

Haucap, Justus; Heimeshoff, Ulrich

**Working Paper**

## Consumer behavior towards on-net/off-net price differentiation

DICE Discussion Paper, No. 16

**Provided in Cooperation with:**

Düsseldorf Institute for Competition Economics (DICE), Heinrich Heine University Düsseldorf

*Suggested Citation:* Haucap, Justus; Heimeshoff, Ulrich (2011) : Consumer behavior towards on-net/off-net price differentiation, DICE Discussion Paper, No. 16, ISBN 978-3-86304-015-4, Heinrich Heine University Düsseldorf, Düsseldorf Institute for Competition Economics (DICE), Düsseldorf

This Version is available at:

<https://hdl.handle.net/10419/44999>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

# DISCUSSION PAPER

No 16

## Consumer Behavior towards On-net/Off-net Price Differentiation

Justus Haucap,  
Ulrich Heimeshoff

January 2011

## IMPRINT

### DICE DISCUSSION PAPER

Published by

Heinrich-Heine-Universität Düsseldorf, Department of Economics, Düsseldorf Institute for Competition Economics (DICE), Universitätsstraße 1, 40225 Düsseldorf, Germany

### Editor:

Prof. Dr. Hans-Theo Normann

Düsseldorf Institute for Competition Economics (DICE)

Phone: +49(0) 211-81-15125, e-mail: [normann@dice.uni-duesseldorf.de](mailto:normann@dice.uni-duesseldorf.de)

### DICE DISCUSSION PAPER

All rights reserved. Düsseldorf, Germany, 2011

ISSN 2190-9938 (online) – ISBN 978-3-86304-015-4

The working papers published in the Series constitute work in progress circulated to stimulate discussion and critical comments. Views expressed represent exclusively the authors' own opinions and do not necessarily reflect those of the editor.

# Consumer Behavior towards On-net/Off-net Price Differentiation\*

Justus Haucap<sup>†</sup>     Ulrich Heimeshoff<sup>‡</sup>

January 2011

## Abstract

This paper explores how consumers react towards price differentiation between on-net and off-net calls in mobile telecommunications - a pricing policy that is common in many mobile telecommunications markets. Based on a survey of 1044 students we demonstrate that some consumers may suffer from a "price differentiation bias", i.e., a fair number of consumers may overestimate the savings that result from reduced on-net and/or off-net charges, as they do not appear to weigh the prices with the probabilities of placing off-net and on-net calls. This may help to explain why it have been the smaller operators in various countries who have introduced on-net/off-net price differentiation. We also discuss the implications that such a consumer bias may have for market competition.

*JEL Classification:* L40, L96.

---

\*We would like to thank two anonymous referees as well as Ralf Dewenter and seminar participants at the Universities of Augsburg, Cologne, Kassel, and Wuerzburg and at the 17th Biennial Conference of the International Telecommunications Society (ITS) at Montreal for helpful comments and suggestions. Anja Brieger provided excellent research assistance.

<sup>†</sup>Heinrich-Heine-University of Duesseldorf, Duesseldorf Institute for Competition Economics, Universitaetsstr. 1, 40225 Duesseldorf, Email: justus.haucap@uni-duesseldorf.de, Fax: 0049-211-81-15499.

<sup>‡</sup>Heinrich-Heine-University of Duesseldorf, Duesseldorf Institute for Competition Economics, Universitaetsstr. 1, 40225 Duesseldorf, Email: ulrich.heimeshoff@uni-duesseldorf.de, Fax: 0049-211-81-15499.

# 1 Introduction

In July 2007, *KPN* lodged a complaint with the European Commission that *T-Mobile* and *Vodafone* would have a position of collective dominance in the German mobile telecommunications market (see *KPN*, 2007). According to the reasoning of *KPN*, the main source of that allegedly dominant position was the price differentiation between on-net and off-net calls which leads to tariff-mediated network effects. As *T-Mobile* and *Vodafone* entered the market two years prior to *E-Plus* (*KPN*'s mobile subsidiary in Germany) and six years prior to *O2* (the fourth and still smallest mobile network operator in Germany), the two early movers were able to build a customer base which, in combination with differentiation between on-net and off-net prices, enabled the two larger firms to act largely independent from their smaller rivals, so the argument. While the Federal Cartel Office in Germany has discontinued its investigations by the end of 2009 (see Bundeskartellamt, 2010), similar complaints against price differentiation between on-net and off-net calls have been made in other countries such as Austria and Italy (see *ERG*, 2008, p. 43), Turkey (see *Atiyas and Dogan*, 2007) or New Zealand (see *Commerce Commission*, 2010).

The argument that the combination of a large initial market share and tariff-mediated network effects can be strategically used to foreclose the market and to secure market power sounds initially rather reasonable and has also been explored in the academic literature (see, e.g., *Hoernig*, 2007, 2008). In addition, there has also been some empirical support for this hypothesis by *Kim and Kwon* (2003). Based on a consumer survey for the Korean mobile telecommunications market, their conditional logit analysis reveals that consumers prefer carriers with a larger number of subscribers other things being equal. As *Kim and Kwon* (2003) argue intra-network call discounts are, among other factors, one likely source of that effect.

