2/13 for both short-term and medium-term effects, and a higher magnitude of the effects. For the Low and Mid baskets the estimated effect and the significance level is mostly unchanged. The result of this robustness check supports the indication of the Base specification in the classical difference-in-differences methodology introduced in the previous Section; that is, the merger was associated with a more pronounced increase in prices for heavy users than for low- and medium-intensity users.

Finally, we applied the synthetic control group approach with tariffs' price series computed using a common OECD basket across countries. Table 36 in Annex B reports the results of this robustness check. The estimated effects associated with the merger are positive for the Mid and High baskets, and close to zero or even negative for the Low basket. It thus appears that this robustness check supports the results for the Mid and High baskets.

The application of the synthetic control approach may be confounded by effects of the KPN/Telfort merger that was cleared in August 2005. Specifically, the effects of the KPN/Telfort merger may have affected the predictor parameters that are used to estimate the synthetic control for the T-Mobile/Orange merger (especially the price measure). Therefore, there is a risk that the selected controls do not necessarily approximate well the unobservable and time-varying factors which affect mobile telecommunications prices in the Netherlands. Moreover, the very short pre-merger period of only four quarters based on which we construct the synthetic control reduces the reliability of the country selection, as in this short period temporary effects cannot be separated well from structural differences affecting the price development in the control countries.

Overall, the synthetic control group approach consistently indicates a relative price increase in the Netherlands for medium and heavy users associated with the T-Mobile/Orange merger. However, the reliability of these results also is limited. The small sample of countries and the short length of the time series due to the KPN/Telfort merger in the Netherlands severely limit the scope for applying this methodology to the merger under study.

6.4 Conclusions on the T-Mobile/Orange merger

Overall, the prices in the Netherlands appear to have increased after the T-Mobile/Orange merger compared to unaffected control countries, especially for tariffs geared at heavy users. However, whereas the results indicate that the T-Mobile/Orange merger is associated with a price increase, it cannot be excluded that the price increase identified in the Netherlands was enhanced or even caused by other factors affecting the market, beyond the T-Mobile/Orange merger.

A serious limitation of the Dutch analysis is the unclear influence of the previous KPN/Telfort merger which took place in 2005[133]. We cannot rule out the possibility that the previous merger in the Netherlands mobile telecommunications market influenced the development of the prices, in particular in the pre-merger period of the T-Mobile/Orange merger. Despite best efforts to adapt the econometric analysis so as to account for this issue, short- and medium-term effects of the KPN/Telfort merger could bias the effects estimated for the T-Mobile/Orange merger by our analysis. However, the observed price increases relative to the control countries may still indicate that the KPN/Telfort merger and the T-Mobile/Orange merger together led to price increases in the analysed period.

When using all control countries, according to the Base specification the merger is associated with a price increase which becomes more pronounced over time and attains roughly 10% for the Mid and roughly 17% for the High usage baskets in the medium term. Also the Low usage basket shows price increases, but they are not significant. Especially for the High basket, however, we observe that the pre-merger price trend of the Netherlands significantly diverges from the trend in the control countries, indicating that the identifying assumption of the Base specification might be violated.

[133] Another possible confounding event (of much smaller magnitude than the KPN/Telfort merger) is the acquisition of Debitel by KPN in Q3/2008.

Due to the very short pre-merger period of four quarters and a number of further issues, the synthetic control approach and, in particular the Trend specification, are less reliable than in the Austrian analysis. We therefore mainly use these approaches to improve our understanding of the signs and the potential magnitude of any bias associated with pre-merger trend differences between the Netherlands and the control countries. The Trend specification largely confirms the results but points to lower but still positive effects for the High basket. The magnitude of the estimated effects of the synthetic control group approach is similar to the Base specification, but the estimated effects generally do not stand out compared to price changes in other countries during the post-merger period.

The MVNOs, which were one of the factors used to support the unconditional clearance of the merger, maintained their market share after the T-Mobile/Orange merger and even managed to expand further somewhat after 2010. All three MNOs provided wholesale access to MVNOs after the T-Mobile/Orange merger, as shown by the new MVNOs entering the market each year and by the existing MVNOs who switched networks[134]. To the extent the observed increase in the prices of the mobile telecommunication market in the Netherlands is ascribed to the T-Mobile/Orange merger, this may suggest that the MVNOs did not represent a strong enough competitive constraint on the MNOs. However, the available information does not allow us to draw firm conclusions and analysing the impact of MVNOs on the market in more detail is beyond the scope of this study[135].

As in the Austrian analysis, despite estimated price increases of up to 17%, we cannot firmly establish that these effects are significant[136]. The same reasons set out for the Austrian analysis (Section 5.4) for the relatively low precision of the estimated price effects apply.

Overall, in the Netherlands we observe price increases in the analysed period relative to the control countries which are sometimes far above the threshold that would normally trigger an intervention in merger control. Although we do not have enough evidence to infer firmly that these were caused by the T-Mobile/Orange merger, the sizable price increases we estimated across several alternative specifications indicate an anti-competitive effect associated with this merger. Possibly, beyond the T-Mobile/Orange merger, late effects of the KPN/Telfort merger may also have contributed to the estimated price increases.

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134 However, the retail market share of Ethnic MVNOs such as Lebara or Lycamobile (which do not primarily compete for mainstream customers) strongly increased at the expense of MVNOs focusing on the mainstream mobile market.

135 Tariff data is available only for a subset of MVNOs. Moreover, the role of MVNOs varies substantially across control countries, so it would be challenging to construct a counterfactual scenario for MVNOs. Moreover, with the available data even the effects of the merger on the prices of the Dutch MNOs cannot be clearly identified.

136 The presented cluster robust standard errors likely overestimate the precision, whereas inference based on the wild bootstrap approach yields generally insignificant results. The permutation test also indicates that the price increases in the Netherland did not stand out compared to price changes in the control countries.

7 Conclusions

This report presents several quantitative and qualitative analyses to assess the effect on retail prices of the mergers between T-Mobile and tele.ring in Austria and T-Mobile and Orange in the Netherlands.

To estimate the effect of the mergers in their respective domestic mobile telecommunications markets we adopted the following strategy. First, we constructed a price index which is invariant to changes in the usage patterns over time. Such changes may falsely attribute price variations to the merger which are instead due to the development of the consumption preferences regarding mobile telecommunication services. Second, we estimated the counterfactual price development that would likely have taken place in Austria and the Netherlands if the respective mergers had not taken place. Because of a general trend of decreasing prices in similar countries, *inter alia*, the merger effect cannot be properly estimated by simply comparing the prices before and after the merger.

The quantitative results suggest that the Austrian T-Mobile/tele.ring merger as modified by the offered commitments did not lead to price increases in Austria. In contrast, mobile telecom prices in the Netherlands increased after the T-Mobile/Orange merger compared to the control countries. Whilst prices in the Netherlands did not increase in absolute terms, they decreased slower than in the control countries. Although we cannot firmly establish that this price increase was caused exclusively by the T-Mobile/Orange merger, it could well be linked to the T-Mobile/Orange merger, but may also involve late effects of the earlier KPN/Telfort merger.

There are four primary reasons for the challenges in firmly identifying the effects of the analysed mergers on prices. First, the effects of the analysed mergers exclusively materialize in a single country. This implies that it is very difficult to separate unobservable effects which affect prices in the country where the merger took place from the effects of the merger[137]. This issue is particularly relevant when analysing mergers in the mobile telecommunications industry, as pricing is often done at a national level, so that the merger effects often materialize uniformly in the country where the merger took place[138]. Under such circumstances, merger effects can be only identified to the extent they are much larger than other confounding effects in a given country. Second, there may be structural differences across countries which affect the price level and which are difficult to control. Third, prices in all countries appear to be substantially affected over time by idiosyncratic price developments. Such confounding effects generally reduce the precision of the econometric model. Fourth, the analysis of the T-Mobile/Orange merger in the Netherlands illustrates that it is very difficult to separate the effects of an earlier important event (such as a preceding merger) from those of the merger of interest.

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[137] The imbalance between only one country in which the tariffs were affected by a given merger and many other countries which were not affected by that merger also raises econometric difficulties in correctly estimating the precision of the estimation as set out in Section 4.1.

[138] In other industries (e.g. retailing or gasoline stations), competition takes place at a local level and the effects of a merger differ across local markets. This can be exploited in order to separate the merger effect from other confounding effects in a given country.

One objective of this project was to improve the understanding of the participating authorities of econometric ex-post evaluation techniques with a view to future ex-post evaluation studies. A number of methodological aspects, among many, are particularly relevant.

First, we derived a unidimensional price index for tariffs which are characterized by many price dimensions, such as the level of the monthly fee or the per-minute price for calls. Summarizing a number of price dimensions by a single index is particularly useful if the main interest lies on studying effects on the price level as opposed to the price structure, especially when the latter is complex.

Second, we considered some recent approaches to inferring correctly the precision of the estimated merger effects in a setting characterized by one affected country and few control countries. This discussion may also be relevant for other case studies where only a single market is affected (as opposed to many markets which are similarly affected by a merger). These cases are particularly challenging, as the estimated precision of the merger effects tends to be biased upwards when relying on the frequently used cluster-robust standard error specification. We point to an alternative method (wild bootstrap) which may provide added value in future ex-post estimations.

Third, we discussed in detail the challenge of carefully distinguishing between describing the observed price movements before and after the analysed merger as opposed to inferring causal effects of the examined mergers. In this context it is important to examine whether a control group is indeed suited to evaluate a given merger. In our case studies, the prices of the affected markets and of the control countries did not always follow a similar trend, which casts doubt on whether the effects of a merger can be estimated in an unbiased manner on the basis of a simple difference-in-differences specification.

This report also illustrates the importance of having access to reliable data in order to carry out a proper ex-post evaluation. The data must cover not only those markets in which the relevant merger took place, but also suitable control markets in which no intervention took place[139]. As an example, in our setting, access to data which includes all MNOs of the control countries and in particular the handset subsidies linked to each tariff would have drastically improved the reliability of the estimated price effects. Obtaining reliable information on handset subsidies appears to be difficult, since for a given tariff often several subsidized handsets are offered, and the implied subsidy often differs across handsets. If SIM-only tariffs (which by definition do not include subsidized handsets) are properly identified in the data and are sufficiently prevalent, focusing the analysis on SIM-only tariffs may be a promising alternative to collecting handset subsidy data.

Data limitations are also the main obstacle to assessing the effect of mergers on network quality. Conceptually, the econometric framework used in this report could also be applied to estimate changes in network quality associated with mergers. However, it appears very

[139] In some cases, a merger has a markedly different effect across different products, so that the counterfactual post-merger development of affected products can be constructed on the basis of other suitable products unaffected by the merger.

difficult to obtain data on suitable indicators of network quality which would be available for all countries included in the analysis[140].

The quality of data which can be used for ex-post evaluation depends on the information sources which are available to competition authorities. As discussed above, data which can be gathered in the context of merger control proceedings often does not suffice to evaluate mergers meaningfully ex-post. Hence, for this study, the participating authorities acquired data from private data providers and were therefore bound to the data stored by those providers. In contrast, some authorities, such as the US Federal Trade Commission, are empowered to request data from market participants for ex-post evaluation purposes[141]. Such powers can prove particularly effective in situations where information which is publicly available or can be acquired from private information providers is insufficient.

