Paying too much and being happy about it: existence, causes and consequences of tariff-choice biases

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ABSTRACT

A common assumption underlying the analysis of consumers' choice between optional tariffs is that consumers choose the tariff that maximizes consumer surplus and, thus, the tariff that leads for a given amount of usage to the lowest billing rate. Yet, there is evidence that many users prefer a flat rate even though their billing rate would be lower on a pay-per-use tariff (flat-rate bias) and some users prefer a pay-per-use tariff even though they would save money on a flat rate (pay-per-use bias). The authors conduct four empirical analyses based on three different data sets. They show that the flat-rate bias is more important and has a greater regularity and time-persis-tence than the pay-per-use bias. They classify potential causes of the flat-rate bias as "insurance effect," "taxi meter effect," "convenience effect," and "overestimation effect" and show that the insurance, the taxi meter and the overestimation effect lead to a flat-rate bias. They provide evidence that underestimation of usage is a major ca use of the pay-per-use bias. They show that the flat-rate bias does not significantly increase customer churn and thus results in a short- and long-term profit increase. In contrast, the pay-per-use bias largely increases churn so that the additional short-term profit is in the long-term offset by higher churn.

Keywords: Nonlinear Pricing, Flat-Rate Bias, Pay-per-Use Bias, Consumer Behavior, Internet

INTRODUCTION

By increasingly adopting technologies such as the Internet and smart cards, many companies can now easily monitor consumers' usage volumes. This allows them to offer sophisticated nonlinear pncmg schemes, ranging from pure pay-per-use tariffs to flat rates. Consumers, for example, can choose between optional tariffs for getting access to the Internet, online services, loca l, long distance and wireless telephone, cable, libraries, and even amusement parks or health clubs. Nonlinear pricing schedules have received great attention in the literature, in particular from researchers considering welfare theoretical problems (for a review see Sundararajan 2004). Their fundamental assumption is that consumers have no tariff-specific preference and maximize their consumer surplus. Consumers choose, at least on average over time, the tariff that leads for a given amount of usage to the lowest billing rate. However, studies on telephone service (e.g. Kling and van der Ploeg 1990; Kridel, Lehman, and Weisman 1993; Train, McFadden, and Ben-Akiva 1987) and health club tariff choice (DellaVigna and Malmendier 2005; Nunes 2000) show that consumers that would save money by paying per use often prefer a flat rate to a pay-per-use tariff. This preference has been dubbed the "flat-rate bias" (Train 1991). Fewer studies observe a "pay-per-use bias",

i.e., a preference for a pay-per-use tariff even though a flat rate would be cheaper (Kridel, Lehman, and Weisman 1993; Miravete 2002a). The existence of both flat-rate and pay-per-use bias contradicts the assumption that consumers choose for a given amount of usage the tariff that leads to the lowest billing rate.

Evidence of existence, causes, and consequences of tariff-choice biases is scarce. There are only few insights on the share of consumers with flat-rate and pay-per-use biases, the magnitude of these biases as well as on the regularity and time-persistence of tariff-choice biases. In addition, the effects of potential causes of tariff-choice biases have not been explored comprehensively. Likewise, little research addresses the impact of tariff-choice biases on tariff switching and churn as well as on customer profitability and customer lifetime value.

Consequently, the objective of this paper is to analyze the existence, causes and consequences of tariff-choice biases. We review current evidence of tariff-choice biases and potential causes of the flat-rate bias. We empirically demonstrate the existence of tariff-choice biases based on transactional and on survey data in the context of Internet access. Furthermore, we use transactional data to evaluate bias regularity and time-persistence. We use multi-item scales to simultaneously measure the impact of the four potential causes on flat-rate and pay-per-use bias in two surveys. In the second survey, we combine survey and transactional data to validate the results of the first survey and measure real-world behavior. Finally, we analyze the consequences of tariff-choice biases on tariff switching and churn as well as on customer profitability and customer lifetime value.

The remainder of the article is organized as follows. First, we review previous work on existence, causes and consequences of tariff-choice biases. Next, we report the results of four empirical analyses. Analysis 1 provides evidence of the existence of tariff-choice biases. Analysis 2 focuses on causes of the flat-rate bias. Analysis 3 validates causes of the flat-rate bias and explores causes of the pay-per-use bias. Analysis 4 examines consequences of tariff-choice biases. We conclude by summarizing our results, proposing implications, and discussing the limitations of our work.

RESEARCH SETTING

In this section we provide the theoretical background for the empirical analysis of tariff-choice biases. We review previous work on the existence of tariff-choice biases and present potential causes of flat-rate and pay-per-use bias. Last, we comment on previous work related to the consequences of tariff-choice biases.

Existence of tariff-choice biases

Train et al. (1987) are among the first to report evidence of the flat-rate bias based on the analysis of households' choices among telephone service options. The authors find a tariff-specific constant in a logit model that shows a preference for a flat rate vs. a pay-per-use tariff. Other researchers (Hobson and Spady 1988; Train, Ben-Akiva, and Atherton 1989; Kling and van der Ploeg 1990; Mitchell and Vogelsang 1991) also find a tendency of consumers to choose a flat rate that is not explained by actual usage. In addition to a flat-rate bias, Kridel, Lehman, and Weisman (1993) and Miravete (2002a) also observe the pay-per-use bias, i.e. consumers that choose a pay-per-use tariff even though they would have paid less under a flat rate. Kridel, Lehman, and Weisman (1993) find that nearly 65% of customers that have selected flat rates would save money had they purchased local measured service. Only 10% of customers that selected local measured service would benefit from switching to the flat rate. The authors report an average magnitude of the flat-rate bias of $9.49. Studies of other products or services, such as grocery delivery or food during a cruise,

confirm the flat-rate bias but rely on survey data (Nunes 2000; Prelec and Loewenstein 1998). In contrast to those results, Miravete (2002a) reports that only 12% of customers wrongly choose the flat rate but 67% wrongly choose measured service. He finds that flat-rate and pay-per-use bias often fall below $4.