An interesting observation in this context is, however, the fact that in a number of European mobile telecommunications markets it have been the small entrants who started to price differentiate between on-net and off-net calls. In Germany, it was in fact *E-Plus* (the complainant's own subsidiary) who started to price differentiate between on-net and off-net calls when it entered the market in 1994 (see *Frontier Economics*, 2004). Similarly, it has been reported by *Frontier Economics* (2004) that in the UK, on-net/off-net differentials were first introduced in late 1993 by *One2One* and in early 1994 by *Orange* when the two new networks launched their services, while the

two incumbents only introduced such differentials in their charges in October 1998 (*Vodafone*) and in spring 1999 (*BT Cellnet*). In Ireland, *Digifone* entered the market in May 1997 with on-net/off-net differentials while incumbent operator *Eircell*, only responded with similar differentials in May 1999 (see Frontier Economics, 2004). Finally, in Austria it was *tele.ring* who first introduced on-net price discounts upon its market entry in 2001 (see Dewenter, Haucap and Kruse, 2004). In other countries, however, the combination of on-net discounts and high off-net prices has apparently been used by incumbents to stifle competition. The most dramatic example may have been the case of the third mobile network operator in Slovenia, *Vega*, which exited from the Slovenian mobile market in 2006 after five years of operations, reportedly at least partly due to the aggressive on-net/off-net price differences offered by the two incumbents (see Trilogy International Partners, 2009). Similarly, the third mobile operator which entered the New Zealand mobile market in 2009 (called *2degrees*) has lodged complaints against anti-competitive on-net/off-net differentials by the two incumbent operators (see Commerce Commission, 2010). However, even though in some instances (such as recently in New Zealand) incumbents appear to have clearly used on-net discounts to foreclose the market against competitive entry, the above observation that, at least in a fair number of countries, entrants have initiated on-net discounts appears to be at odds with the idea that on-net price discounts are only used as a tool to foreclose the market by large incumbent operators.

One potential explanation may be based on the so-called "calling club" argument, formulated among others by Gabrielson and Vagstad (2008). According to this line of reasoning, consumers are grouped into social networks or "calling clubs", the members of which call each other more often than people outside the network. Therefore, customers are less interested in the absolute size of a mobile network than in the number of friends and family members associated with a given mobile operator. In fact, many European operators offer tariff options with discounts for calls to "family and friends". Moreover, based on UK survey data, Birke and Swan (2006) find that the proportion of off-net calls falls as mobile operators charge a premium for off-net calls, but even in the absence of any price differential between on-net and off-net, there is still a form of pure network effect, where a disproportionate number of calls are on-net. In addition, they find that the choice of operator is heavily influenced by the choices of others in the same household. The utility that an individual consumer derives from using mobile telecom-

munications heavily depends on who of her potential calling partners has already subscribed and to which network. More precisely, Birke and Swan (2006) estimate that roughly 9.2 million subscribers to a network have the same impact as one additional member from the same household being on the same network. Similarly, Corrocher and Zirulia (2009) have found that local network effects (among partners, friends, and family) play a role for customers in Italy. Their paper investigates the extent to which that consumers take account of their contacts' mobile operators when choosing a provider for themselves. To this aim Corrocher and Zirulia (2009) rely on a survey of 193 high-school and university students in Italy and show that these consumers are highly heterogeneous with respect to the importance they give to the operators chosen by their friends/family members in choosing which provider to use. Against this background, discounting on-net calls may be seen as a tariff innovation in order to compete for families or other "calling clubs".

In this paper, we offer another, complementary explanation, which is based on recent observations from marketing science and behavioral economics. We start from the observation that, in reality, many consumers are choosing calling plans that are not cost minimizing for them (see, e.g., Lambrecht and Skiera, 2006). As we will argue, the bounded rationality of mobile telecommunications consumers may be exploited to some degree by operators, and it may be more attractive for new entrants to offer plans with discounted on-net calls than for incumbents with a large installed customer base. If customers fail to weigh prices with the appropriate call minutes or probability of placing a certain call, but base decisions on unweighted prices, discounting certain call prices may be more attractive for newcomers than for incumbent operators, as we will argue below. This observation also offers a new perspective on the competitive effects of on-net price discounts.

The rest of the paper is now organized as follows: In the next section we review the related literature on consumer choice of multi-part tariffs and tariff choice biases as well as the literature on price discrimination between on-net and off-net calls. Section 3 describes our survey and presents our empirical analysis, before section 4 draws out policy conclusions. Finally, section 5 summarizes our main findings.

## 2 Related Literature

In recent times, there has been a fastly growing literature on consumers' decisions between multi-part tariffs and various tariff choice biases. This literature usually finds that consumers fail to chose calling plan which would minimize their expenses. Given that the four mobile network operators alone offer more than 400 different tariffs and that, as of 2010, there have been more than 150 mobile telecommunications services providers in Germany,<sup>1</sup> it is not really surprising that consumers do not chose the calling plan that would minimize their expenses. Even the neoclassical search cost literature, as initiated by Stigler (1961), has shown that, if consumers face search costs, it is not optimal to compare all the prices available in the market, but to limit ones search to a limited number of offerings. As mobile calling plans are rather complex, usually consisting of far more than ten single prices for various types of calls or data services (such as SMS etc.) and as the human capacity to calculate and to compare complex pricing schemes is scarce, even standard economic theory would predict that not all consumers chose calling plans that minimize their expenses.