There are also interesting implications for further ex-post evaluation studies in the mobile telecom sector. On the one hand, the observed price changes after the Austrian T-Mobile/tele.ring merger and the Dutch T-Mobile/Orange merger differ significantly, indicating that the effects of mergers in this sector likely depend on the specificities of each case (in our case one merger was cleared subject to structural remedies and the two countries had a different number of MNOs active in the market at the time of the respective mergers). On the other hand, due to the above-mentioned statistical difficulties in identifying the effects of a given merger in isolation, the understanding of likely effects of mergers could be further improved by running broader econometric studies whereby the effects of several mergers are analysed simultaneously. In order for a broad study to generate meaningful results, it will be important, however, to find good predictors of the effects of mergers (e.g. the number of MNOs in a market, type of remedy imposed, etc.) on the basis of which mergers with similar effects can be grouped together.

One important consideration for the interpretation of ex-post evaluations of mergers is the role of merger control. As illustrated by the Austrian analysis, often only the effect of the merger as modified by submitted commitments can be estimated. Moreover, commitments will likely be imposed whenever the involved competition authority expects that the unmodified merger would have significant anti-competitive effects. Therefore, if no significant anti-competitive effects are found for a merger which was conditionally cleared, this indicates that the remedies were sufficient for that case. Still, on this basis, it could not be concluded that the merger would have had no significant anti-competitive effects even if no commitments had been imposed[142]. On the other hand, if a merger which was modified by commitments still entails significant anti-competitive effects, this indicates that the accepted commitments were insufficient.

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[140] In this context, estimating the effects on mergers on capital expenditures per subscriber appears to be of limited value, as this leaves open the important issue of whether larger operators can achieve a better network quality for a given level of investments per subscriber.

[141] For example, the FTC is empowered to compel the production of information relevant for ex-post evaluations under Section 6(b) of the FTC Act. See https://www.ftc.gov/about-ftc/what-we-do/enforcement-authority.

[142] Typically it cannot be evaluated whether the unmodified merger would have caused anti-competitive effects and thus whether imposing commitments was necessary in the first place, or whether the commitments were proportionate.

This project further illustrated how important cooperation among authorities is, especially in the field of ex-post evaluation. The market knowledge of the national authorities proved to be extremely useful for the two case studies. Moreover, this report greatly benefitted from leveraging pre-existing experience of the participating parties. Enormous synergies also resulted from the parallel analyses of two mergers in the same industry, as the methodological challenges and the solutions in both cases were similar. All participating authorities expanded their experience in ex-post evaluation, which will be useful for further similar studies.

Competition authorities need to ensure a high quality of ex-post evaluation. To this end, this study was independently assessed by two renowned academic experts in the field of ex-post evaluation. The assessment was done at two stages: the experts first received a preliminary version of the study on which they provided feedback. This feedback was addressed by the European Commission in the present report. The experts then provided a final assessment which is published alongside this report.

We think this form of external evaluation can be extremely valuable for several reasons. First, it is important that academic experts provide constructive feedback at a point where substantial changes are still feasible. Second, the academic experts' expertise, in particular as regards econometric methods which are not yet commonly applied in practice, can be very helpful. Third, the final evaluation fosters transparency and helps interested readers to understand better the strengths and the weaknesses of ex-post evaluations. Based on our experience, close cooperation with academic experts appears advisable for retrospective studies carried out by competition authorities.

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Annex A Austria

A.1 Comparison between Teligen and AK Vienna data

We compare the tariffs offered by the biggest two operators (Mobilkom with the brand A1 and T-Mobile) in both datasets and find only minor differences in the price time series (see Figure 15). The differences are mainly due to different methodologies in the data collection (e.g. different frequency of observations might result in promotions that are taken into account in one dataset and not in the other).

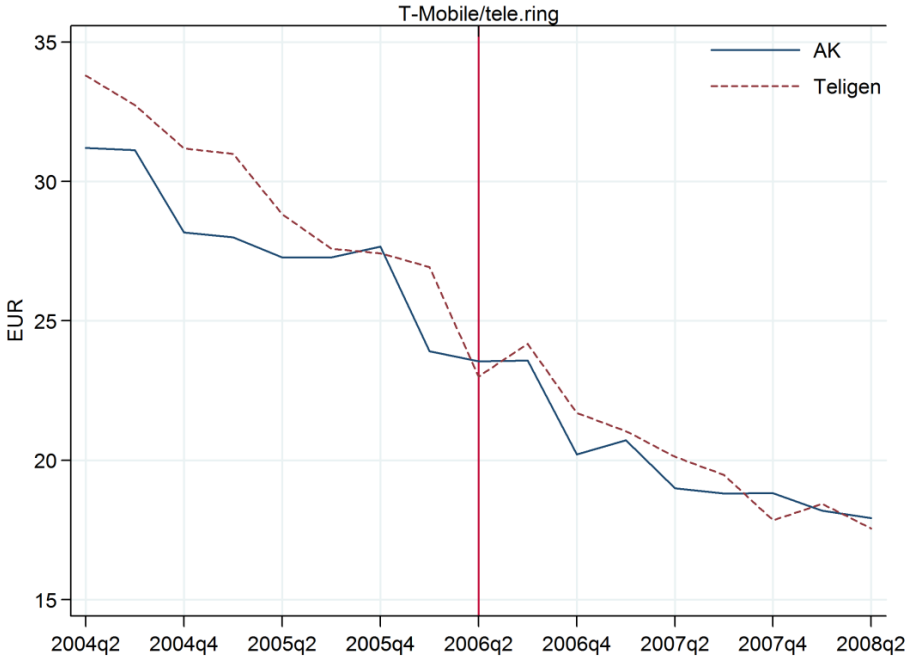

Figure 15. Teligen data compared to the AK data (same MNOs, medium user, four cheapest tariffs per operator)

We also test in the regression framework whether the use of the AK data in place of the Teligen data for the Austrian prices might lead to different results.

Table 12 and Table 13 present the results of our main regression specifications (Base DiD and Trend DiD) when we estimate the Austrian price series respectively with the Teligen and AK data. For the purpose of this comparison, the price series on which we run the regressions presented in Table 13 are based on the sub-sample of AK data that only includes the tariffs of A1 and T-Mobile, the two MNOs covered by the Teligen dataset for Austria.

The comparison of the two tables shows that there are some differences between the estimated effects. However if we consider those differences in light of the variations between the two data sources these appear negligible. When using the Teligen data also for Austria we estimate stronger price reductions associated with the merger both for the short term and medium term (for most parameters) and for both the Base and the country-specific Trend specifications compared to Table 13.

Table 12: Estimation of market-wide effect of the merger – Teligen data

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	log Price	log Price	log Price	log Price	log Price	log Price
Specification	Base	Base	Base	Trend	Trend	Trend
Basket	Low	Mid	High	Low	Mid	High
Short-term effect	0.006	-0.045	-0.094*	0.069	-0.046	-0.101
	(0.871)	(0.307)	(0.061)	(0.243)	(0.45)	(0.111)
Medium-term effect	-0.219***	-0.112	-0.147*	-0.112	-0.114	-0.157
	(0.001)	(0.143)	(0.072)	(0.271)	(0.294)	(0.13)
GDP growth	1.125	0.700	1.239	0.954	1.171	1.504
	(0.399)	(0.660)	(0.431)	(0.391)	(0.360)	(0.277)
log MTR	0.025	0.105	0.125	0.107	0.111	0.131
	(0.850)	(0.538)	(0.480)	(0.381)	(0.211)	(0.133)
Constant	3.204***	3.843***	4.335***	1.733	2.715	4.089**
	(0.000)	(0.000)	(0.000)	(0.301)	(0.125)	(0.021)
Observations	1,535	1,535	1,535	1,535	1,535	1,535
R-squared	0.780	0.840	0.837	0.797	0.869	0.872
Country-spec. trend	NO	NO	NO	YES	YES	YES
Common trend test	Passed	Passed	Passed	-	-	-

Cluster-robust pval below coefficients (s.e. clustered at country level)
Time fixed effects and country-provider fixed-effects
Excluded quarter (merger) Q2/2006; pre-period 8 quarters; post-period 8 quarters; cheapest 4 tariffs
Common trend test if: "Failed" we reject the null hypothesis of common trend at 10% level
*Significance level: *** 1%, ** 5%, * 10%*

Table 13: Estimation of market wide effect of the merger – AK data only 2 main MNOs

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	log Price	log Price	log Price	log Price	log Price	log Price
Specification	Base	Base	Base	Trend	Trend	Trend
Basket	Low	Mid	High	Low	Mid	High
Short-term effect	-0.111***	-0.037	-0.060	0.049	-0.041	-0.137**
	(0.010)	(0.397)	(0.208)	(0.398)	(0.495)	(0.037)
Medium-term effect	-0.149**	-0.040	-0.090	0.112	-0.046	-0.211**
	(0.015)	(0.582)	(0.248)	(0.269)	(0.66)	(0.049)
log MTR	0.025	0.110	0.132	0.124	0.121	0.132
	(0.852)	(0.517)	(0.456)	(0.313)	(0.177)	(0.134)
GDP growth	1.356	0.865	1.234	1.161	1.288	1.493
	(0.312)	(0.582)	(0.430)	(0.303)	(0.313)	(0.282)
Constant	3.208***	3.809***	4.318***	4.256**	2.611	2.264
	(0.000)	(0.000)	(0.000)	(0.021)	(0.137)	(0.162)
Observations	1,535	1,535	1,535	1,535	1,535	1,535
R-squared	0.774	0.837	0.841	0.791	0.866	0.878
Country-spec. trend	NO	NO	NO	YES	YES	YES
Common trend test	Failed	Passed	Passed	-	-	-

Cluster-robust pval below coefficients (s.e. clustered at country level)
Time fixed effects and country-provider fixed-effects
Excluded quarter (merger) Q2/2006; pre-period 8 quarters; post-period 8 quarters; cheapest 4 tariffs
Common trend test if: "Failed" we reject the null hypothesis of common trend at 10% level
*Significance level: *** 1%, ** 5%, * 10%*

A.2 Descriptive Statistics

Table 14: Summary statistics Austria vs Control

	Austria			Control		
	N	mean	s.d.	N	mean	s.d.
Pre-merger						
Low Price Basket	160	18.08	5.31	703	16.09	6.02
Mid Price Basket	160	26.26	5.59	703	26.50	8.24
High Price Basket	160	39.21	8.43	703	44.98	13.66
MTR	160	0.13	0.01	703	0.14	0.04
GDP growth	160	0.01	0.00	703	0.01	0.01
Post-merger						
Low Price Basket	160	10.63	4.42	704	12.27	5.57
Mid Price Basket	160	16.43	5.35	704	19.44	7.75
High Price Basket	160	25.24	7.64	704	32.38	12.65
MTR	160	0.08	0.01	704	0.09	0.02
GDP growth	160	0.01	0.00	704	0.00	0.01