Even though researchers use different methods to measure a flat-rate bias, most find a tendency of consumers to choose a flat rate or a tariff with a higher fixed fee and allowance that is not explained by usage volume. Yet, current studies do not analyze in detail: (i) the relative importance of flat-rate and pay-per-use biases, (ii) the time persistence and regularity of tariff-choice biases, and (iii) the additional expenditures consumers incur due to tariff-choice biases.

Causes of tariff-choice biases

Much behavioral research focuses on how consumption is affected, e.g., by sunk cost (Arkes and Blumer 1985; Thaler 1980; Thaler 1985), prior payment mechanisms (Soman 2001), bundling (Soman and Gourville 2001), timing of payment (Gourville and Soman 1998) or purchasing (Wertenbroch 1998). Little research has been conducted on what affects the choice of a tariff apart from expected consumption. In addition to behavioral work by Nunes (2000) and Prelec and Loewenstein (1998) economists working on telephone service usage examine causes of tariff-choice biases (Kling and van der Ploeg 1990; Kridel, Lehman, and Weisman 1993; Train, Ben-Akiva, and Atherton 1989). To allow for a more comprehensive analysis we classify motivational and cognitive explanations into four distinct causes: the "insurance effect", the "taxi meter effect", the "convenience effect", and the "overestimation effect".

Insurance effect: Consumers may choose a flat rate in order to avoid variation in their monthly billing rate. Risk-averse consumers who cannot predict their future demand exactly can choose a flat rate to insure against the risk of high costs in periods of higher than average usage (Train 1991; Miravete 2002b; Winer 2005). In addition, loss aversion could affect tariff choice if the negative value attributed to losses relative to the price of the flat rate is higher than the positive value attributed to a gain of the same amount (Kahneman and Tversky 1979; Tversky and Kahneman 1991). Kridel, Lehman, and Weisman (1993) argue that there is an option value of the flat rate, which is not related to the actual use of the service. When estimating penetration of extended area service, Kridel, Lehman, and Weisman (1993) find an option value of $9.49. Train et al. (1989) claim that their results of the analysis of telephone service show evidence of the insurance effect. However, Nunes (2000) does not find a correlation between tariff choice and each respondent's level of risk aversion measured by a risk aversion coefficient.

Taxi meter effect: A taxi meter effect can be observed if consumers enjoy their usage more on a flat rate than on a pay-per-use tariff. For example, the ticking of the taxi meter reduces the pleasure of a taxi ride. Mental accounting assumes that consumers dispose over mental accounts and budgets (Heath and Soll 1996; Shefrin and Thaler 1992; Thaler 1985). They attribute the disutility of payment for a good directly to the utility derived from its consumption (Prelec and Loewenstein 1998; Soman 2001). Paying per use lessens the joy from consumption, as the cost and thus the pain of paying are attributed to the consumption at the time of usage. In contrast, paying a flat fee decouples consumption from payment as the costs are mentally prepaid, e.g. at the beginning of each month. Thus, usage which has been paid for beforehand can be enjoyed as if it were free (Prelec and Loewenstein 1998; Thaler 1999). Prelec and Loewenstein (1998) ask people whether a person would enjoy himself more when paying a fixed fee or being charged for actual use and find that for most people the

pleasure would be greater with a flat rate than with a pay-per-use tariff.

Convenience effect: Consumers might feel choosing between optional tariffs is inconvenient and try to avoid the effort of identifying alternative tariffs and calculating the respective expected billing rate (Winer 2005). In order to minimize information cost they might choose the tariff that seems to be the "default tariff", i. e., the tariff they are accustomed to choosing (Train 1991). If this tariff is a flat rate, a flat-rate bias can result from the convenience of not having to search for the least costly tariff. When calculating consumer surplus for flat rate and usage-based pricing, Kling and van der Ploeg (1990) capture a bias towards flat rates in a parameter that measures habit inertia to switch tariffs. They also find that households that have not explicitly examined the cost difference under different tariffs are more likely to choose the flat rate.

Overestimation effect: Consumers may overestimate their demand for a good, e.g., due to producer advertising (Mitchell and Vogelsang 1991). Nunes (2000) suggests that consumers overestimate the likelihood of using more than the breakeven volume of two optional tariffs. He compares the subjective likelihood of using more than the breakeven volume with the subjective likelihood of using less than the breakeven volume. This ratio is calculated as the difference of the highest expected usage and the break-even usage divided by the difference of the break-even usage and the lowest expected usage. The subjective likelihood of using more than the breakeven volume increases with the ratio. Thus, consumers that perceive maximum and minimum usage as particularly high are more likely to choose a flat rate. Nunes (2000) also provides empirical evidence of the overestimation effect.

Conclusion: Even though some research has empirically examined causes of tariff-choice biases, results do not provide a comprehensive picture. Each study focuses on different causes and neither measures empirically the impact of all causes at a time. Thus, comparing results from different studies is difficult. Studies using transactional data only allow limited conclusions on consumers' attitudes so that some of the results might also be due to other effects than the stated ones. In addition, studies on the overestimation effect do not measure whether and how much consumers overestimate their usage in real life.

Pay-per-use bias: Research on causes of the pay-per-use bias is limited because the pay-per-use bias has hardly been observed. Train (1991) suggests that a risk-averse consumer who does not know her future income might prefer a pay-per-use tariff even if this is on average more costly than a flat rate. Empirical results have not been provided.

Consequences of tariff-choice biases

Little research addresses the consequences of tariff-choice biases, in particular tariff switching and churn and the impact on customer profitability and customer lifetime value. Miravete (2002a) reports that customers whose behavior entails either flat-rate or pay-per-use biases also have a tendency to switch to the cheapest tariff, even in response to small differences in cost. However, due to the quasi-experimental setting, consumers were particularly aware of choosing the least costly tariff. For health clubs DellaVigna and Malmendier (2005) find that customers with a flat-rate bias delay contract cancellation, but the authors do not provide results on tariff-switching. The overall effect of tariff-choice biases on tariff-switching, churn, customer profitability and customer lifetime value has not been examined. In the short term, customer profitability increases. However, if customers churn as a consequence of paying too much, higher short-term customer profitability could be offset in the long run by lower customer lifetime value.