This search cost-based argument is not fully convincing, however, given the evidence on consumer choice in rather simple settings. In fact, for telecommunications services there is a long array of evidence by now, starting with Train, McFadden & Ben-Akiva (1987), which suggests that consumers suffer from a flat-rate bias, i.e., consumers tend to prefer flat rates even in situations were measured rates are clearly less costly (also see Kling & van der Ploeg, 1990, Mitchell & Vogelsang, 1991, Taylor, 1994, Kridel, Lehman & Weisman, 1993, Kreye, 2005, Lambrecht & Skiera, 2006).<sup>2</sup> Contrary evidence, however, is provided by Miravete (2002, 2003) who finds that consumers correct their eventual mistakes so that any flat-rate bias vanishes once one allows for consumer learning (also see Narayanan et al., 2007).

In addition, there is also some evidence that consumers have difficulties in choosing cost-minimizing calling plans if the price vectors are rather complex (see Bolle & Heimpl, 2005). This paper is most closely related to our survey. As Bolle & Heimpl (2005) show consumers' comparison of price *vectors* can be the source of a fallacy in the presence of tariff-mediated network effects.

---

<sup>1</sup>The price comparison website [www.teltarif.de](http://www.teltarif.de) listed 156 mobile service providers as of 30 December 2010 (see <http://www.teltarif.de/a/mobilfunk.html>).

<sup>2</sup>A similar phenomenon has been observed in other industries such as health clubs (see DellaVigna & Malmendier, 2006).



In the presence of on-net price discounts a provider with a small installed customer bases may be more expensive for consumers than a larger provider even if the smaller one has both lower on-net and lower off-net tariffs than the large provider. Mistakenly comparing absolute price levels rather than average prices is called “a fallacy of dominant price vectors” by Bolle and Heimel (2005).

This paper provides further evidence based on a different survey and also examines, by means of regression analyses, the characteristics of the individuals that (do not) suffer from this fallacy. Hence, the present study also adds to the limited empirical research that is available so far on factors influencing tariff type selection decisions. Surprisingly enough, given the abundance of mobile tariff types it is striking that empirical evidence on customers’ choices among various tariff options and on factors influencing tariff type selection decisions is still scarce for the mobile telephony service industry.

The related literature on price discrimination between on-net and off-net calls is limited. While Laffont, Rey & Tirole (1998) deal with the issue in their seminal paper, they take firms as symmetric and treat market structure as exogeneous. Hence, they do not address the main competition concern, namely whether on-net discounts can be used to foreclose the market or to preempt market entry.<sup>3</sup> This question is addressed by Hoernig (2007, 2008). While the effects depend on parameter constellations in his models, his papers show (a) that on-net price discounts can be used for anticompetitive purposes, but (b) that larger operators will also charge higher off-net prices in the absence of any anticompetitive intent. Hence, it is not the mere fact that on-net and off-net prices differ, but the size of the difference that makes on-net/off-net price differences anticompetitive. Calzada and Valletti (2007) show that incumbents have incentives to set high mobile-to-mobile termination rates which results in entrants having to charge higher prices for off-net calls. This in turn harms smaller entrants more than incumbents as most of the entrants’ subscribers’ calls will be made off-net. Moreover, call externalities further reinforce this effect, as subscribers of smaller networks will receive relatively few calls, thus reducing the utility from joining a smaller network. Similar arguments have been developed under slightly different

---

<sup>3</sup>This is also true for many other papers that address the issue of on-net/off-net price discrimination such as Cambini and Valletti (2003, 2007), Jeon et al. (2004), or Berger (2005). None of these papers deals with the question of foreclosure and/or preemption.

assumptions and model specifications in two recent papers by Lopez and Rey (2009) and Cabral (2009). In a similar vein, various consultancy reports have highlighted that on-net/off-net price discrimination can be used to preempt entry or to constrain entrants' growth (see, e.g., Elliott, 2004; Harbord and Pagnozzi, 2008). If, however, consumers suffer from tariff choice biases, the case may be less clear cut than usually thought. As Bolle and Heibel (2005, p. 203) suggest "policymakers concerned that price discrimination in network industries may be used to limit competition may have less reason to worry than previously thought". This paper aims at shedding some more light on this question, based on a survey to be described in the next section.

### 3 Survey and Data Description

During the 2007 summer term a survey among 1044 students of economics (Wirtschaftswissenschaft) was carried out at the Ruhr-University of Bochum in Germany. The focus of the survey was on (a) the students' true behavior in telecommunications markets and (b) their hypothetical tariff choice under various given scenarios. Moreover, the survey contained a number of questions on the following issues:

1. Socio-economic background (age, sex, siblings, income, religion, political attitudes),
2. actual behavior with respect to telecommunications (carrier, calling plan, usage),
3. students' knowledge about the German telecommunications market,
4. their hypothetical choice of mobile telephone tariff.

Of the students surveyed by us, 68% reported to possess a mobile phone for at least four years, while less than two percent had a phone for not even two years. The average age of the students surveyed was 24.5 years, and 61 % of the students were male. Importantly, 90 percent of all students reported to pay themselves for their telephone bills. Moreover, 20% reported to use prepaid cards, 46 % postpaid contracts with free minutes (allowances), and 13% a flat rate. The remaining students were on standard measured rates. Finally, students self-report to use their mobile telephone for an average of 154 minutes per month.

Table 1 provides further descriptive statistics for the variables that are used in the regression analysis.