A.3 DiD robustness checks

Table 15: Market-wide effect of the merger – AK data only pre-paid tariffs

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	log Price	log Price	log Price	log Price	log Price	log Price
Specification	Base	Base	Base	Trend	Trend	Trend
Basket	Low	Mid	High	Low	Mid	High
Short-term effect	-0.380***	-0.357***	-0.348***	-0.116*	-0.069	-0.061
	(0.000)	(0.001)	(0.002)	(0.082)	(0.416)	(0.499)
Medium-term effect	-0.502***	-0.445***	-0.426**	-0.075	0.018	0.037
	(0.000)	(0.006)	(0.013)	(0.498)	(0.904)	(0.818)
GDP growth	0.313	-0.150	-0.568	1.596	1.926	2.296
	(0.711)	(0.902)	(0.695)	(0.170)	(0.134)	(0.103)
log MTR	-0.096	-0.049	0.020	0.082	0.157	0.198
	(0.698)	(0.893)	(0.959)	(0.649)	(0.451)	(0.314)
Constant	2.950***	3.768***	4.638***	11.360***	11.266***	12.821***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	1,148	1,148	1,148	1,148	1,148	1,148
R-squared	0.756	0.722	0.712	0.781	0.767	0.762
Country-spec. trend	NO	NO	NO	YES	YES	YES
Common trend test	Failed	Failed	Failed	-	-	-

Cluster-robust pval below coefficients (s.e. clustered at country level)
Time fixed effects and country-provider fixed-effects
Excluded quarter (merger) Q2/2006; pre-period 8 quarters; post-period 8 quarters; cheapest 4 tariffs
Common trend test if: "Failed" we reject the null hypothesis of common trend at 10% level
*Significance level: *** 1%, ** 5%, * 10%*

Table 16: Market-wide effect of the merger – AK data only 2 tariffs

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	log Price	log Price	log Price	log Price	log Price	log Price
Specification	Base	Base	Base	Trend	Trend	Trend
Basket	Low	Mid	High	Low	Mid	High
Short-term effect	-0.302***	-0.124**	-0.104**	0.006	0.014	-0.112
	(0.000)	(0.010)	(0.031)	(0.914)	(0.841)	(0.136)
Medium-term effect	-0.358***	-0.134	-0.146*	0.149	0.091	-0.159
	(0.000)	(0.107)	(0.077)	(0.165)	(0.477)	(0.196)
GDP growth	0.652	-0.344	0.265	1.321	1.010	1.039
	(0.609)	(0.821)	(0.858)	(0.269)	(0.429)	(0.439)
log MTR	-0.020	0.107	0.159	0.177	0.151	0.145*
	(0.893)	(0.539)	(0.351)	(0.231)	(0.156)	(0.071)
Constant	3.144***	3.850***	4.347***	9.440***	6.534***	3.963*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)	(0.052)
Observations	864	864	864	864	864	864
R-squared	0.814	0.862	0.874	0.833	0.890	0.904
Country-spec. trend	NO	NO	NO	YES	YES	YES
Common trend test	Failed	Failed	Passed	-	-	-

Cluster-robust pval below coefficients (s.e. clustered at country level)
Time fixed effects and country-provider fixed-effects
Excluded quarter (merger) Q2/2006; pre-period 8 quarters; post-period 8 quarters; cheapest 2 tariffs
Common trend test if: "Failed" we reject the null hypothesis of common trend at 10% level
*Significance level: *** 1%, ** 5%, * 10%*

Table 17: Estimation of market-wide effect of the merger – AK data shorter estimation period

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	log Price	log Price	log Price	log Price	log Price	log Price
Specification	Base	Base	Base	Trend	Trend	Trend
Basket	Low	Mid	High	Low	Mid	High
Short-term effect	-0.193***	-0.121**	-0.086*	-0.02	-0.023	-0.157**
	(0.000)	(0.013)	(0.080)	(0.721)	(0.748)	(0.048)
Medium-term effect	-0.316***	-0.179**	-0.151*	0.005	0.003	-0.275**
	(0.000)	(0.020)	(0.055)	(0.962)	(0.983)	(0.048)
GDP growth	1.064	0.918	1.251	1.045	1.013	1.291
	(0.353)	(0.399)	(0.256)	(0.229)	(0.237)	(0.172)
log MTR	-0.097	0.009	0.053	0.044	0.105	0.115**
	(0.434)	(0.941)	(0.680)	(0.748)	(0.314)	(0.041)
Constant	2.919***	3.572***	4.080***	3.622*	3.896	0.912
	(0.000)	(0.000)	(0.000)	(0.098)	(0.136)	(0.715)
Observations	1,296	1,296	1,296	1,296	1,296	1,296
R-squared	0.735	0.822	0.850	0.750	0.841	0.870
Country-spec. trend	NO	NO	NO	YES	YES	YES
Common trend test	Failed	Passed	Passed	-	-	-

Cluster-robust pval below coefficients (s.e. clustered at country level)
Time fixed effects and country-provider fixed-effects
Excluded quarter (merger) Q2/2006; pre-period 8 quarters; post-period 8 quarters; cheapest 4 tariffs
Common trend test if: "Failed" we reject the null hypothesis of common trend at 10% level
*Significance level: *** 1%, ** 5%, * 10%*

Table 18: Estimation of market-wide effect of the merger – OECD common basket

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	log Price	log Price	log Price	log Price	log Price	log Price
Specification	Base	Base	Base	Trend	Trend	Trend
Basket	Low	Mid	High	Low	Mid	High
Short-term effect	-0.097**	-0.088**	-0.054	0.085	0.011	-0.035
	(0.026)	(0.047)	(0.233)	(0.156)	(0.849)	(0.616)
Medium-term effect	-0.207***	-0.134**	-0.078	0.084	0.019	-0.051
	(0.003)	(0.037)	(0.293)	(0.406)	(0.849)	(0.651)
GDP growth	0.779	0.201	0.053	0.824	0.862	0.705
	(0.566)	(0.880)	(0.974)	(0.451)	(0.441)	(0.586)
log MTR	0.073	0.110	0.177	0.144	0.095	0.148**
	(0.613)	(0.400)	(0.262)	(0.286)	(0.329)	(0.048)
Constant	3.252***	3.762***	4.242***	2.798	4.537**	3.960**
	(0.000)	(0.000)	(0.000)	(0.105)	(0.016)	(0.042)
Observations	1,727	1,727	1,727	1,727	1,727	1,727
R-squared	0.675	0.785	0.827	0.699	0.807	0.857
Country-spec. trend	NO	NO	NO	YES	YES	YES
Common trend test	Failed	Passed	Passed	-	-	-

Cluster-robust pval below coefficients (s.e. clustered at country level)
Time fixed effects and country-provider fixed-effects
Excluded quarter (merger) Q2/2006; pre-period 8 quarters; post-period 8 quarters; cheapest 4 tariffs
Common trend test if: "Failed" we reject the null hypothesis of common trend at 10% level
*Significance level: *** 1%, ** 5%, * 10%*

A.4 Synthetic control group

Table 19: Weights of the synthetic series of Austria

Low Basket		Mid Basket		High Basket	
Country	Weight	Country	Weight	Country	Weight
Switzerland	0.511	UK	0.271	Germany	0.570
Sweden	0.296	Switzerland	0.239	Finland	0.144
France	0.192	Sweden	0.204	Hungary	0.124