Objectives of the empirical studies

Despite first results on existence, causes, and consequences of tariff-choice biases, more detailed knowledge of tariff-choice biases is required to derive insights on consumer behavior and practical implications. Therefore, the objectives of our empirical studies are to:

(i) Examine whether tariff-choice biases exist, whether they occur in a regular and time-persistent manner, and by how much consumers overpay,

(ii) Test whether taxi meter, insurance, convenience, and overestimation effects simultaneously lead to a flat-rate bias and obtain first indications on causes of the pay-per-use bias,

(iii) Examine whether tariff-choice biases result in higher tariff switching and churn and how this affects customer lifetime value.

We focus on consumers choosing tariffs for getting access to the Internet. The results are based on three data sets: (i) transactional data of a representative sample of 10,882 customers of a European Internet service provider for a sample period of up to 5 months, (ii) a first survey on tariff choices and causes of tariff-choice biases conducted with a convenience sample of 241 MBA students, (iii) a second survey of 1,078 customers of the Internet service provider that provided the transactional data. The responses for 941 customers are matched to their transactions. This allows us to measure tariff-choice biases and the overestimation effect by real-world data. It should provide additional support for the validity of the results and, in addition, avoid common method variance. Common method variance, i.e., the overstatement of the relationship between dependent and independent variables may result when both variables are measured with the same method (Mazursky and Geva 1989; Kline, Sulsky, and Rever-Moriyama 2000).

RESULTS ON THE EXISTENCE OF TARIFF-CHOICE BIASES

Data and method

We first examine the existence of the flat-rate and the pay-per-use bias with transactional data of 10,882 customers of an Internet service provider and then validate the results in a tariff choice experiment.

Transactional data: Customers of the Internet service provider had the choice between three different tariffs for DSL Internet access: (i) Tariff 1 has a fixed fee and a monthly allowance, with a usage price charged per megabyte (MB) transferred for any usage exceeding the allowance. (ii) Tariff 2 has a higher fixed fee and a higher allowance than tariff 1 but the same usage price for usage exceeding the allowance. (iii) Tariff 3 is a flat rate with unlimited usage. Whereas in the United States the flat rate is by far the most common pricing scheme for Internet access, optional tariffs including a usage price or different allowances are common for pricing Internet access in many European countries. All customers can monitor their usage on the provider's Web site.

In this dataset we consider a flat-rate bias to occur if a consumer regularly chooses a tariff with a higher fixed fee and allowance even though she would save money on a tariff with a lower fixed fee and allowance. We observe a pay-per-use bias if a consumer regularly chooses a tariff with a lower fixed fee and allowance, even though she would save money on a tariff with a higher fixed fee and allowance. We use two criteria to empirically determine whether a consumer regularly chooses a suboptimal tariff: (i) The consumer chooses a tariff that does not minimize her billing rate in sum over all billing periods analyzed ("overall wrong"). (ii) The consumer chooses a tariff that does not minimize her billing rate in every single billing period ("always wrong"). Consequently, criterion 2 is more stringent than criterion 1.

Survey data 1: Subjects are asked to imagine that they have an average monthly Internet usage of 30 hours. We vary minimum and maximum usage (minimum: 0 and 20 hours, maximum: 40 and 60 hours) and ask subjects to choose between a flat rate and a pay-per-use tariff in four different situations. This set-up is adapted from Nunes (2000). We divide subjects into two subgroups. For group 1 the flat rate is priced at 30 Euro and the pay-per-use tariff at 1 Euro per hour. Thus, for an average usage of 30 hours the billing rate under both tariffs is equal. If consumers do not have a preference for a flat rate, half of them should choose the flat rate and the other half the pay-per-use tariff. For group 2 the flat rate is priced at 34 Euros, which exceeds the average cost of the pay-per-use tariff. Now, all consumers should choose the pay-per-use tariff unless they have a preference for the flat rate.

Results

Transactional data: The results in Table 1 confirm the existence of the flat-rate bias and to a lesser extent the existence of a pay-per-use bias. The vertical axis lists the chosen tariffs, while the horizontal axis lists the optimal tariff in terms of lowest billing rate. The diagonal thus represents customers who have chosen a tariff that minimizes their billing rate. Consumers in the lower left-hand corner have a flat-rate bias and consumers in the upper right-hand corner have a pay-per-use bias. E.g., according to criterion 1 based on three consecutive months of usage, 48.1% of consumers on tariff 2 have a flat-rate bias and 8.5% have a pay-per-use bias. The share of consumers with a flat-rate bias decreases under criterion 2, but the decline in consumers with a pay-per-use bias is even stronger. This indicates that the flat-rate bias occurs regularly, i.e., each month, whereas the pay-per-use bias occurs only irregularly. The analysis over 5 months shows that according to criterion 1, up to 46.6% of consumers have a flat-rate bias and only up to 5.8% of consumers have a pay-per-use bias. The effect is even stronger for criterion 2 where up to 29.3% of consumers have a flat-rate bias but less than 1% a pay-per-use bias. Criterion 2 thus confirms the regularity of the flat-rate bias and the irregularity of the pay-per-use bias. In addition, the analysis of 5 months indicates that the flat-rate bias is time-persistent whereas the pay-per-use bias seldom persists over a longer time period.

Next, we analyze the magnitude of flat-rate and pay-per-use biases as a percentage of the billing rate for the least costly tariff. We find that more than half of the consumers with a flat-rate bias pay at least 100% more than they would have paid on the least costly tariff. More than half of the consumers with pay-per-use bias pay at least 20% more than on the least costly tariff. This confirms that most consumers do not just deviate slightly from the least costly tariff.

Survey data 1: If there were no tariff-choice biases, we would expect 50% of consumers in group 1 to choose the flat rate. We find that in one setting (minimum usage: 0, maximum usage: 40) 82% of consumers choose a pay-per-use tariff, which indicates a pay-per-use bias. In all other situations more than half of consumers (54%, 71% and 95%) choose a flat rate indicating a flat-rate bias. In group 2, for which the flat rate is more expensive than the pay-per-use tariff, 18%-89% of respondents choose the flat rate and thus have a flat-rate bias. This confirms the previous result that the flat-rate bias occurs more frequently than the pay-per-use bias.