Table 1: Descriptive Statistics

Variable	Obs.	Mean	Min	Max
Monthly bill	625	15.834	0	53.95
Age	613	22.785	19	48
Male	615	0.389	0	1
Fixed line access	617	0.81	0	1
Knowledge on-net/off-net prices	605	0.355	0	1
Call length off-net/on-net	617	0.425	0	1
Switches	567	1.115	0	8
Search length	559	2.92	1	6
"Do not look at the monthly bill"	625	0.138	0	1
Importance subscribtion charge	574	5.427	0	10
Importance on-net price	570	6.223	0	10
Importance off-net price	573	6.138	0	10
Share on-net/off-net	586	6.234	0	10
Importance SMS price	575	6.287	0	10
Importance free SMS	575	6.428	0	10
Importance free minutes	574	6.223	0	10
Importance access charge	568	8.19	0	10
T-Mobile	594	0.91	0	1
Vodafone	594	0.93	0	1
E-Plus	604	0.93	0	1
Base	594	0.21	0	1
O2	594	0.91	0	1
Expenditure per minute	529	0.792	0.006	20

Participants were asked to report the average amount of their monthly bills as well as age and sex. Furthermore, students were asked whether they have fixed line access and whether they know their providers' off-net and on-net prices as well as their average length of calls. In order to obtain some impression of our students' behavior as consumers of telecommunications services, students were asked how often they had switched their mobile phone providers in the past and also how much time they had spent on gathering information before they made the decision which provider to choose. Additionally, students have been identified who report that they usually do not look at their monthly bill by including a dummy variable. The next

set of questions asked students to evaluate on a 0 to 10 scale how important different elements of their mobile telecommunications contracts was for them, for example the subscription charge, on-net and off-net prices, ratio of off-net versus on-net calls, SMS charges, free SMS, free minutes, and access charges. Finally, participants were asked which provider they had chosen in real life. The variable "expenditure per minute" is a measure of mobile phone expenditures per minute as a result of students' answers in the survey.

Table 2 provides some first descriptive result. Students were asked to choose between two tariffs, offered by two different operators, A and D. Students were told they should assume that they would steadily place exactly 80 minutes of telephone calls per month (no uncertainty) and that operator A had a market share of 40 %, while operator D had a market share of 10% (with the rest of the market being divided between operators B and C). Assuming that calls would be distributed according to market shares, column 5 of Table 2 ("Total Bill") indicates the prospective bill a student would hypothetically face if (s)he had chosen either A or D.

Table 2: Descriptive Results

No	Firm	On-Net Price	Off-Net Price	Monthly Fee	Total Bill	Chosen by %
1.1	A/D	0.19/0.19	0.69/0.59	-	39.20/44.00	37%/65%
1.2	A/D	0.19/0.19	0.69/0.59	12.95/9.95	52.15/53.95	25%/75%
2.1	A/D	0.29/0.09	0.59/0.59	-	37.60/43.20	25%/75%
2.2	A/D	0.29/0.09	0.59/0.59	11.95/9.95	49.55/53.15	17%/83%
3.1	A/D	0.29/0.19	0.69/0.59	10.50/9.50	52.95/53.95	23%/77%
3.2	A/D	0.29/0.19	0.69/0.59	12.95/14.95	55.35/58.95	30%/70%
4.1	A/D	0.19/0.19	0.59/0.59	12.50/4.95	46.90/48.95	20%/80%

It is easy to see from Table 2 that most students did not choose the cost minimizing calling plan. The total bill clearly shows that the majority of participants could have saved money (hypothetically) by choosing operator A instead of D. However, in each of the seven experiments the vast majority of students chose the smaller operator, D, even though operator A would have been less expensive. This result provides some first evidence that people face difficulties in thinking about the relationship between off-net and on-net tariffs. The next section provides detailed information on the results of the econometric analysis.

## 4 Empirical Results

### 4.1 Mobile Phone Expenditures in the "Real Life"

Participants were asked about their average monthly bill for mobile phone calls and their average number of outgoing call minutes per month. Based on this information, the customer's average expenditures per minute of outgoing traffic were calculated, and personal characteristics that determine these expenditures were analyzed. The equation is estimated by standard OLS including heteroskedasticity robust standard errors following the White methodology (White, 1980). The results are reported in Table 3.

Table 3: On-Net/Off-Net-Bias and Consumers' "Real" Monthly Bill

	Coeff.	Std. Err.
Customer expenditure per minute		
Age	0.002	0.027
Male	-0.013	0.122
Fixed line access	0.005	0.249
Switches	-0.083***	0.032
Search length	-0.115**	0.047
Share on-net/off-net	-0.039**	0.019
Importance subscription charge	0.009	0.028
Importance SMS charge	0.005	0.014
Importance minutes without charge	-0.038**	0.019
Importance SMS without charge	0.001	0.015
Importance access charge	0.005	0.012
T-Mobile	0.105	0.144
Vodafone	0.393**	0.163
E-Plus	-0.081	0.150
Base	-0.149	0.124
O2	-0.058	0.126
Cons.	1.165**	0.589
$R^2$	0.06	
Obs.	373	

\*, \*\*, \*\*\* Statistically significant on the 10, 5 or 1% level, standard errors are heteroskedasticity consistent.

An important determinant of customers' expenditures per minute is how often a consumer has switched to a new mobile operator in the past ("switches"). This suggests that learning is an important phenomenon in mobile telecommunications markets, as consumers who have switched more often in the past tend to face a lower expenditure per minute. Note that we control for the age of participants and that most of our participants are of very similar age in any case. Hence, it is rather unlikely that this finding results from an omitted variable bias.