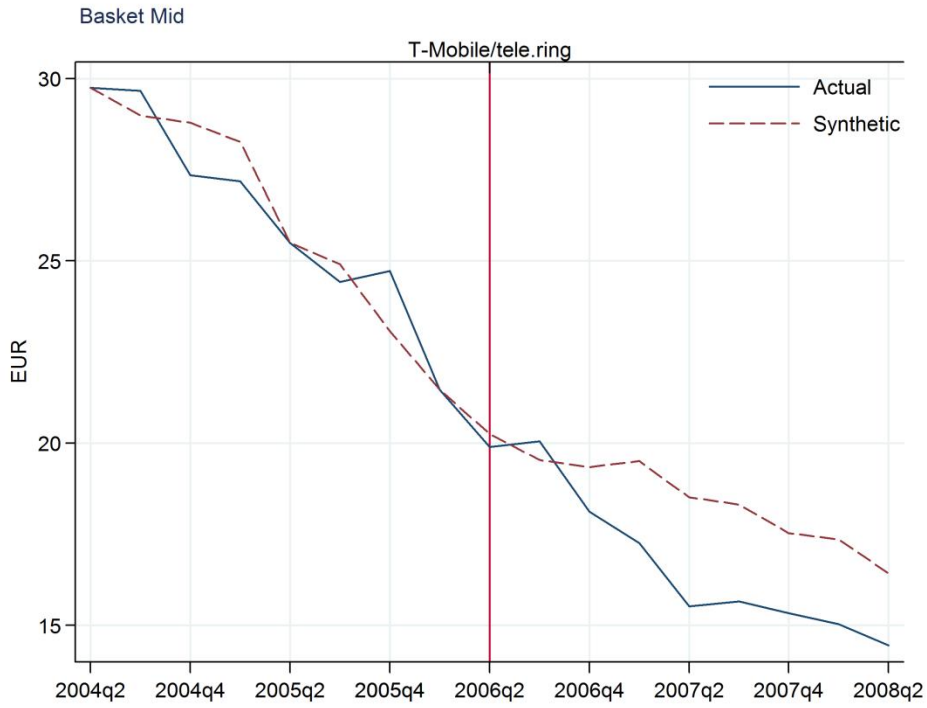

Figure 16: Price development Austria and Synthetic control – Mid basket

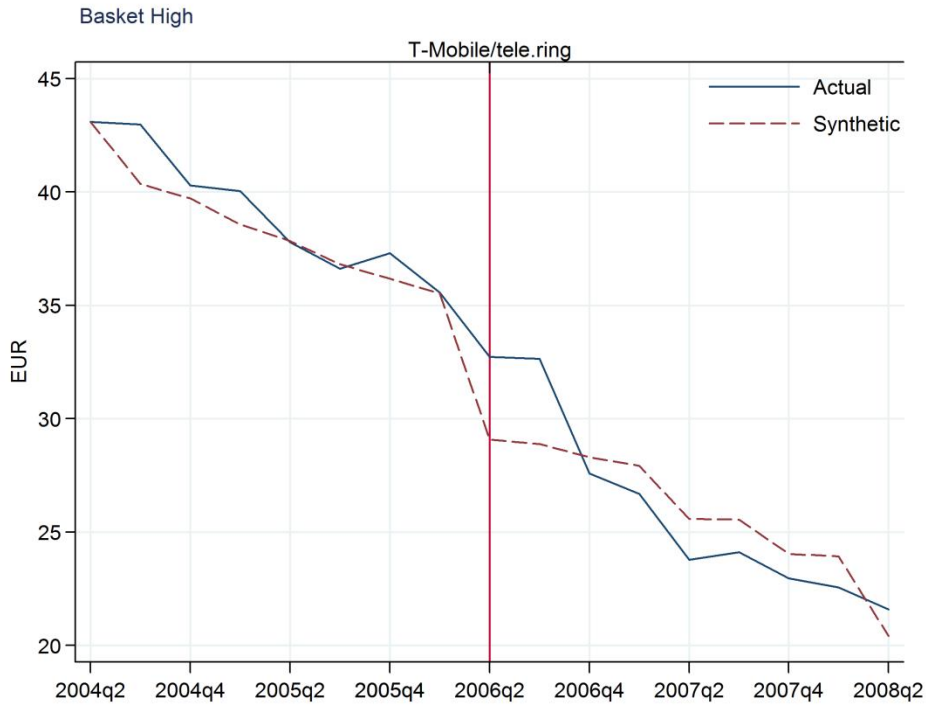

Figure 17: Price development Austria and Synthetic control – High basket

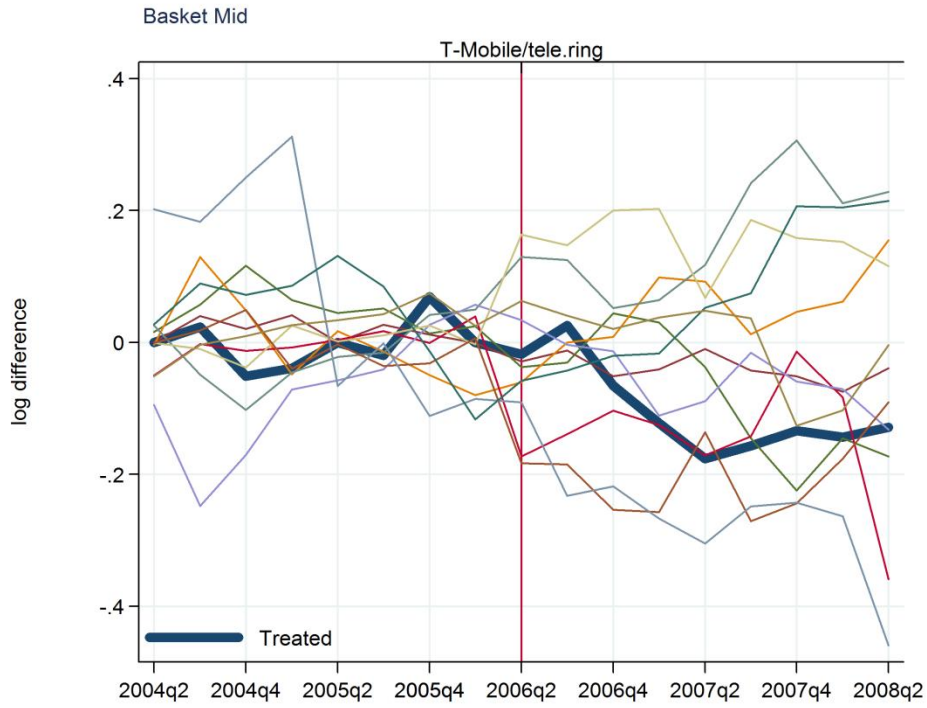

Figure 18: Log price gap in Austria and in placebo for control countries – Mid basket

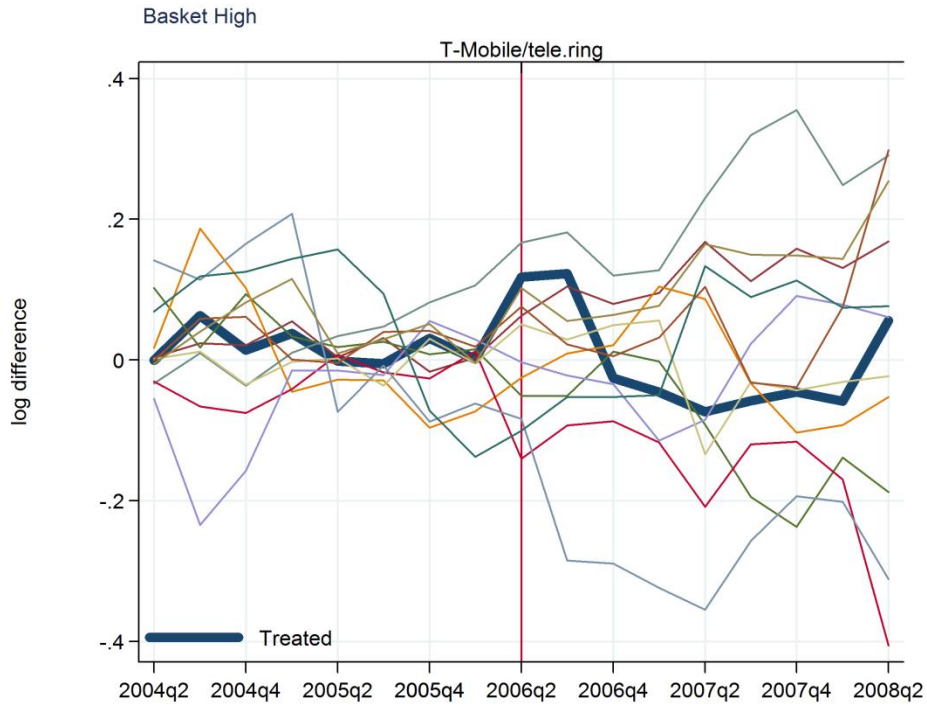

Figure 19: Log price gap in Austria and in placebo for control countries – High basket

Robustness checks for synthetic control approach

Table 20: Synthetic control approach, 4 tariffs, country with the highest weight dropped

Basket	Period	Coef	Rank	Selected Control	Dropped Country
Low	short	-0.184	3/11	BE; FR; SE	CH
Low	medium	-0.284	3/11		
Mid	short	-0.120	3/11	BE; CZ; SE; FI; CH	UK
Mid	medium	-0.203	3/11		
High	short	-0.069	1/11	CZ; FR; PT; HU; UK	DE
High	medium	-0.162	1/11		

Excluded quarter (merger) Q2/2006; pre-period 8 quarters; post-period 8 quarters; cheapest 4 tariffs

Table 21: Synthetic control approach, 2 tariffs

Basket	Period	Coef	Rank	Selected Control
Low	short	-0.231	3/12	SE; CH
Low	medium	-0.345	3/12	
Mid	short	-0.069	4/12	All; BE, CH, FI highest weight
Mid	medium	-0.116	6/12	
High	short	-0.089	1/12	CH; UK; PT; HU
High	medium	-0.173	2/12	

Excluded quarter (merger) Q2/2006; pre-period 8 quarters; post-period 8 quarters; cheapest 2 tariffs

Table 22: Synthetic control approach, 4 tariffs, price series computed using OECD baskets

Basket	Period	Coef	Rank	Selected Control
Low	short	-0.081	7/12	CH; FR; SE
Low	medium	-0.235	3/12	
Mid	short	-0.002	9/12	CH, SE, DE; UK; CZ
Mid	medium	-0.059	9/12	
High	short	-0.056	6/12	ALL; UK; CH; FI; HU; IT highest weights
High	medium	-0.092	5/12	

Excluded quarter (merger) Q2/2006; pre-period 8 quarters; post-period 8 quarters; cheapest 4 tariffs

A.5 MNO-specific analysis

The main objective of our analysis is to estimate the market-wide effect of the mergers under study. Still, our tariff data are at the level of the single MNO and we could also estimate the effect of the merger at the MNO level. In this section, we estimate a variation of the model discussed in Sections 4.1 in which we estimate the individual change in prices associated with the merger for each MNO active in Austria at the time of the merger[143].

[143] This is done by introducing an interaction between the Austrian MNO fixed effect dummies and the dummy for the post-merger periods (short term and medium terms).

However, the estimated MNO-specific effects should not be interpreted as being necessarily caused by the analysed mergers. The across-country econometric analysis (Section 5.3 or even the graphical analysis of Section 5.2.3) shows that already at the aggregate country level the basic assumptions of the DiD framework may not be satisfied, as Austria may be subject to a different trend in prices (in particular for the Low basket). The same problems affecting the country level analysis are still present at the MNO level and they are likely to be further exacerbated at this more granular level.

To estimate the MNO-specific effects properly we would need to estimate MNO-specific counterfactuals that take into account both common country developments and heterogeneous movements within the same country. This analysis would likely require more detailed and more comprehensive data at the operator level for both the treated and control countries, and is out of the scope of this project.

In light of these issues we believe that the estimated MNO-specific effects are less reliable than the estimates we obtain at the country level and their magnitude should not be interpreted as merger-specific effects but rather as (descriptive) quantification of observed relative price changes over time, also in line with what is presented in the graphical comparison of Section 5.2.2.

At the MNO level we present three different estimates. We first estimate the Base model and then estimate two other models in which we introduce country-specific trends and MNO-specific trends.

Table 23 presents the results of the Base specification. These estimates are effectively a decomposition of the average contribution of each MNO to the market-wide effect estimated in Table 5. Notably, these estimates assume a common country-wide counterfactual price development for all MNOs absent the merger, adding further assumptions beyond those on which hinges the estimation of the country-wide effects (i.e. common post-merger market-wide price trend for all MNOs).

Table 24 presents two other estimates assuming a common country-specific trend (columns 1-3), like in the country level analysis (Table 6) and MNO-specific trends (columns 4-6). The latter specification allows for the possibility that different MNOs follow different linear trends even within the same (affected) country. We note that we would obtain very similar average market effects either with country-specific or with MNO-specific trends.

The identification of the effect of the merger when allowing for country-level trends relies on the assumption that absent the merger the (log) price of each MNO in the treated country would have followed the same pre-existing country-specific trend (after controlling for the other time varying explanatory variables and for the common time effect). In contrast, when allowing for MNO-specific trends, the identification relies on the assumption that each MNO would have followed its pre-merger trend in the absence of the merger (again net of the impact of time varying explanatory variables and for the common time effect).

In general, we observe that when introducing country-specific trends all the estimated coefficients uniformly increase in absolute terms by around 20 percentage points (pp) in the short term and 33pp in the medium term for the Low basket, by around 7pp/12pp for the Mid basket and by roughly 5pp/14pp for the High basket. The differences are very similar to those of the country level analysis between the Base and the Trend specification

(see Sections 5.3.1 and 5.3.2). This is because under this setting the counterfactual price for each MNO would be projected also taking into account the common pre-existing trend in prices specific to Austria compared to the control countries.

If we allow for MNO-specific trends the counterfactual of each MNO takes into account the MNO specific pre-merger trend. Compared to the Base estimates we therefore do not find a similar shift for all MNOs. The results show that changing the level at which we model the trend has a relatively large impact for some of the results at the MNO level, and overall suggest that these results are less robust when compared to the country level presented in the main text. Consequently, this makes it particularly difficult to conclude on possible effects caused by the merger at the MNO level. Nevertheless, these price developments are consistent with the conclusion we reach at the country level, where we exclude significant market-wide price increases following the merger since they are negative on average.