RESULTS ON THE CAUSES OF THE FLAT-RATE BIAS FROM SURVEY DATA

In this section, we aim to test whether taxi meter, insurance, convenience, and overestimation effects simultaneously lead to a flat-rate bias.

Data and method

Taxi meter, insurance and convenience effect: We use multi-item scales to measure the

Table 1: Existence of tariff-choice biases, transactional data

Criterion 1: "Overall wrong"

3 Months		Best Tariff		
		Tariff 1	Tariff 2	Flat Rate
Chosen Tariff	Tariff 1	93.7%	5.3%	1.0%
	Tariff 2	48.1%	43.4%	8.5%
	Flat Rate	19.8%	8.4%	71.8%

N = 10,882

5 Months		Best Tariff		
		Tariff 1	Tariff 2	Flat Rate
Chosen Tariff	Tariff 1	94.7%	4.7%	0.8%
	Tariff 2	46.4%	47.8%	5.8%
	Flat Rate	14.3%	12.0%	73.7%

N = 7,559

Criterion 2: "Always wrong"

3 Months		Best Tariff		
		Tariff 1	Tariff 2	Flat Rate
Chosen Tariff	Tariff 1	98.7%	1.2%	0.1%
	Tariff 2	37.6%	61.1%	1.3%
	Flat Rate	17.6%	7.8%	74.8%

N = 10,882

5 Months		Best Tariff		
		Tariff 1	Tariff 2	Flat Rate
Chosen Tariff	Tariff 1	99.6%	0.4%	0.0%
	Tariff 2	29.3%	70.4%	0.3%
	Flat Rate	10.5%	10.5%	79.0%

N = 7,559

constructs for the taxi meter, insurance and overestimation effect and in total retain 10 items (see appendix). In a survey of 241 MBA students, we measure attitudes with regard to tariff choice.

Overestimation: As previously explained, consumers in survey 1 choose between a flat rate and a pay-per-use tariff in four different tariff-choice situations with different minimum and maximum amounts of usage (minimum: 0 and 20 hours, maximum: 40 and 60 hours). We assess whether for a constant average usage different amounts of perceived minimum and maximum usage impact tariff choice. Overestimation of usage leads to the flat-rate bias if the likelihood of choosing a flat rate increases with minimum or maximum usage. In addition, we assess whether a higher value of the ratio (maximum usage-breakeven usage) / (minimum usage-breakeven usage) increases the likelihood of choosing a flat rate as proposed by Nunes (2000).

Tariff choice: We analyze whether the constructs for taxi meter, insurance, convenience and overestimation effect explain tariff choice in addition to the price of the tariff.

Results

We use a binomial logit model to estimate the effect of potential causes of the flat-rate bias. Taxi meter effect, insurance effect, convenience effect, minimum and maximum usage and price of the flat rate are the independent variables. The dependent variable is binary with the categories "choice of flat rate " and "choice of pay-per-use tariff". The share of correct classification of 74.6% exceeds the maximum-chance criterion (MCC) and the proportional-chance criterion (PCC) (see Table 2). Price has a negative effect on choice of the flat rate. Taxi meter and insurance effect both have a positive impact on choice of the flat rate. Also, higher amounts of minimum and maximum usage and thus the overestimation effect increase the probability of choosing a flat rate. The parameter of the convenience effect is not significant. Given our setting, this is not surprising. In contrast to the U.S. where the

flat rate is common for telecommunications services, such as local phone calls or Internet access, Europe does not have a long history of flat rates. Therefore, consumers who feel it is more convenient to choose a "default tariff" might choose either the flat rate or the pay-per-use tariff. Furthermore, we test the stability of our model by eliminating non-significant variables and by splitting our data set according to tariff-choice situations. Table 2 shows that these variations do not have a major impact on the results.

We estimate a similar model with the ratio (maximum usage-breakeven usage) / (breakeven usage-minimum usage) instead of minimum and maximum usage (Nunes 2000) but find that the corresponding result is slightly worse than the previous result (Log Likelihood decreases from 479.224 to -493.129). This indicates that overestimation is best measured with minimum and maximum usage and not with the ratio.

RESULTS ON THE CAUSES OF FLAT-RATE AND PAY-PER-USE BIAS IN REAL-WORLD CHOICES

The objective of our third analysis is to confirm the validity of our previous results by using measures that are partly based on real-world behavior. We match transactional and survey data of customers of the Internet service provider and measure the impact of potential causes on real-world tariff-choice biases. In addition, we measure whether consumers in fact overestimate their usage.

Table 2: Analysis of causes of flat-rate bias, survey data 1

	Model 1	Model 2	Model 3	Model 4
Dependent variable: Choice of flat rate			Tariff choice situations with minimum usage equal to …	
	All tariff-choice situations		0	20
Intercept	-4.435 (1.364) ***	-4.367 (1.357) ***	-8.409 (1.891) ***	2.602 (2.036)
Price flat rate	-0.106 (0.040) ***	-0.105 (0.040) ***	0.031 (0.053)	-0.285 (0.063) ***
Taxi meter	0.332 (0.101) ***	0.328 (0.101) ***	0.405 (0.139) ***	0.265 (0.150) *
Insurance	0.297 (0.104) ***	0.310 (0.101) ***	0.288 (0.136) **	0.330 (0.161) **
Convenience	0.050 (0.097) ***		-0.056 (0.131)	0.186 (0.149)
Usage estimation				
– Minimum	0.109 (0.009) ***	0.109 (0.009) ***		
– Maximum	0.102 (0.009) ***	0.102 (0.009) ***	0.096 (0.009) ***	0.116 (0.015) ***
Log Likelihood	-479.224	-479.357	-263013	-207.369
Nagelkerke R_	41.9%	41.9%	27.8%	32.3%
Correct Classification	74.6%	74.8%	73.9%	79.0%
MMC				
PCC	56.5%	56.5%	62.8%	75.9%
	50.9%	50.9%	53. 2%	63.4%
	N=241·4	N=241·4	N=241·2	N=241·2

*** Significant at 0.01, ** Significant at 0.05, * Significant at 0.1
Standard deviations are reported berween parentheses

Descriptives of scales (mean and standard deviation)

Taxi meter	3.262 (0.963)
Insurance	2.722 (0.975)
Convenience	2.738 (0.858)

Data and method

Subjects and data: About 12,000 customers of the Internet service provider were asked via e-mail to participate in an online survey. Customers could win one of five gift certificates for an online shop. Twenty days after the first notification, the Internet service provider sent a reminder, resulting in 1,078 completed responses. For 941 customers we can match usage data to survey data. We compare customers participating in our survey to customers not participating. Average usage does not differ significantly between the two groups. Participating customers are only 0.9 years younger than customers that did not respond (significant at $p<0.01$). Thus we conclude that a non-response bias does not affect our results.