Furthermore, the length of consumers' information search before choosing a new provider strongly affects a consumer's monthly mobile phone bill. The longer consumers search the lower their expenditure per minute for mobile phone calls. In addition, consumers' beliefs about the share of on-net versus off-net calls is important. Participants who indicate that this ratio is an important factor in choosing between providers have in fact, on average, a lower expenditure per minute. This finding can be regarded as an indication that consumers who understand the mechanics of on-net/off-net price differentiation are better off than their counterparts who suffer from a "price differentiation bias".

These results are largely in line with the findings of Corrocher and Zirulia (2009). While the authors use a different approach (namely a cluster analysis), they also find that "consumers that spend time and attention around the use of mobile phone services (...) spend relatively little as compared to what could be expected and (...) consumers who do not take into account the choice of their social contacts when choosing their own operator pay an extra cost for this behavior." The results presented in Table 3 above suggest, quite similarly, that the time spent for choosing between operators, customer experience, and consumers' emphasis on on-net/off-net differentials saves consumers money.

In addition, participants who highly value monthly free minutes have lower expenditures per minute. An explanation may be that these customers are rather price sensitive and invest more time into minimizing their mobile phone bill. Furthermore, dummy variables were included as indicators of participants' real life mobile phone operators. As one can see, *Vodafone* customers have higher expenditures per minute than other mobile phone users in the present data set. This observation is not that surprising, as the larger network operators in Germany, *T-Mobile* and *Vodafone*, usually have customers that value network and service quality more highly than low

prices.<sup>4</sup> To obtain more information about consumers' decision processes when choosing between calling plans, students were asked to choose between tariffs in various different situations described in the survey. The next section presents the regression results for these experiments.

## 4.2 Mobile Phone Tariffs and Price Differentiation Bias

This section presents results of the regressions related to the tariff experiment contained in the survey. The equations are estimated by standard OLS with heteroskedasticity robust standard errors (Wooldridge, 2001). Table 4 presents results for two different questions. In the first case students were given two alternative calling plans to choose from, while in the second case students had to choose between four alternative plans, which also included a monthly subscription charge.

Consumers are usually better off if they look at off-net prices, whereas a strong focus on on-net prices increases the monthly bill in our survey. Hence, participants with an "on-net bias" tend to receive higher monthly bills. Consumers who describe themselves as well informed about the structure of on-net and off-net tariffs have, on average, a higher probability of choosing the bill minimizing calling plan. Again, this finding can be interpreted as being in accordance with Corrocher and Zirulia (2009) who report that consumers who focus on local network effects face lower mobile phone bills. However, in our survey knowledge of on-net/off-net prices is only significant (in a statistical sense) in the case of four alternatives. In such an environment, there is also evidence that consumers who place much emphasis on subscription charges usually have higher bills and, consequently, also higher probabilities of choosing more expensive calling plans.

---

<sup>4</sup>While the effects are statistically not significant for *T-Mobile*, *O2*, *Base* and *E-Plus* in our sample, note that the coefficients have the expected sign.

Table 4: Monthly Bill

Monthly Bill	Coeff. 2 Alternatives	Std. Err.	Coeff. 4 Alternatives, subs. charge	Std. Err.
Age	-0.417	0.830	-0.459	0.820
Male	-3.514	4.261	3.834	3.469
Fixed line access	-1.319	4.818	4.922	5.090
Knowledge on-net/off-net prices	-3.811	4.324	-8.003**	3.572
Call length off-net/on-net	3.004	4.388	-1.132	3.427
Switches	0.258	1.555	-0.759	1.498
Search length	2.067	1.345	1.368	0.913
"Do not look at the monthly bill."	2.928	5.438	-	0.764
Importance subscription charge	0.426	0.705	2.291***	0.826
Importance on-net price	1.478**	0.694	1.521**	0.764
Importance off-net price	-2.008***	0.707	-1.606**	0.824
Share on-net/off-net	-0.641	0.784	-	-
Importance SMS price	-0.970	0.670	-0.040	0.651
Importance free SMS	-0.210	0.545	-0.153	0.576
Importance free minutes	-0.224	0.549	0.567	0.578
Importance access charge	-0.274	0.568	-0.508	0.499
T-Mobile	-4.546	8.503	-6.120	4.360
Vodafone	13.439	13.558	3.831	6.601
E-Plus	-9.455*	5.771	-6.120	4.360
Base	7.492*	4.677	2.698	3.970
O2	10.998	8.883	-1.895	4.898
Cons.	48.210	35.220	29.452	23.474
$R^2$	0.16		0.21	
Obs.	151		154	

\*,\*\*,\*\*\* Statistically significant on the 10, 5 or 1% level, Standard errors are heteroskedasticity consistent.

## 5 Conclusions

This paper has explored how consumers react towards price differentiation between on-net and off-net calls in mobile telecommunications - a pricing



policy that is common in many mobile telecommunications markets. Based on a survey of 1044 students it is demonstrated that some (but not all) consumers may suffer from a "price differentiation bias", i.e., a fair number of consumers may overestimate the savings that result from reduced on-net and/or off-net charges, as they do not appear to weigh the prices with the probabilities of placing off-net and on-net calls. In contrast, consumers who understand the mechanics of on-net/off-net price differences have lower mobile phone bills and are better in choosing expenditure minimizing tariff options.