Table 23: Estimation of MNO-specific effects of the merger – Base specification

	(1)	(2)	(3)
Dep. Variable	log Price	log Price	log Price
Basket	Low	Mid	High
T-Mobile Short-term effect	-0.256***	-0.157***	-0.131**
	(0.000)	(0.003)	(0.015)
T-Mobile Medium-term effect	-0.373***	-0.206**	-0.186**
	(0.000)	(0.015)	(0.029)
Tele.ring Short-term effect	-0.305***	-0.256***	-0.266***
	(0.000)	(0.000)	(0.000)
Tele.ring Medium-term effect	-0.761***	-0.510***	-0.374***
	(0.000)	(0.000)	(0.000)
A1 Short-term effect	0.033	0.083*	0.011
	(0.380)	(0.072)	(0.810)
A1 Medium-term effect	0.069	0.121	0.006
	(0.212)	(0.118)	(0.935)
Hutchison Short-term effect	-0.150***	-0.009	0.160***
	(0.002)	(0.827)	(0.005)
Hutchison Medium-term effect	-0.243***	-0.136*	-0.073
	(0.001)	(0.083)	(0.347)
Orange Short-term effect	-0.475***	-0.330***	-0.142***
	(0.000)	(0.000)	(0.009)
Orange Medium-term effect	-0.391***	-0.172**	-0.013
	(0.000)	(0.035)	(0.862)
GDP growth	1.562	0.906	1.114
	(0.255)	(0.559)	(0.469)
log MTR	0.007	0.098	0.130
	(0.958)	(0.571)	(0.465)
Constant	3.094***	3.717***	4.272***
	(0.000)	(0.000)	(0.000)
Observations	1,727	1,727	1,727
R-squared	0.751	0.825	0.839
Country-spec. trend	NO	NO	NO
Common trend test	Failed	Passed	Passed

Cluster-robust pval below coefficients (s.e. clustered at country level)
Time fixed effects and country-provider fixed-effects
Excluded quarter (merger) Q2/2006; pre-period 8 quarters; post-period 8 quarters; cheapest 4 tariffs
Common trend test if: "Failed" we reject the null hypothesis of common trend at 10% level
*Significance level: *** 1%, ** 5%, * 10%*

Table 24: Estimation of MNO-specific effects of the merger – Trend specification

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	log Price	log Price	log Price	log Price	log Price	log Price
Basket	Low	Mid	High	Low	Mid	High
T-Mobile Short-term effect	-0.045	-0.08	-0.161**	0.03	-0.014	-0.043
	(0.436)	(0.199)	(0.019)	(0.604)	(0.816)	(0.489)
T-Mobile Medium-term effect	-0.028	-0.082	-0.235**	0.089	0.021	-0.049
	(0.774)	(0.442)	(0.033)	(0.38)	(0.847)	(0.627)
Tele.ring Short-term effect	-0.094	-0.178**	-0.297***	-0.05	-0.135**	-0.147**
	(0.12)	(0.011)	(00)	(0.39)	(0.044)	(0.032)
Tele.ring Medium-term effect	-0.417***	-0.386***	-0.423***	-0.349***	-0.318**	-0.188*
	(0.001)	(0.003)	(0.001)	(0.004)	(0.011)	(0.081)
A1 Short-term effect	0.244***	0.16**	-0.02	0.064	-0.074	-0.234***
	(0.001)	(0.019)	(0.744)	(0.275)	(0.235)	(0.002)
A1 Medium-term effect	0.414***	0.245**	-0.043	0.13	-0.124	-0.38***
	(0.001)	(0.036)	(0.668)	(0.207)	(0.258)	(0.003)
Hutchison Short-term effect	0.062	0.068	0.13**	0.216***	0.191***	0.107*
	(0.293)	(0.269)	(0.049)	(0.003)	(0.008)	(0.1)
Hutchison Medium-term effect	0.101	-0.012	-0.122	0.344***	0.181	-0.158
	(0.316)	(0.908)	(0.233)	(0.005)	(0.11)	(0.135)
Orange Short-term effect	-0.264***	-0.252***	-0.173**	-0.366***	-0.264***	-0.203***
	(0.001)	(0.001)	(0.013)	(00)	(0.001)	(0.006)
Orange Medium-term effect	-0.046	-0.048	-0.062	-0.209*	-0.068	-0.11
	(0.64)	(0.65)	(0.534)	(0.054)	(0.53)	(0.286)
GDP growth	1.351	1.282	1.433	1.284	1.146	1.480
	(0.252)	(0.314)	(0.301)	(0.270)	(0.346)	(0.294)
log MTR	0.128	0.120	0.125	0.126	0.132	0.112
	(0.303)	(0.185)	(0.155)	(0.320)	(0.115)	(0.226)
Constant	5.505***	4.629**	3.403**	1.033	-0.307	-3.007*
	(0.005)	(0.016)	(0.047)	(0.475)	(0.841)	(0.055)
Observations	1,727	1,727	1,727	1,727	1,727	1,727
R-squared	0.770	0.854	0.874	0.778	0.860	0.882
Trend level	Country	Country	Country	MNO	MNO	MNO

Cluster-robust pval below coefficients (s.e. clustered at country level)
Time fixed effects and country-provider fixed-effects
Excluded quarter (merger) Q2/2006; pre-period 8 quarters; post-period 8 quarters; cheapest 4 tariffs
*Significance level: *** 1%, ** 5%, * 10%*

Annex B The Netherlands

B.1 Comparison between Teligen and Telecompaper data

Figure 20 shows the comparison of the average price series of the two largest operators in the Netherlands (KPN and Vodafone) using the Teligen data and the Telecompaper data.[144]. The two series display some significant differences in the period around the KPN/Telfort merger, and particularly in Q1/2006. However, the analysis includes the period from Q2/2006 to Q3/2009, during which the two price series of Figure 20 display a rather similar pattern over time.

These discrepancies are in part due to differences between Teligen data and Telecompaper data as to how activation fees are recorded. As the activation fee is often reduced or waived for marketing reasons, and Teligen confirmed it recorded these special offers, no changes were made to the activation fees of the Teligen data.

Figure 20: Teligen data (Netherlands) compared to the Telecompaper data including the same operators (medium user, four cheapest tariffs per operator, see Section 3.2)

[144] From a comparison of the tariffs included in Teligen and Telecompaper data, we noted that until 2006 the included minutes in KPN's and Vodafone's tariffs recorded in the Teligen data were incorrectly mixed with the allowance, and after 2006 the included minutes were missing. Additionally, some of KPN's tariffs were missing for the third and fourth quarter of 2005. After checking the websites of the providers, we decided to change the included minutes and the allowance, and to include the missing tariffs in the Teligen data.

We tested the reliability of mixing the two datasets (Telecompaper for the Netherlands and Teligen for the control countries) by conducting the main difference-in-differences analysis using the Teligen data (Table 25), which includes the tariffs of only the two largest MNOs, and the Telecompaper data with only KPN and Vodafone, the two largest MNOs (Table 26).

Table 25: 4 tariffs – Teligen data

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	log Price	log Price	log Price	log Price	log Price	log Price
Specification	Base	Base	Base	Trend	Trend	Trend
Basket	Low	Mid	High	Low	Mid	High
Short-term effect	0.073	0.062	0.076***	0.084	-0.071	-0.187***
	(0.167)	(0.116)	(0.006)	(0.134)	(0.21)	(0.000)
Medium-term effect	0.094*	0.048	0.116***	0.106	-0.174*	-0.32***
	(0.085)	(0.290)	(0.008)	(0.156)	(0.060)	(0.000)
GDP growth	2.325**	1.752*	1.762**	1.369**	0.915*	0.753*
	(0.035)	(0.052)	(0.022)	(0.036)	(0.068)	(0.072)
log MTR	0.024	-0.031	-0.087	-0.034	-0.039	-0.032
	(0.855)	(0.738)	(0.216)	(0.617)	(0.315)	(0.599)
Constant	2.612***	3.066***	3.517***	0.233**	1.150***	3.670***
	(0.000)	(0.000)	(0.000)	(0.015)	(0.000)	(0.000)
Observations	1,246	1,246	1,246	1,246	1,246	1,246
R-squared	0.709	0.778	0.824	0.731	0.800	0.842
Country-spec. trend	NO	NO	NO	YES	YES	YES
Common trend test	Passed	Failed	Failed	-	-	-

Cluster-robust pval below coefficients (s.e. clustered at country level)

Time fixed effects and country-provider fixed-effects

Excluded quarters (merger) Q2-Q3/2007; pre-period 4 quarters; post-period 8 quarters; cheapest 4 tariffs
Common trend test "Failed" we reject the null hypothesis of common trend at 10% level
*Significance level: *** 1%, ** 5%, * 10%*

Table 26: 4 tariffs – Telecompaper data – Only KPN and Vodafone included in the Netherlands

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	log Price	log Price	log Price	log Price	log Price	log Price
Specification	Base	Base	Base	Trend	Trend	Trend
Basket	Low	Mid	High	Low	Mid	High
Short-term effect	0.091*	0.129***	0.139***	0.013	-0.018	-0.029
	(0.090)	(0.004)	(0.000)	(0.803)	(0.747)	(0.436)
Medium-term effect	0.033	0.116**	0.163***	-0.104	-0.13	-0.114*
	(0.523)	(0.020)	(0.001)	(0.165)	(0.146)	(0.096)
GDP growth	2.709**	1.989**	1.880**	1.344**	0.930*	0.792*
	(0.012)	(0.026)	(0.015)	(0.039)	(0.064)	(0.061)
log MTR	0.019	-0.030	-0.084	-0.033	-0.037	-0.029
	(0.886)	(0.745)	(0.228)	(0.620)	(0.334)	(0.631)
Constant	2.595***	3.065***	3.525***	0.230**	1.149***	3.671***
	(0.000)	(0.000)	(0.000)	(0.017)	(0.000)	(0.000)
Observations	1,246	1,246	1,246	1,246	1,246	1,246
R-squared	0.714	0.788	0.828	0.734	0.810	0.846
Country-spec. trend	NO	NO	NO	YES	YES	YES
Common trend test	Failed	Failed	Failed	-	-	-

Cluster-robust pval below coefficients (s.e. clustered at country level)

Time fixed effects and country-provider fixed-effects

Excluded quarters (merger) Q2-Q3/2007; pre-period 4 quarters; post-period 8 quarters; cheapest 4 tariffs
Common trend test "Failed" we reject the null hypothesis of common trend at 10% level
*Significance level: *** 1%, ** 5%, * 10%*

As Table 25 and Table 26 show, the results are relatively comparable, both for the Base specification and for the Trend specification. In both Tables, the Base specifications show a price increase for all the baskets, with a higher magnitude for the High basket. However, using the Telecompaper data with only KPN and Vodafone delivers somewhat higher price increases compared to the Base specification in the main analysis presented in Section 6.3.2. This is consistent with the MNO-level analysis presented in Section B.6.

Furthermore, both datasets are particularly sensitive to the inclusion of country-specific trends in the Trend specifications. Indeed, Table 25 and Table 26 both display a price decrease for the Mid and High baskets for the respective Trend specifications, with a particularly high magnitude (in absolute value) using the Teligen data. However, as already noted in Section 6.3.3, the inclusion of country-specific trends in the case of the Netherlands severely suffers from the short pre-merger period, which makes the estimation of the Netherlands' trend unreliable. Hence, on the one hand the consistent results using Teligen and Telecompaper data with the two largest operators give us confidence in the quality of the data; on the other hand little weight should be put on the estimated merger effect of the Trend specification.

Overall, the results using the two datasets are fairly comparable, which gives us confidence that the dataset that we use in the main analysis (resulting from the mix of Teligen and Telecompaper data) does not induce any substantial bias.