Taxi meter, insurance and convenience effect: We measure taxi meter, insurance and convenience effect via the developed multi-item scales (see appendix).

Overestimation of usage: To measure real-world overestimation we combine transactional and survey data. Respondents classify their estimated average, minimum and maximum usage into one of nine categories: "0-1,000 MB," "1,000-2,000 MB," "2,000-3,000 MB," "3,000-4,000 MB," "4,000-5,000 MB," "5,000-6,000 MB," "6,000-7,000 MB," "7,000-8,000 MB" and "more than 8,000 MB." Next, respondents' actual average, minimum and maximum usage is calculated over 3 months. Results are classified into the nine categories. The difference between estimated and actual usage indicates goodness of estimation, a positive value indicates overestimation, a negative value underestimation of usage. For 513 of the 941 respondents we also calculate goodness of estimation based on 5 months of usage. The high correlation between both measures (average usage 0.940, maximum usage 0.924, minimum usage 0.923) confirms its validity.

Tariff-choice biases: We assess the existence of tariff-choice biases in transactional data based on criterion 1 ("overall wrong") and a period of 3 months. We create a categorical variable with the categories "flat-rate bias," "pay-per-use bias," "no bias," and use a multinomial logit model to measure the impact of the insurance, taxi meter, convenience and overestimation effect on the existence of biases. We also assess the existence of the flat-rate bias based on criterion 2 ("always wrong"). The number of customers with pay-per-use bias according to criterion 2 is too small to perform the analysis. In addition, we measure the impact of taxi meter, insurance, convenience and overestimation effect on the magnitude of flat-rate and pay-per-use bias in tobit models.

Results

We calculate the difference between real and estimated usage to assess the quality of customers' usage estimation. Results suggest that consumers are particularly bad at estimating their maximum usage which they often overestimate (20% of consumers in tariff 1, 37% of consumers in tariff 2, 31% of consumers in the flat rate). Table 3 shows that the joint multinomial logit model for flat-rate and pay-per-use bias is significant and has a share of correct classification of 81.9% that exceeds the proportional chance criterion (PCC) and the maximum chance criterion (MCC). The significance of the coefficients indicates that taxi meter effect, insurance effect and overestimation of maximum usage explain the real-world flat-rate bias. Again we find that the convenience effect is not significant. The pay-per-use bias is explained by an underestimation of average and maximum usage. To analyze the stability of the results, we omit the non-significant variables from the analysis and conduct separate analyses of the flat-rate and the pay-per-use bias. The binomial logit models 2 to 5 confirm the results for the flat-rate and the pay-per-use bias. Models 6 and 7 assess the flat-rate bias based on criterion 2 and again confirm the results.

Table 3: Causes of flat rate- and pay-per-use bias in real-world tariff choice, 3 months

Model	1: Multinomial logit	2: Binomial logit	3: Binomial logit	4: Binomial logit	5: Binomial logit	6: Binomial logit	7: Binomial logit
Values of dependent variable:	"Flat-rate bias". "pay-per-use", "no bias"	"Flat-rate bias". "no bias"	"pay-per-use", "no bias"	"pay-per-use", "no bias"	"pay-per-use", "no bias"	"Flat-rate bias". "no bias"	"Flat-rate bias". "no bias"
Criterion:	1. "Overall wrong"	1. "Overall wrong"	1. "Overall wrong"	1. "Overall wrong"	1. "Overall wrong"	2. "Always wrong"	2. "Always wrong"
Flat-rate bias							
Intercept	-4.721 (0.553) ***	-4.586 (0.529) ***				-5.477 (0.643) ***	-5.179 (0.610) ***
Taxi meter	0.242 (0.145) *	0.248 (0.144) *				0.306 (0.165) *	0.310 (0.163) *
Insurance	0.358 (0.131) ***	0.379 (0.129) ***				0.303 (0.147) **	0.336 (0.144) **
Convenience	0.098 (0.130)					0.185 (0.143)	
Usage estimation							
– Average							
– Minimum	0.116 (0.125)					0.095 (0.136)	
– Maximum	-0.125 (0.115)					-0.154 (0.125)	
Pay-per-use bias	0.299 (0.069) ***	0.319 (0.062) ***				0.403 (0.074) ***	0.401 (0.055) ***
Intercept	-3.680 (0.612) ***		-2.360 (0.140) ***	-2.296 (0.612) ***	-2.436 (0.137) ***		
Taxi meter	0.270 (0.168)						
Insurance	0.121 (0.155)						
Convenience	0.013 (0.167)						
Usage estimation							
– Average	0.360 (0.162) **				-0.773 (0.100) ***		
– Minimum	-0.143 (0.125)			-0.334 (0.085) ***			
– Maximum	0.578 (0.115) ***		-0.757 (0.087) ***				
Log Likelihood	-476 156	-268.000	-210.638	-256.926	-223.709	-224.055	-225.682
Nageikerke R^2	27.3%	15.5%	25.6%	3.9%	19.8%	20.6%	19.8%
Correct Classification	81.9%	87.9%	91.4%	90.0%	90.5%	90.8%	90.6%
	N=94	N=941 less subjects with flat-rate bias	N=941 less subjects with flat-rate bias	N=941 less subjects with flat-rate bias	N=941 less subjects with flat-rate bias	N=941 less subjects with pay-per-use bias	N=941 less subjects with pay-per-use bias