In addition, a learning effect has been identified showing that consumers who have switched more often to other network operators in the past pay, on average, less for mobile telecommunications services. The same result holds for participants who take more time collecting information about the tariff options best suitable for their telecommunications behavior. Furthermore, students reporting that they are aware of differences in on-net/off-net charges in their own mobile phone tariffs do better in our experiment resulting in lower expenditure per minute for our hypothetical mobile phone calls.

Another important result is the finding that a large share of students does not correctly incorporate the structure of on-net and off-net calls in their calculations to find optimal tariffs. This may help to explain why it have been the smaller operators in various countries who have introduced on-net/off-net price differentiation. For competition authorities these findings suggest that the presence of on-net/off-net price differentiation does not *automatically* raise competition concerns. Hence, a per se prohibition of on-net/off-net price differentiation would most likely constitute a case of over-regulation, also against the evidence that small entrants sometimes use on-net discounts as a tool for competitive entry. Having said this, it should be nonetheless clear that a combination of low on-net and high off-net prices can still be used for anticompetitive purposes. For example, this was apparently the case in New Zealand when *Vodafone New Zealand* reacted to the entry of the third mobile operator, *2degrees*, with an offer of 0,06 NZ\$ for on-net calls, while charging 0,89 NZ\$ for off-net calls (see Pullar-Strecker, 2010). Overall, a rule-of-reason approach to on-net/off-net pricing appears to be warranted where cases are judged on an individual basis, taking into account consumers' behavior towards such pricing policies. More generally, it is suggested to carefully study consumer behavior towards complex pricing schemes before reaching conclusions about their anti- or pro-competitive effects.

## References

- [1] Atiyas, I., & Dogan, P. (2007). When good intentions are not enough: Sequential entry and competition in the Turkish mobile industry. *Telecommunications Policy*, 31, 502-523.
- [2] Berger, U. (2005). Bill-and-keep vs. cost-based access pricing revisited. *Economics Letters*, 86, 107-112.
- [3] Birke, D., & Swann, G.P. (2006). Network effects and the choice of mobile phone operator. *Journal of Evolutionary Economics*, 16, 65-84.
- [4] Bolle, F., & Heibel, J. (2005). A fallacy of dominant price vectors in network industries. *Review of Network Economics*, 4, 197-204.
- [5] Bundeskartellamt (2010): Prüfung eines möglichen Missbrauchs einer marktbeherrschenden Stellung durch günstigere On-Net-Tarife in der Mobilfunksprachtelefonie durch T-Mobile und Vodafone, online at: [http://www.bundeskartellamt.de/wDeutsch/download/pdf/Missbrauchsaufsicht/Kurzberichte/Fallbericht\\_B07-170-07-endg.pdf](http://www.bundeskartellamt.de/wDeutsch/download/pdf/Missbrauchsaufsicht/Kurzberichte/Fallbericht_B07-170-07-endg.pdf).
- [6] Cabral, L. (2009) Dynamic price competition with network effects. IESE Business School working paper no. WP-843, University of Navarra.
- [7] Calzada, J., & Valletti, T. (2008). Network competition and entry deterrence. *Economic Journal*, 112, 1223-1244.
- [8] Cambini, C., & Valletti, T. (2003). Network competition with price discrimination: "Bill and keep" is not so bad after all. *Economics Letters*, 81, 205-213.
- [9] Cambini, C., & Valletti, T. (2008). Information exchange and competition in communications networks. *Journal of Industrial Economics*, 56, 707-728.
- [10] Commerce Commission (2010). Final report on whether the mobile termination access services (incorporating mobile-to-mobile voice termination, fixed-to-mobile voice termination and short-message-service termination) should become designated or specified services, online at: <http://www.comcom.govt.nz//IndustryRegulation/Telecommunications/Investigations/MobiletoMobileTermination/ContentFiles/Documents/>

MTAS%20Final%20Report%20-%20PUBLIC%20Version%20-22%20Feb%202010.pdf.

- [11] Corrocher, N., & Zirulia, L. (2009). Me and you and everyone we know: An empirical analysis on consumers' choices and local network externalities in mobile communications. *Telecommunications Policy*, 33, 68-79.
- [12] DellaVigna, S., & Malmendier, U. (2006). Overestimating self-control: Evidence from the health club industry. *American Economic Review*, 96, 694-719.
- [13] Dewenter, R., Haucap, J., & Kruse, J. (2004). *Wettbewerb im Mobilfunk in Österreich*. Law and Economics of International Telecommunications Vol. 52. Baden-Baden: Nomos-Verlag.
- [14] Elliott, D. (2004). Two-way access charges and on-net/off-net differentials. Working paper online at: [http://www.frontier-economics.com/\\_library/publications/frontier%20paper%20-%20differentials%2015-10-04.pdf](http://www.frontier-economics.com/_library/publications/frontier%20paper%20-%20differentials%2015-10-04.pdf).
- [15] ERG (2008). ERG report on the consultation for the ERG common position on symmetry of fixed call termination rates and symmetry of mobile call termination rates (ERG (07) 83b final 080312). Brussels: European Regulators Group.
- [16] Frontier Economics (2004). On-net/off-net differentials. Working paper online at: [http://www.frontier-economics.com/\\_library/publications/frontier%20paper%20-%20on-%20and%20off-net%20differentials%20-%20mar04.pdf](http://www.frontier-economics.com/_library/publications/frontier%20paper%20-%20on-%20and%20off-net%20differentials%20-%20mar04.pdf)
- [17] Gabrielsen, T., & Vagstad, S. (2008). Why is on-net traffic cheaper than off-net traffic? Access markup as a collusive device? *European Economic Review*, 52, 99-115.
- [18] Harbord, D., & Pagnozzi, M. (2008). On-net/off-net price discrimination and "bill-and-keep" vs. "cost-based" regulation of mobile termination rates. Working paper, online at: [http://www.market-analysis.co.uk/PDF/Topical/harbord\\_pagnozzi\\_b&k\\_22jan2008.pdf](http://www.market-analysis.co.uk/PDF/Topical/harbord_pagnozzi_b&k_22jan2008.pdf).