B.2 Descriptive Statistics

Table 27: Summary statistics Netherlands vs Control

	Netherlands			Control		
	N	mean	s.d.	N	mean	s.d.
Pre-merger						
Low Price Basket	64	13.60	2.64	384	13.15	5.15
Mid Price Basket	64	20.86	4.00	384	21.51	7.47
High Price Basket	64	29.83	3.91	384	35.92	12.35
MTR	64	0.11	0.00	384	0.10	0.02
GDP growth	64	0.01	0.01	384	0.01	0.01
Post-merger						
Low Price Basket	104	12.98	2.96	766	11.95	5.77
Mid Price Basket	104	20.05	3.94	766	18.37	7.17
High Price Basket	104	28.23	3.24	766	29.94	11.56
MTR	104	0.09	0.01	766	0.08	0.02
GDP growth	104	0.00	0.01	766	-0.01	0.01

B.3 Exclusion of Q2/2007 from the analysis

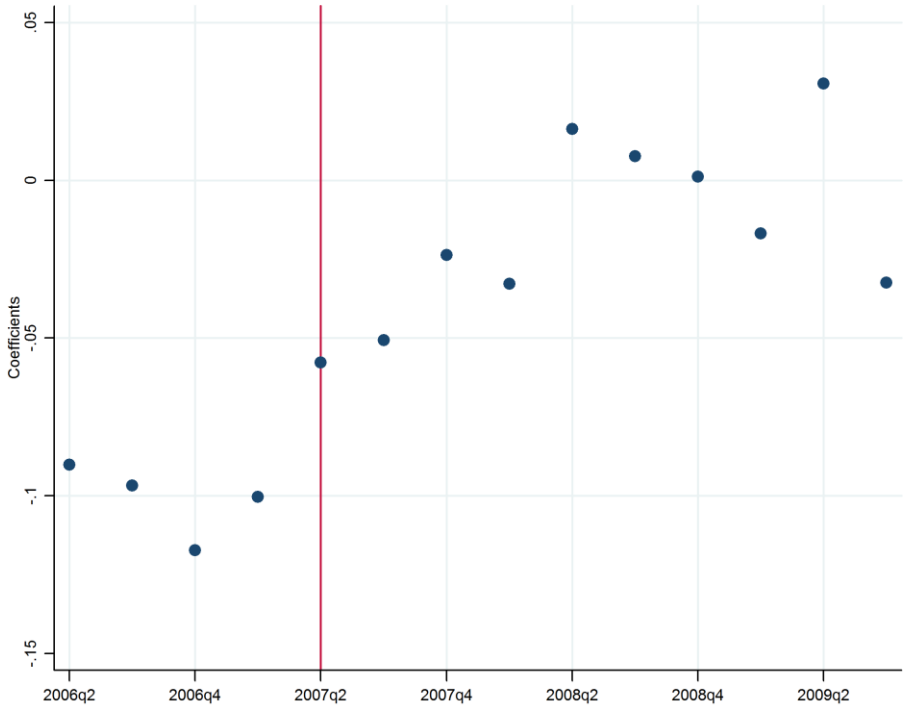

Figure 21: Unexplained price differences between the Netherlands and control countries – Mid basket

Figure 21 displays the estimated coefficients of the Netherlands-specific time effects for the Mid basket including in the analysis the four cheapest tariffs. That is, compared to the country-level Base specification we replaced the merger dummies with one Netherlands-specific dummy variable for each quarter. The points in Figure 21 are the estimated coefficients of those dummy variables. Each coefficient represents the deviation of the Netherlands' price from the average price of all the countries captured by the time fixed effects, once the country-MNO effects and the control variables are controlled for. In other words, the figure displays the evolution of the difference in mobile tariff prices in the Netherlands relative to the control countries which cannot be explained by MTR or GDP growth, and can be used to observe the merger effect over time.

The vertical line is positioned in Q2/2007, the quarter before the merger closing. Figure 21 shows that while in the pre-merger period the effects specific to the Netherlands follow a rather flat trend, we observe in Q2/2007 an upward shift in the coefficient. From Q2/2007 onwards, the coefficients follow a slightly upward trend throughout the post-merger period.

The pattern of the estimated coefficients of the effect specific to the Netherlands displayed in Figure 21 indicates that some of the merger effect may have manifested before the closing of the merger in Q3/2007.

The pattern in the Netherlands' coefficients and the possibility that it might be due to an early effect of the merger persuaded us to exclude both Q2/2007 and Q3/2007 from the analysis.

B.4 DiD robustness checks

Table 28: Estimation of market-wide effect of the merger – four cheapest tariffs, pre-paid only

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	log Price	log Price	log Price	log Price	log Price	log Price
Specification	Base	Base	Base	Trend	Trend	Trend
Basket	Low	Mid	High	Low	Mid	High
Short-term effect	0.094*	0.131***	0.150***	0.155	0.128	0.096
	(0.057)	(0.008)	(0.008)	(0.121)	(0.142)	(0.148)
Medium-term effect	0.077	0.149*	0.188*	0.183	0.152	0.107
	(0.372)	(0.090)	(0.059)	(0.28)	(0.347)	(0.403)
GDP growth	3.945***	3.547***	3.316**	1.364	0.925	0.937
	(0.003)	(0.010)	(0.035)	(0.158)	(0.309)	(0.259)
log MTR	0.061	0.015	-0.026	0.032	0.076	0.049
	(0.725)	(0.911)	(0.843)	(0.889)	(0.592)	(0.489)
Constant	2.820***	3.298***	3.817***	0.831***	-0.983***	-2.456***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	897	897	897	897	897	897
R-squared	0.676	0.714	0.730	0.717	0.753	0.772
Country-spec. trend	NO	NO	NO	YES	YES	YES
Common trend test	Passed	Passed	Passed	-	-	-

Cluster-robust pval below coefficients (s.e. clustered at country level)

Time fixed effects and country-provider fixed-effects

Excluded quarters (merger) Q2-Q3/2007; pre-period 4 quarters; post-period 8 quarters; cheapest 4 tariffs
Common trend test "Failed" we reject the null hypothesis of common trend at 10% level
*Significance level: *** 1%, ** 5%, * 10%*

Table 29: Estimation of market-wide effect of the merger – two cheapest tariffs

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	log Price	log Price	log Price	log Price	log Price	log Price
Specification	Base	Base	Base	Trend	Trend	Trend
Basket	Low	Mid	High	Low	Mid	High
Short-term effect	0.073	0.118**	0.125***	0.151*	0.118	0.099**
	(0.206)	(0.016)	(0.001)	(0.077)	(0.194)	(0.042)
Medium-term effect	0.027	0.134*	0.182***	0.151	0.131	0.138
	(0.728)	(0.059)	(0.008)	(0.234)	(0.373)	(0.122)
GDP growth	2.296**	1.677*	1.459	0.834	0.837	0.546
	(0.035)	(0.094)	(0.125)	(0.111)	(0.124)	(0.348)
log MTR	0.037	-0.030	-0.083	0.051	-0.001	-0.022
	(0.797)	(0.771)	(0.378)	(0.566)	(0.991)	(0.753)
Constant	2.551***	3.011***	3.484***	0.536***	2.246***	4.376***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	660	660	660	660	660	660
R-squared	0.817	0.852	0.864	0.861	0.896	0.900
Country-spec. trend	NO	NO	NO	YES	YES	YES
Common trend test	Passed	Passed	Passed	-	-	-

Cluster-robust pval below coefficients (s.e. clustered at country level)

Time fixed effects and country-provider fixed-effects

Excluded quarters (merger) Q2-Q3/2007; pre-period 4 quarters; post-period 8 quarters; cheapest 2 tariffs
Common trend test "Failed" we reject the null hypothesis of common trend at 10% level
*Significance level: *** 1%, ** 5%, * 10%*

Table 30: Estimation of market-wide effect of the merger – four cheapest tariffs, inclusion of Q2/2007

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	log Price	log Price	log Price	log Price	log Price	log Price
Specification	Base	Base	Base	Trend	Trend	Trend
Basket	Low	Mid	High	Low	Mid	High
Short-term effect	0.052	0.084**	0.121***	0.076**	0.052	0.012
	(0.282)	(0.031)	(0.000)	(0.035)	(0.184)	(0.730)
Medium-term effect	-0.005	0.085*	0.159***	0.026	0.03	-0.032
	(0.921)	(0.057)	(0.000)	(0.502)	(0.624)	(0.599)
GDP growth	2.572***	2.101**	1.994**	1.346**	1.037**	0.928*
	(0.009)	(0.018)	(0.012)	(0.040)	(0.047)	(0.064)
log MTR	0.026	-0.021	-0.076	-0.028	-0.024	-0.019
	(0.839)	(0.812)	(0.239)	(0.662)	(0.563)	(0.752)
Constant	2.613***	3.087***	3.539***	0.207**	1.118***	3.652***
	(0.000)	(0.000)	(0.000)	(0.043)	(0.000)	(0.000)
Observations	1,430	1,430	1,430	1,430	1,430	1,430
R-squared	0.709	0.783	0.822	0.728	0.804	0.839
Country-spec. trend	NO	NO	NO	YES	YES	YES
Common trend test	Passed	Passed	Failed	-	-	-

Cluster-robust pval below coefficients (s.e. clustered at country level)

Time fixed effects and country-provider fixed-effects

Excluded quarters (merger) Q2-Q3/2007; pre-period 4 quarters; post-period 8 quarters; cheapest 4 tariffs

Common trend test "Failed" we reject the null hypothesis of common trend at 10% level
*Significance level: *** 1%, ** 5%, * 10%*

Table 31: Estimation of market-wide effect of the merger – two cheapest tariffs pre-paid only

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	log Price	log Price	log Price	log Price	log Price	log Price
Specification	Base	Base	Base	Trend	Trend	Trend
Basket	Low	Mid	High	Low	Mid	High
Short-term effect	0.091*	0.139***	0.145***	0.188**	0.196*	0.128
	(0.072)	(0.006)	(0.004)	(0.044)	(0.084)	(0.123)
Medium-term effect	0.037	0.123	0.151*	0.197	0.219	0.127
	(0.677)	(0.148)	(0.085)	(0.191)	(0.256)	(0.393)
GDP growth	4.447***	4.131***	4.060**	2.035**	1.597	1.644
	(0.003)	(0.004)	(0.011)	(0.038)	(0.146)	(0.186)
log MTR	0.143	0.035	-0.043	0.288	0.212	0.140
	(0.462)	(0.803)	(0.692)	(0.257)	(0.198)	(0.127)
Constant	2.778***	3.206***	3.675***	2.495***	0.173	-2.069***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.276)	(0.000)
Observations	601	601	601	601	601	601
R-squared	0.770	0.806	0.829	0.807	0.837	0.858
Country-spec. trend	NO	NO	NO	YES	YES	YES
Common trend test	Passed	Passed	Passed	-	-	-

Cluster-robust pval below coefficients (s.e. clustered at country level)

Time fixed effects and country-provider fixed-effects

Excluded quarters (merger) Q2-Q3/2007; pre-period 4 quarters; post-period 8 quarters; cheapest 2 tariffs
*Significance level: *** 1%, ** 5%, * 10%*

Table 32: Estimation of market-wide effect of the merger – OECD common basket

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	log Price	log Price	log Price	log Price	log Price	log Price
Specification	Base	Base	Base	Trend	Trend	Trend
Basket	Low	Mid	High	Low	Mid	High
Short-term effect	0.062	0.093**	0.133***	0.148**	0.126**	0.05
	(0.232)	(0.021)	(0.000)	(0.015)	(0.036)	(0.194)
Medium-term effect	0.009	0.099**	0.167***	0.141*	0.149	0.03
	(0.864)	(0.038)	(0.001)	(0.066)	(0.101)	(0.643)
GDP growth	2.598**	1.964**	1.825**	1.315**	0.980*	0.806*
	(0.013)	(0.025)	(0.015)	(0.043)	(0.053)	(0.058)
log MTR	0.015	-0.032	-0.083	-0.032	-0.036	-0.029
	(0.906)	(0.723)	(0.226)	(0.632)	(0.345)	(0.631)
Constant	2.591***	3.066***	3.527***	0.225**	1.154***	3.672***
	(0.000)	(0.000)	(0.000)	(0.019)	(0.000)	(0.000)
Observations	1,318	1,318	1,318	1,318	1,318	1,318
R-squared	0.707	0.727	0.785	0.806	0.825	0.842
Country-spec. trend	NO	NO	NO	YES	YES	YES
Common trend test	Failed	Passed	Failed	-	-	-