*** Significant at 0.01, ** Significant at 0.05 * Significant at 0.1

Descriptives of scales (mean and standard deviation)			Standard deviations reported between parentheses				
Taxi meter	3.548 (0.991)	Insurance	2.805 (1.032)	Convenience	1.968 (0.836)		

Table 4: Causes of magnitude of flat-rate and pay-per-use bias in real-world tariff choice, 3 months

Tobit-Model	Model 1	Model 2	Model 3	Model 4
Dependent variable: Criterion:	Magnitude of flat-rate bias 1: "Overall wrong"	Magnitude of flat-rate bias 1: "Overall wrong"	Magnitude of flat-rate bias 2: "Always wrong"	Magnitude of flat-rate bias 2: "Always wrong"
Intercept	-108.942 (14.697) ***	-106.067 (14.255) ***	-145.906 (21.102) ***	-140.166 (20 .274) ***
Taxi meter	5.948 (3.032) **	6 155 (3.032) **	8.778 (4.041) **	8.999 (4.028) **
Insurance	6.991 (2.811) **	7.564 (2.781) ***	6.632 (3.580) *	7.481 (3.545) **
Convenience	2.656 (2.834)		4.517 (3.608)	
Usage estimation				
– Average				
– Minimum				
– Maximum	2.864 (2.818)		2.957 (3.557)	
Log Likelihood	-2.491 (2.526)		-3.509 (3.179)	
Pseudo-R^2	7 308 (1.667) ***	8.077 (1.292) ***	10.967 (2.206) ***	11.496 (1.768) ***
	-645.149	-646.221	-534.814	-536.275
	6.2%	6,0%	8.5%	8.2%
N=941 less subjects with pay-per-use bias				
Tobit-Model	Model 5	Model 6	Model 7	Model 8
Dependent variable: Criterion:	Magnitude of pay-per-use bias 1: "Overall wrong"	Magnitude of pay-per-use bias 1: "Overall wrong"	Magnitude of pay-per-use bias 1: "Overall wrong"	Magnitude of pay-per-use bias 1: "Overall wrong"
Intercept	-90.630 (15.282) ***	-63.418 (6.936) ***	-74.966 (8.410) ***	-64.621 (7.230) ***
Taxi meter	4.818 (3.596)			
Insurance	3.234 (3.310)			
Convenience	1.935 (3.507)			
Usage estimation				
– Average				
– Minimum	-13.148 (3.191) ***	-18.284 (2 177) ***		
– Maximum	5.161 (2.537) **		-10.004 (2.529) ***	
Log Likelihood	-8.436 (2.321) ***			-16.328 (2.053) ***
Pseudo-R^2	-541.989	-556.666	-596.996	-554 .949
	10.5%	8.1%	1,4%	8.4%
N=941 less subjects with flat-rate bias			Standard deviations reported between parentheses	
*** Significant at 0.01, ** Significant at 0.05 * Significant at 0.1				

The results of tobit models to explain the magnitude of flat-rate and pay-per-use bias in Table 4 confirm previous results. They indicate that taxi meter and insurance effect as well as the overestimation of maximum usage have a positive impact on the magnitude of the flat-rate bias. The magnitude of the pay-per-use bias is explained by the usage estimation. All three measures of usage estimation are correlated and the opposite signs of their parameters indicate multicollinearity (Model 5). However, the separate analyses in models 6 to 8 lead to negative parameter values and indicate that an underestimation of usage is responsible for the magnitude of the pay-per-use bias.

Discussion

Measuring the overestimation effect via two different methods reveals two interesting results. First, the results based on survey 1 confirm that for a given average amount of usage, higher estimated minimum and maximum usage leads to a flat-rate bias. Second, comparison of real and estimated usage indicates that consumers do have imprecise usage estimations, particularly with regard to their maximum usage, which they often overestimate.

Both studies show that consumers have different motivations in addition to price for choosing flat rates. Consumers enjoy their usage more when consumption is decoupled from payment and cost does not increase with additional usage (taxi meter effect). Also, consumers like to avoid variation in the amount of their monthly billing rate. They choose the flat rate to insure against the risk of bill variation (insurance effect). In addition, consumers tend to commit a cognitive error because they overestimate and underestimate their maximum usage. Overestimation leads to a flat-rate bias (overestimation effect), underestimation to a pay-per-use bias. The convenience effect does not lead to a flat-rate bias. However, this result may be influenced by the fact that flat rates are not the dominant tariffs to price Internet access in Europe.

RESULTS ON THE CONSEQUENCES OF TARIFF-CHOICE BIASES

Last, we examine consequences of tariff-choice biases on tariff switching and churn. In addition, we investigate if higher billing rates and, thus, a short-term increase in customer profitability may in the long run be offset by higher customer churn and lower customer lifetime value.

Data and method

Consequences on tariff switching and churn: We use the transactional data of the Internet service provider to calculate tariff-switching and churn probabilities for each of the nine combinations of chosen tariff and best tariff. For each tariff we examine whether tariff switching and churn probabilities of consumers with flat-rate or pay-per-use bias are significantly different from tariff switching and churn probabilities of consumers without tariff-choice biases. To identify factors that impact tariff switching and churn in more detail, we estimate a nested logit model. On the first level, consumers decide to keep or change the current tariff. On the second level, consumers that decided to stay, can either switch to another tariff of the same provider or churn.

Consequences on profit: We calculate profits based on the actual billing rate of consumers and the billing rate they would incur had they chosen the least costly tariff, assuming usage would stay the same. The long-term consequences of higher churn rates on customer lifetime value are measured with a customer migration model (Dwyer 1997). We assume that consumers with tariff-choice biases can choose between keeping the tariff, switching to the least costly tariff or churning, and use the observed switching and churn rates as the probabilities to move from one state to another. We discount future profits by 10% and compare the customer lifetime value for customers with tariff-choice biases to their customer lifetime value in case they had chosen the least costly tariff from the beginning. To analyze the sensitivity of the results, we also apply discount rates of 8%, 12%, and 14%.