- [19] Hausman, J.A., & Sidak, J.G. (2004). Why do the poor and the less-educated pay more for long-distance calls? *Contributions to Economic Analysis & Policy*, 3 (1), Article 3, online at: <http://www.bepress.com/bejeap/contributions/vol3/iss1/art3>.
- [20] Hoernig, S. (2007). On-net and off-net pricing on asymmetric telecommunications networks. *Information Economics and Policy*, 19, 171-188.
- [21] Hoernig, S. (2008). Tariff-mediated network externalities: Is regulatory intervention any good? CEPR Working Paper No. 6866.
- [22] Jeon, D., Laffont, J.-J., & Tirole, J. (2004). On the receiver pays principle. *RAND Journal of Economics*, 35, 85-110.
- [23] Kim, H.-S., & Kwon, N. (2003). The advantage of network size in acquiring new subscribers: A conditional logit analysis of the Korean mobile telephony market. *Information Economics and Policy*, 15, 17-33.
- [24] Kling, J. P., & van der Ploeg, S. (1990). Estimating local elasticities with a model of stochastic class of service and usage choice. In A. de Fontenay, M. Shugard, & D. Sibley (Eds.), *Telecommunications demand modelling: An integrated view* (pp. 119-136). Amsterdam et al.: Elsevier.
- [25] KPN (2007). Complaint by Royal KPN N.V. against T-Mobile Deutschland GmbH and Vodafone D2 GmbH to the European Commission pursuant to Council Regulation EC No. 1/2003, 16 July 2007.
- [26] Kreye, C. (2005). *Preisverarbeitung durch Privatkunden im deutschen Mobilfunkmarkt*. Hamburg: Kovac.
- [27] Kridel, D.J., Lehman, D.E., & Weisman, D.L. (1993). Option value, telecommunications demand, and policy. *Information Economics and Policy*, 5, 125-144.
- [28] Lambrecht, A., & Skiera, B. (2006). Paying too much and being happy about it: Existence, causes, and consequences of tariff-choice biases. *Journal of Marketing Research*, 43, 212-223.
- [29] Lopez, A., & P. Rey (2009) Foreclosing competition through access charges and price discrimination. IDEI working paper no. 570.

- [30] Mitchell, B. M., & Vogelsang, I. (1991). *Telecommunications pricing: Theory and practice*. Cambridge: Cambridge University Press.
- [31] Miravete, E. (2002). Estimating demand for local telephone service with asymmetric information and optional calling plans. *Review of Economic Studies*, 69, 943-971.
- [32] Miravete, E. (2003). Choosing the wrong calling plan? Ignorance and learning. *American Economic Review*, 93, 297-310.
- [33] Mitomo, H., Otsuka, T., & Nakaba, K. (2009). A behavioral economic interpretation of the preference for flat rates: The case of post-paid mobile phone services. In: B. Preissl, J. Haucap, & P. Curwen (Eds.), *Telecommunication markets: Drivers and impediments* (pp. 59-73). Heidelberg et al.: Physica.
- [34] Narayanan, S., Chintagunta, P.K., & Miravete, E. (2007). The role of self selection, usage uncertainty and learning in the demand for local telephone service. *Quantitative Marketing and Economics*, 5, 1-34.
- [35] Pullar-Strecker, T. (2010). 2degrees attacks 6 cent calling. *BusinessDay.co.nz*, 19 April 2010, online at: <http://www.stuff.co.nz/business/industries/telecoms-it-media/3594874/2degrees-attacks-6-cent-calling>.
- [36] Stigler, G. (1961). The economics of information. *Journal of Political Economy*, 69, 213-225.
- [37] Taylor, L. (1994). *Telecommunications demand in theory and practice*. Dordrecht: Kluwer Academic Publishers.
- [38] Train, K.E., McFadden, D.L., & Ben-Akiva, M. (1987). The demand for local telephone service: A fully discrete model of residential calling patterns and service choices. *Rand Journal of Economics*, 18, 109-123.
- [39] Trilogy International Partners (2009). Mobile termination investigation, 27 July 2009. Online at: <http://www.comcom.govt.nz/assets/Imported-from-old-site/industryregulation/Telecommunications/Investigations/MobiletoMobileTermination/ContentFiles/Documents/Trilogy-International-Partners-submission-27-July-2009.pdf>

- [40] White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica*, *48*, 817-838.
- [41] Wooldridge, J. (2001). *Econometrics of cross section and panel data*. Cambridge, MA: MIT Press.