Cluster-robust pval below coefficients (s.e. clustered at country level)

Time fixed effects and country-provider fixed-effects

Excluded quarters (merger) Q2-Q3/2007; pre-period 4 quarters; post-period 8 quarters; cheapest 4 tariffs

Common trend test "Failed" we reject the null hypothesis of common trend at 10% level

*Significance level: *** 1%, ** 5%, * 10%*

B.5 Synthetic control group approach

Table 33: Weights of the synthetic series of the Netherlands

Low Basket		Mid Basket		High Basket	
Country	Weight	Country	Weight	Country	Weight
Belgium	0.456	Belgium	0.766	Belgium	0.272
France	0.001	Finland	0.159	Finland	0.395
Italy	0.543	Sweden	0.074	UK	0.334

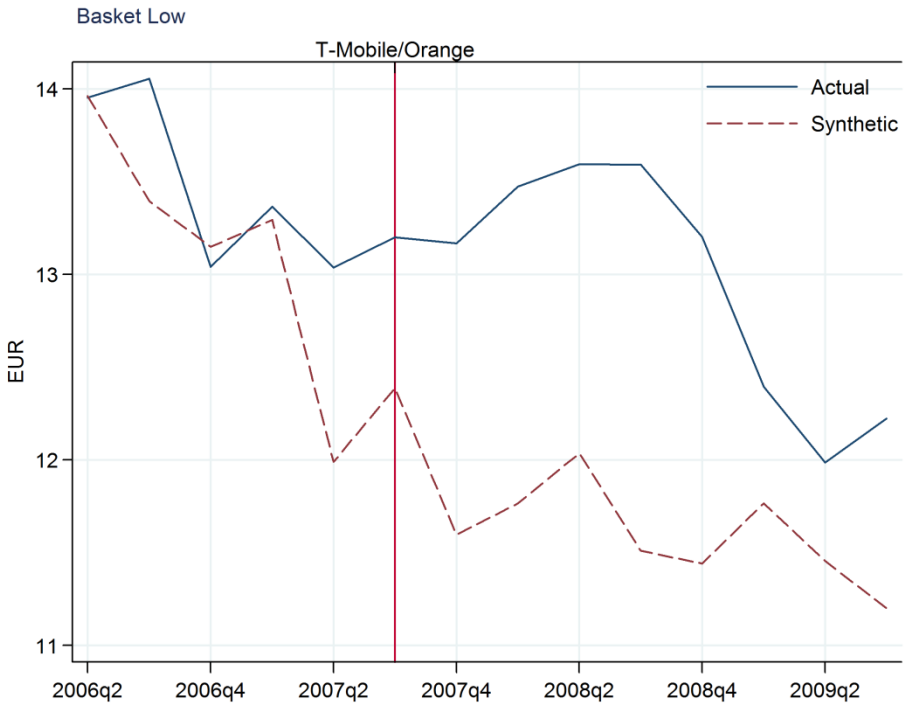

Figure 22: Price development the Netherlands and Synthetic control – Low basket

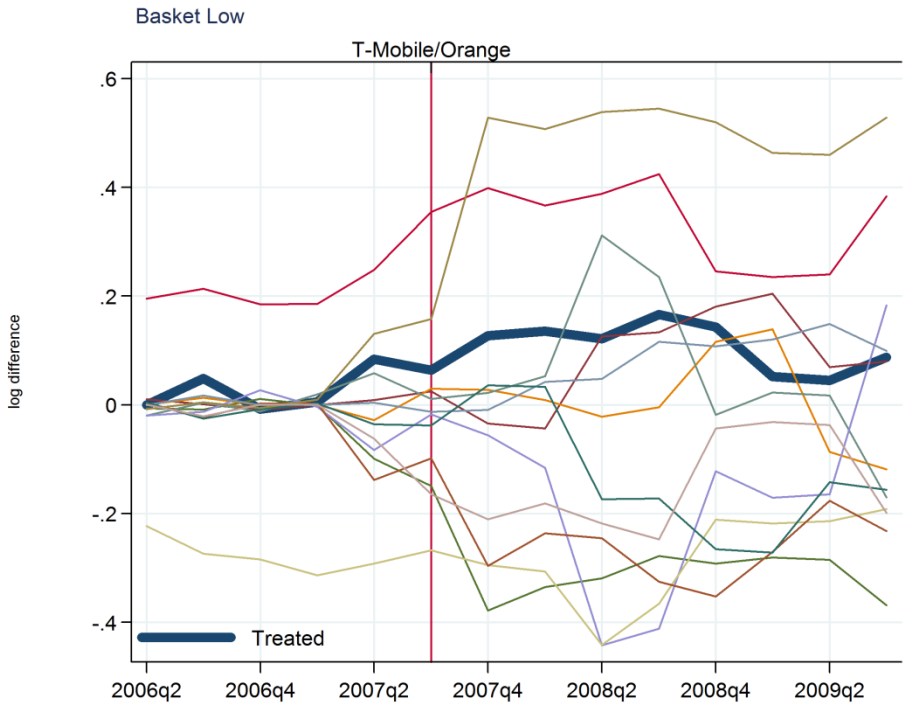

Figure 23: Log price difference in Netherlands and in placebo for control countries – Low basket

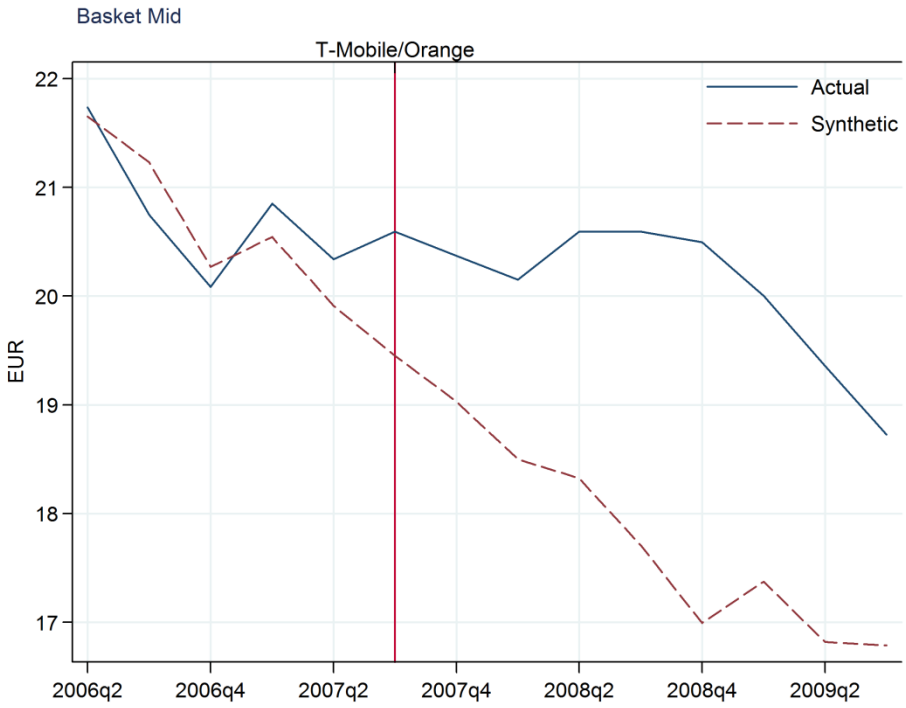

Figure 24: Price development the Netherlands and Synthetic control – Mid basket

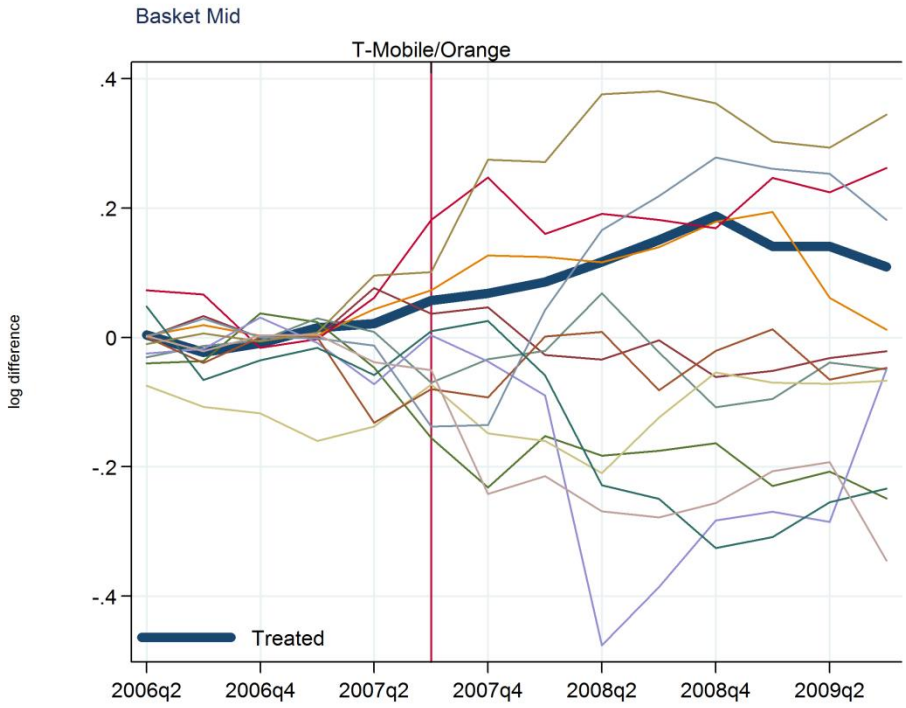

Figure 25: Log price difference in Netherlands and in placebo for control countries – Mid basket

Robustness checks for synthetic control approach

Table 34: Synthetic control approach, 4 tariffs, country with the highest weight dropped

Basket	Period	Effect	Rank	Selected Control	Dropped Country
Low	short	-0.031	11/12	BE; FI; CH	IT
Low	medium	-0.076	10/12		
Mid	short	0.159	5/12	FI; FR; IT; SE	BE
Mid	medium	0.187	4/12		
High	short	0.095	7/12	BE; DK; UK	FI
High	medium	0.115	8/12		

Excluded quarters (merger) Q2-Q3/2007; pre-period 4 quarters; post-period 8 quarters; cheapest 4 tariffs

Table 35: Synthetic control approach, 2 tariffs

Basket	Period	Effect	Rank	Selected Control
Low	short	0.110	6/13	BE; CZ; PT; SE
Low	medium	0.038	10/13	
Mid	short	0.190	6/13	BE; DK; SE
Mid	medium	0.243	5/13	
High	short	0.164	2/13	BE; SE
High	medium	0.275	2/13	

Excluded quarters (merger) Q2-Q3/2007; pre-period 4 quarters; post-period 8 quarters; cheapest 2 tariffs

Table 36: Synthetic control approach, 4 tariffs, price series computed using OECD baskets

Basket	Period	Effect	Rank	Selected Control
Low	short	0.006	13/13	BE; FR; CH
Low	medium	-0.034	13/13	
Mid	short	0.049	9/13	BE; FR; CH
Mid	medium	0.077	10/13	
High	short	0.106	9/13	BE; FI
High	medium	0.169	8/13	

Excluded quarters (merger) Q2-Q3/2007; pre-period 4 quarters; post-period 8 quarters; cheapest 4 tariffs

B.6 MNO-specific analysis

In this section of the Annex we present the results of the difference-in-differences analysis decomposed at the level of the MNOs. We estimate separately the change in prices associated with the merger for each MNO active in the Netherlands at the time of

the merger[145]. The cheapest four tariffs of each of the MNOs recorded in the Teligen data of the countries where no merger occurred are used as controls.