Results on tariff switching and churn

In Table 5 we analyze the differences in tariff switching and churn probabilities between consumers with and without tariff-choice biases. For a given tariff the tariff-switching probability of consumers for whom this is the least costly tariff serves as a reference point. We compare the tariff-switching probability of consumers under the same tariff with a flat-rate or a pay-per-use bias to that reference point. According to criterion 1, the tariff-switching probability of consumers in tariff 1 that would pay least in tariff 2 (and thus have a pay-per-use bias) exceeds the tariff-switching probability of consumers for whom tariff 1 is least costly by 220%. The tariff-switching probability of consumers that would pay least in the flat rate (and thus again have a pay-per-use bias) is 240% higher than that of consumers in tariff 1 that do not have a tariff-choice bias. These differences are significant.

Table 5: Tariff switching and churn rates

Tariff switching and churn probabilities compared to least costly tariff

			Criterion 1: "Overall wrong"					Criterion 1: "Always wrong"				
			Best Tariff			Significance		Best Tariff			Significance	
			Tariff 1	Tariff 2	Flat R.	FRB	PPUB	Tariff 1	Tariff 2	Flat R.	FRB	PPUB
Tariff switching	Chosen Tariff	Tariff 1		+220%	+240%		***		+233%	+180%		***
		Tariff 2	+150%		+250%	-	-	+67%		+100%	-	-
		Flat R.	0%'	1%'		-		0%	1.1%'		*	
			Best Tariff			Significance		Best Tariff			Significance	
			Tariff 1	Tariff 2	Flat R.	FRB	PPUB	Tariff 1	Tariff 2	Flat R.	FRB	PPUB
Churn	Chosen Tariff	Tariff 1		+340%	+1040%		***		+650%	+833%		***
		Tariff 2	-25%		+538%	-	-	-50%		+492%	**	***
		Flat R.	+63%	-25%		-		+67%	-100%		-	

*** Difference is significant at 0.01 ** Difference is significant 0.05 N=10,882

* Difference is significant 0.1 - Not significant at 0.1

'Tariff switching rates of ftat-rate customers for whom ftat rate is least costly tariff are zero, therefore actual tariff-switching rates are listed

Table 6: Models for tariff switching and customer churn

Nested Logit Model Criterion	1: "Always wrong"	2: "Overall wrong"
Level 1	Choices: Keep – Change	
Intercept	-3.034 (0.105) ***	-2.936 (0.112) ***
Existence FRB	0.153 (0.320)	-0.208 (0.467)
Existence PPUB	1.532 (0.128) ***	2.038 (0.287) ***
Magnitude FRB	-0.002 (0.011)	0.004 (0.014)
Magnitude PPUB	0.001 (0.000) *	-0.002 (0.003)
Inclusive value	0.018 (0.122)	0.078 (0.125)
Level 2	Choices: Switch - Churn	
Intercept	2.949 (1.227) ***	2700 (1.243) **
Existence FRB	-1.075 (0.564) **	-1.299 (0.570) **
Existence PPUB	0.543 (0.211) ***	0.826 (0.374) **
Tariff 1	-2.965 (1.228) ***	-2.656 (1.246) **
Tariff 2	-1.615 (1.163) *	-1.242 (1.197)
Log Likelihood	-2,673.211	-2,726.113
Wald-Test	0.000	0.000

*** Significant at 0.01, ** Significant at 0.05, * Significant at 0.1
Standard deviations are reported between parentheses

The overall results for tariff switching with regard to criteria 1 and 2 show that in tariff 1 consumers with pay-per-use bias have a significantly higher probability to switch tariffs than consumers who have chosen the least costly tariff. In tariff 2 the differences in tariff switching probability are not significant. Flat-rate users with a flat-rate bias have a significantly higher tariff-switching probability only according to criterion 2. Thus, both biases lead to a higher tariff-switching probability but this is more likely for consumers with a pay-per-use bias than for consumers with a flat-rate bias.

Similarly, we analyze the probability of consumers to churn. The probability to churn of consumers for whom a certain tariff is the least costly tariff serves as a reference point. We compare the churning probabilities of consumers with tariff-choice biases to that reference point. Results for churn point to a different direction than results for tariff switching: Consumers with flat-rate bias do not have a significantly higher probability to churn. In contrast, monthly churn rates of consumers with pay-per-use bias are 340% - 1040% higher than monthly churn rates of consumers that have chosen the least costly tariff. Therefore, the pay-per-use bias but not the flat-rate bias seems to lead to higher churn.

Table 6 summarizes the results of the nested logit model according to criteria 1 and 2. We find that the existence and the magnitude of the pay-per-use bias but not the flat-rate bias impact the decision to change the current tariff. When deciding whether to switch or to churn, consumers with flat-rate bias rather switch to another tariff of the same provider whereas consumers with pay-per-use bias are more likely to churn. The results are consistent with results obtained when comparing switching and churn probabilities.

Results on company's profit

The flat-rate bias leads to a short-term increase of customer profitability of between 141% (criterion 1) and 182% (criterion 2) and the pay-per-use bias to an increase of between 157% (criterion 1) and 283% (criterion 2). The total impact of tariff-choice biases on the profit from all customers is in the range of 16% (criterion 1) to 30% (criterion 2). The migration model shows an increase in customer lifetime value of customers with flat-rate bias of between 87% (criterion 1) and 135% (criterion 2). Thus, the customer lifetime value of customers with flat-rate bias is substantially higher than the customer lifetime value of customers that have chosen the least costly tariff. In contrast, profits from the pay-per-use bias are in the long term fully compensated by higher churn and switching rates for customers with pay-per-use biases. The impact of the pay-per-use bias on customer lifetime value is -8% (criterion 1) to 2% (criterion 2). Analyzing the sensitivity of the results to a variation of the discount rate from 8%-14% shows that the flat-rate bias increases customer lifetime value by 82% to 98% (criterion 1), or respectively 130% to 145% (criterion 2). In contrast, the impact of the pay-per-use bias is around zero, ranging from -13% to 5% for criterion 1 and -8% to 14% for criterion 2. In total over all customers, both tariff-choice biases together result in an increase of customer lifetime value of 4% (criterion 1) to 7% (criterion 2).