## 6 Appendix

Table A1: Definition of Variables

Variable	Definition
Monthly bill	Participants reported their average monthly mobile phone bill.
Age	Age of participants.
Male	Dummy variable taking the value 1 for male and 0 for female.
Fixed line access	Dummy variable taking the value 1 if participants have fixed line access in their homes and 0 if not.
Knowledge on-net/off-net prices	Dummy variable taking the value 1 if participants know on-net and off-net prices of their providers.
Call length off-net versus on-net	Dummy variable taking the value 1 if participants know different length of their on-net and off-net calls.
Switches	Number of times students switched to another network operator in reality.
Search length	Time participants needed to find a new network operator before switching on a 1 to 6 scale (no search time, 1 day, 1 week, 2 weeks, 1 month, more than 1 month).
"Do not look at the monthly bill."	Dummy variable taking the value 1 if participants usually do not look at their monthly bills.
Importance subscription charge	Participants reported the importance of the subscription charge in choosing their actual mobile tariff on a 0 to 10 scale (from 0: not relevant to 10: extremely important).
Importance on-net price	Participants reported the importance of the on-net price in choosing their actual mobile tariff on a 0 to 10 scale (from 0: not relevant to 10: extremely important).
Importance off-net price	Participants reported the importance of the off-net price in choosing their actual mobile tariff on a 0 to 10 scale (from 0: not relevant to 10: extremely important).
Share on-net/off-net calls	Participants reported the importance of their share of on-net versus off-net calls in choosing their actual mobile tariff on a 0 to 10 scale (from 0: not relevant to 10: extremely important).
Importance SMS price	Participants reported the importance of the SMS price in choosing their actual mobile tariff on a 0 to 10 scale (from 0: not relevant to 10: extremely important).
Importance free SMS	Participants reported the importance of free SMS in choosing their actual mobile tariff on a 0 to 10 scale (from 0: not relevant to 10: extremely important).
Importance free minutes	Participants reported the importance of free minutes in choosing their actual mobile tariff on a 0 to 10 scale (from 0: not relevant to 10: extremely important).
Importance access charge	Participants reported the importance of access charges in choosing their actual mobile tariff on a 0 to 10 scale (from 0: not relevant to 10: extremely important).
T-Mobile	Dummy variable taking the value one if participant has a T-Mobile contract and 0 else.
Vodafone	Dummy variable taking the value one if participant has a Vodafone contract and 0 else.
E-Plus	Dummy variable taking the value one if participant has a E-Plus contract and 0 else.
Base	Dummy variable taking the value one if participant has a Base contract and 0 else.
O2	Dummy variable taking the value one if participant has a O2 contract and 0 else.
Costperminute	Average cost per minute students virtually had to pay as a result of their tariff choice in our survey.

## PREVIOUS DISCUSSION PAPERS

- 16 Haucap, Justus and Heimeshoff, Ulrich, Consumer Behavior towards On-net/Off-net Price Differentiation, January 2011.
- 15 Duso, Tomaso, Gugler, Klaus, Yurtoglu, Burcin B., How Effective is European Merger Control? January 2011.
- 14 Haigner, Stefan D., Jenewein, Stefan, Müller, Hans Christian and Wakolbinger, Florian, The First shall be Last: Serial Position Effects in the Case Contestants evaluate Each Other, December 2010.
- 13 Suleymanova, Irina and Wey, Christian, On the Role of Consumer Expectations in Markets with Network Effects, November 2010 (first version July 2010).
- 12 Haucap, Justus, Heimeshoff, Ulrich and Karacuka, Mehmet, Competition in the Turkish Mobile Telecommunications Market: Price Elasticities and Network Substitution, November 2010.
- 11 Dewenter, Ralf, Haucap, Justus and Wenzel, Tobias, Semi-Collusion in Media Markets, November 2010.
- 10 Dewenter, Ralf and Kruse, Jörn, Calling Party Pays or Receiving Party Pays? The Diffusion of Mobile Telephony with Endogenous Regulation, October 2010.
- 09 Hauck, Achim and Neyer, Ulrike, The Euro Area Interbank Market and the Liquidity Management of the Eurosystem in the Financial Crisis, September 2010.
- 08 Haucap, Justus, Heimeshoff, Ulrich and Luis Manuel Schultz, Legal and Illegal Cartels in Germany between 1958 and 2004, September 2010.
- 07 Herr, Annika, Quality and Welfare in a Mixed Duopoly with Regulated Prices: The Case of a Public and a Private Hospital, September 2010.
- 06 Blanco, Mariana, Engelmann, Dirk and Normann, Hans-Theo, A Within-Subject Analysis of Other-Regarding Preferences, September 2010.
- 05 Normann, Hans-Theo, Vertical Mergers, Foreclosure and Raising Rivals' Costs – Experimental Evidence, September 2010.
- 04 Gu, Yiquan and Wenzel, Tobias, Transparency, Price-Dependent Demand and Product Variety, September 2010.
- 03 Wenzel, Tobias, Deregulation of Shopping Hours: The Impact on Independent Retailers and Chain Stores, September 2010.
- 02 Stühmeier, Torben and Wenzel, Tobias, Getting Beer During Commercials: Adverse Effects of Ad-Avoidance, September 2010.
- 01 Inderst, Roman and Wey, Christian, Countervailing Power and Dynamic Efficiency, September 2010.



**Heinrich-Heine-University of Düsseldorf**

**Düsseldorf Institute for  
Competition Economics (DICE)**

Universitätsstraße 1\_ 40225 Düsseldorf  
[www.dice.uni-duesseldorf.de](http://www.dice.uni-duesseldorf.de)