However, the estimated MNO-specific effects should not be interpreted as being necessarily caused by the analysed mergers for the same reasons as discussed in Section 4.1 and Section A.5 of Annex A.

The results of the analysis at MNO level are shown in Table 37 and Table 38. For each MNO the analysis estimates the short-term and medium-term effect, i.e. the first and second year post-merger, respectively[146].

[145] See also Footnote 83.

[146] For Orange it is not possible to estimate the medium-term effect as the brand was discontinued by T-Mobile in Q3/2008.

Table 37: Estimation of MNO-specific effects of the merger: Base specification

	(1)	(2)	(3)
Dep. Variable	log Price	log Price	log Price
Basket	Low	Mid	High
KPN Short-term effect	0.106**	0.167***	0.161***
	(0.043)	(0.000)	(0.000)
KPN Medium-term effect	-0.0165	0.130**	0.183***
	(0.745)	(0.0172)	(0.000)
Orange Short-term effect	0.0208	0.0332	0.0882***
	(0.672)	(0.318)	(0.000)
Orange Medium-term effect	-	-	-
	-	-	-
T-Mobile Short-term effect	0.0390	0.0583	0.146***
	(0.423)	(0.135)	(0.000)
T-Mobile Medium-term effect	-0.0249	0.0835	0.198***
	(0.626)	(0.102)	(0.000)
Vodafone Short-term effect	0.0874*	0.0928**	0.110***
	(0.087)	(0.025)	(0.001)
Vodafone Medium-term effect	0.104*	0.132**	0.161***
	(0.059)	(0.015)	(0.002)
GDP growth	-0.0265	-0.0353	-0.0607
	(0.823)	(0.711)	(0.369)
log MTR	2.573***	2.016**	1.984**
	(0.006)	(0.018)	(0.012)
Constant	2.509***	3.064***	3.577***
	(0.000)	(0.000)	(0.000)
Observations	1,210	1,210	1,210
R-squared	0.713	0.790	0.829
Trend country-spec.	NO	NO	NO

Cluster-robust pval below coefficients (s.e. clustered at country level)

Time fixed effects and country-provider fixed-effects

Excluded quarters (merger) Q2-Q3/2007; pre-period 4 quarters; post-period 8 quarters; cheapest 4 tariffs
*Significance level: *** 1%, ** 5%, * 10%*

Table 37 shows the results of the Base specification for the Low, Mid and High baskets, respectively. It appears that for the Low and Mid baskets in particular the two non-merging MNOs increased their prices, while T-Mobile and Orange did so to a lesser extent. For both low and medium usage users, the estimated coefficients for Orange are close to zero and are not statistically significant. The estimated effects for T-Mobile for the Low basket are also close to zero. For the Mid basket, they range from 6% in the short term to 8% in the medium term, and become almost statistically significant at the 10% level. In the first year post-merger (the short-term effect), KPN increased its prices by 10% and 16% for the Low and Mid baskets, respectively, while in the second year post-merger (the medium-term effect), KPN decreased its prices to the levels pre-merger for the Low basket, while it slightly decreased its prices for the Mid basket, reaching an increase of 13% relative to the pre-merger period. Vodafone increased its

prices for the Low and Mid basket by 8.5% and 9% in the short term, respectively, and continued to increase its prices in the second year post-merger, reaching an increase of 10% and 13%, respectively, relative to the pre-merger period.

For the high users the analysis indicates a price increase common to all the MNOs in the Netherlands. T-Mobile increased its prices by 14.5% and 20%, KPN increased its prices by 16% and 18%, and Vodafone increased its prices by 11% and 16%, respectively for short term and medium term post-merger periods. Orange, for which we can only estimate the short-term effect, increased its prices by 9%.

Table 38: Estimation of MNO-specific effects of the merger: Trend specification

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	log Price	log Price	log Price	log Price	log Price	log Price
Basket	Low	Mid	High	Low	Mid	High
KPN Short-term effect	0.184***	0.197***	0.079*	-0.054	-0.116*	-0.208***
	(0.004)	(0.003)	(0.052)	(0.325)	(0.052)	(0.000)
KPN Medium-term effect	0.079	0.133*	0.04	-0.203***	-0.239***	-0.3***
	(0.174)	(0.06)	(0.412)	(0.003)	(0.003)	(0.000)
Orange Short-term effect	0.044*	0.03	0.01	0.067***	0.16***	0.098***
	(0.053)	(0.128)	(0.486)	(0.006)	(0.000)	(0.000)
Orange Medium-term effect	-	-	-	-	-	-
	-	-	-	-	-	-
T-Mobile Short-term effect	0.116**	0.088	0.064	0.381***	0.129**	0.019
	(0.046)	(0.126)	(0.106)	(0.000)	(0.034)	(0.618)
T-Mobile Medium-term effect	0.073	0.098	0.051	0.387***	0.146**	-0.002
	(0.208)	(0.152)	(0.3)	(0.000)	(0.043)	(0.965)
Vodafone Short-term effect	0.165***	0.123**	0.028	0.082	0.081	0.149***
	(0.008)	(0.041)	(0.459)	(0.148)	(0.157)	(0.002)
Vodafone Medium-term effect	0.169***	0.134*	0.024	0.07	0.086	0.168***
	(0.009)	(0.057)	(0.625)	(0.227)	(0.209)	(0.004)
log MTR	1.290**	0.977**	0.601**	1.289**	0.978**	0.604**
	(0.0377)	(0.0361)	(0.0478)	(0.0387)	(0.0374)	(0.0490)
GDP growth	-0.0239	-0.0341	-0.0302	-0.0232	-0.0357	-0.0360
	(0.766)	(0.490)	(0.621)	(0.774)	(0.477)	(0.564)
Constant	0.341	1.398***	4.155***	6.931***	6.786***	5.166***
	(0.215)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	1,210	1,210	1,210	1,210	1,210	1,210
R-squared	0.736	0.816	0.849	0.749	0.823	0.862
Trend Level	Country	Country	Country	MNO	MNO	MNO

Cluster-robust pval below coefficients (s.e. clustered at country level)

Time fixed effects and country-provider fixed-effects

Excluded quarters (merger) Q2-Q3/2007; pre-period 4 quarters; post-period 8 quarters; cheapest 4 tariffs
*Significance level: *** 1%, ** 5%, * 10%*

In the MNO-level analysis, we include two types of trends: country-specific and MNO-specific. Table 38 reports the results with the inclusion of the trend. The first three

columns have country-specific trends, while the last three columns have MNO-specific trends for the Low, Mid and High baskets, respectively.

When introducing country-specific trends in the analysis the relative price increases among MNOs compared to the Base specification remain unchanged. However, in line with the country-wide effect reported in Table 9, the estimated price increases for the Low basket increase by roughly 7-8 percentage points (pp), whereas the estimated price increases for the High basket are reduced by 9-14 pp.

Once MNO-specific trends are included in the analysis, however, the estimated effects change substantially. The model estimates that KPN strongly decreased its prices across all the baskets, ranging from -11% to -30% depending on the basket. Conversely, Vodafone has an overall price increase in the baskets, with statistical significant effects for the High basket around 15% in both short-term and medium-term periods. Of the merging parties, the model estimates that T-Mobile sizeably increased its prices for the Low (38%) and Mid (around 15%) baskets, while for the High basket its prices remained at the same level as in the pre-merger period. We find a price increase for Orange in the short term of 7%, 16% and 10% for Low, Mid and High baskets, respectively.

As already mentioned in the main analysis, however, in the Trend specification the slope of the treated country's trend is estimated based only on the four quarters of the pre-merger period. As a result, the trend is very sensitive to small changes in the price series and thus to unobservable factors that may affect prices in the pre-merger period, such as the KPN/Telfort merger. This limitation is particularly severe when the model includes MNO-specific trends, as the price series of some MNO appear more unstable over the short pre-merger period than the country average price series, as shown in Figure 11. Therefore, very little weight should be attached to the reported price effects of the Trend specification in the Netherlands' MNO-level analysis.

All in all, the results of the MNO-level analysis in the Netherlands are difficult to interpret. Other factors not taken into account in the analysis may affect the results. For example, the exclusion of the sub-brands and MVNOs may be particularly relevant for KPN which, as explained above, has a multi-brand strategy. It is also possible that the previous KPN/Telfort merger had an effect which continued during the period analysed for the T-Mobile/Orange merger. Additionally, the analysis is conducted at a high level of granularity, which may further exacerbate the data issues mentioned in Section 3.1.2.

Annex C – Further description of minor data issues

Regarding the control countries, we were able to perform a systematic check (similar to those done for Austria and the Netherlands) only for Sweden, where we compared the Teligen data to an alternative data source provided by PTS. Overall, the price series of Sweden based on the two data sources shared similar trends with little variation. Hence no changes were made to the Swedish Teligen data.

For the other control countries alternative data sources were not available, and it was impossible to perform further extensive and systematic checks[147].

The checks suggest that the quality of the data (Teligen as well as the alternative data sources) is mostly reasonable. However, there appear to be some inconsistencies and recording errors cannot be excluded. Nevertheless, it is unlikely that such limitations would significantly bias our results as the analysis includes a relatively large number of tariffs per operator and several of the available countries of the Teligen data in the control group. Therefore, possible errors regarding single tariffs in the data collection are likely diluted or cancelled out.

For the United Kingdom, another issue was present in the Teligen data. As mentioned in Section 3.1.2, the Teligen data records the tariffs of the two largest MNOs in a country. In the United Kingdom the second largest operator was Orange until 2004, and it became O2 from 2005 onwards. As a result, the MNOs of the United Kingdom change in the Teligen data from 2005. However, this change did not result in a major change of the price series for UK at that time.

For Denmark, Finland, Hungary, and the Czech Republic we also observe changes in the names of the MNOs covered by the Teligen data. For Denmark, Telenor replaced Sonofon in Q3/2009, for Finland Radiolinja changed its name into Elisa in Q4/2004, for Hungary T-Mobile replaced Westel 900 in Q2/2004, for the Czech Republic O_2 replaced Eurotel in Q3/2006. However, all these instances are only re-brandings or changes in ownership which do not change the market structure, and we do not observe significant (or unusual) price changes around these dates[148].

[147] From an examination of the data we observed that few tariff plans were missing for one quarter. After consultation with Teligen, we imputed the tariffs for the respective missing quarters (eight imputations in total) for France, Germany and Italy.

[148] In Denmark, Sonofon's parent company, the Norwegian company Telenor, merged Sonofon with Cybercity (Telenor's Danish subsidiary active as internet service provider) in 2009 and named the new company Telenor. In Hungary, the mobile operator Westel 900, already a subsidiary of Deutsche Telekom, was rebranded as T-Mobile in March 2009. Finally, in the Czech Republic, the Spanish firm Telefonica, which was not previously active in the mobile sector in the Czech Republic, bought Eurotel in 2005 and re-branded it to O2 in the course of 2006.

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