SUMMARY, IMPLICATIONS AND CONCLUSIONS

Our results confirm that for Internet access many consumers choose a flat rate or a tariff with a high allowance even though this is not the least costly tariff. A lower number of consumers choose a pay-per-use tariff even though a flat rate would be cheaper. We show that insurance, taxi meter, and overestimation effects, but not the convenience effect are causes of the flat-rate bias. In addition, consumers overestimate their usage. We also find that consumers with a flat-rate bias are

not more likely to churn. We conclude that taxi meter and insurance effects indicate that consumers derive additional benefits from a flat rate that they would not derive from the choice of an alternative tariff. These benefits seem to make consumers happy with their tariff choice, and consequently some consumers pay a flat-rate specific premium.

In contrast, we find that underestimation of usage leads to the pay-per-use bias. We have no indication of tariff-specific benefits of pay-per-use tariffs. Consumers with pay-per-use bias have a higher likelihood to switch tariffs and a much higher likelihood to churn. Therefore, we conclude that they are unhappy with their tariff choice: Once they become aware of their mistake in tariff choice, they are ready to switch to another tariff or churn.

Overall, the results indicate that consumers choose their tariff not only based on the expected billing rate. Rather, consumers prefer flat rates because of tariff-specific characteristics. We belief that these results are true for many other products and services, such as cell phone or fixed-line phone services, access to wireless local area networks, or car rental. For goods where consumers would like to pre-commit to a certain amount of usage, e.g., to exercise twice a week in a health club, pre-commitment might also affect tariff choice (DellaVigna and Malmendier 2005; Nunes 2000; Wertenbroch 1998). Pre-commitment is likely to occur when consumers need to make a considerable short-term investment, e.g., in terms of physical effort, and receive long-term benefits, e.g., in terms of better health. Hence, instead of minimizing their billing rate for a given usage, consumers intend to force themselves to adhere to a certain usage behavior. This might result in an even stronger flat-rate bias. Likewise, pre-commitment to a low consumption, e.g. of cigarettes, might lead to an even stronger pay-per-use bias (Wertenbroch 1998). Whereas pre-commitment to consumption might occur for goods such as health clubs or e-learning, it is unlikely to be important in many other situations such as getting access to the Internet or using cell phones.

The results allow us to derive recommendations for pricing. Companies should carefully consider pricing decisions that may impact flat-rate customers, such as ceasing to offer a flat-rate tariff, or offering the customer the option to be billed for usage according to the least costly tariff. When billing according to the least costly tariff, profits from the flat-rate bias would vanish, whereas virtually no extra profit would be realized from avoiding the pay-per-use bias. Knowing the causes of the flat-rate bias enables managers to affect consumers' tariff-specific willingness-to-pay. They could emphasize the specific value of a flat rate, e.g., the joy and independence in using a flat rate (taxi meter effect) or the reliability of the billing rate (insurance effect). In addition, they could attempt to increase consumers' perceived maximum usage by accenting the different ways a customer could use a product (overestimation effect) (Nunes 2000).

In addition to the negative financial effects of the pay-per-use bias, companies may have to take into account negative reputation effects. High churn rates indicate that customers with a pay-per-use bias are dissatisfied with their tariff choice. They may attribute the wrong tariff choice to the company instead of to their own cognitive mistake. Therefore, companies should encourage new customers to use a flat rate and propose to existing customers with pay-per-use bias to switch them to a tariff with a higher fixed fee.

There are limitations to our work. We have investigated causes of the flat-rate bias that have previously been proposed in literature. We do not, however, conduct an exploratory analysis to identify other potential causes and cannot rule out that other effects might also lead to a flat-rate bias. Our results on causes of the pay-per-use bias are limited to the

underestimation effect. Future research could analyze which other effects lead to a pay-per-use bias. In addition, we might underestimate the share of consumers with tariff-choice biases given that we only observe a tariff-choice bias if a consumer has chosen a tariff that does not minimize her billing rate. A consumer might have a preference for a specific tariff. But if her usage is far below the break-even quantity of the next available tariff, this preference might not be strong enough for her to actually choose the next available tariff.

Future research might look at the effect of the introduction or withdrawal of tariffs from a menu of optional tariffs. On the one hand, larger intervals between fixed fees and allowances in a menu of tariffs entail a smaller number of consumers who do not choose the least costly tariff. On the other hand, smaller intervals between fixed fees and allowances mean that consumers' monetary loss due to tariff-choice biases decreases. Yet, we did not measure consumers' tariff-specific willingness-to-pay and thus cannot predict the overall effect of the introduction or withdrawal of tariffs.

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Acknowledgement: Reprinted with permission from the *Journal of Marketing Research* published by the American Marketing Association, Lambrecht & Skiera, May 2006 Volume XLIII and 212-223.

Appendix

Multi-item scales of taxi meter, insurance and convenience effect:

Taxi meter effect

- The flat rate is great because I don't have to worry about the costs.
- It isn't as fun to surf the Internet when I have to think about the costs increasing every minute.
- It's only when I have a flat rate that I can really enjoy surfing the Internet.
- When I'm paying a flat rate, I feel much freer and more relaxed about using the Internet than with a variable rate.

Insurance effect

- For the security of knowing that my Internet access costs will never go above the amount agreed upon, I'm willing to pay a little more than average.
- Even if a flat rate is somewhat more expensive for me than a usage-driven rate, I'm happy because my costs won't exceed the fixed amount.

Convenience effect

- It takes so long to figure out which rate is better that the effort normally isn't worth it.

- It's too much trouble to find out the prices for Internet access.
- The money you can save by picking a better rate than the one you have now doesn't make up for the time and effort involved.
- It takes so long to switch to a cheaper rate that the effort isn't worth it.

Scale development process:

We generate 84 items based on literature review and own judgment. Five professors and Ph.D. students in marketing and behavioral economics conduct a first selection of items. In a pretest, items are purified based on exploratory factor analysis and Cronbach's Alpha. 49 items remain and are further purified in the survey of 241 MBA students (survey 1) through exploratory and confirmatory factor analyses.

In both surveys, goodness of fit measures show good model fit. Discriminant validity is confirmed by the χ^2-test and the Fornell-Larcker criterion. A simultaneous factor analyses confirms that the factorial structure is identical for both groups.