ANJA LAMBRECHT and BERND SKIERA*

A common assumption underlying the analysis of consumers' choices among optional tariffs is that consumers choose the tariff that maximizes their surplus and, thus, the tariff that leads to the lowest billing rate for a given amount of usage. Yet there is evidence that many users prefer a flat rate even though their billing rate would be lower with a pay-per-use tariff (flat-rate bias), and some users prefer a pay-per-use tariff even though they would save money with 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 persistence 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 effects lead to a flat-rate bias. They provide evidence that underestimation of usage is a major cause 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 in the long run, the additional short-term profit is offset by higher churn.

Paying Too Much and Being Happy About It: Existence, Causes, and Consequences of Tariff-Choice Biases

By increasingly adopting technologies such as the Internet and smart cards, many companies can now easily monitor consumers' usage volumes. This enables these companies to offer sophisticated nonlinear pricing schemes, ranging from pure pay-per-use tariffs to flat rates. For example, consumers can choose among optional tariffs for obtaining access to the Internet and various online services; for local, long-distance, and wireless telephone; for cable television; for libraries; and even for amusement parks and health clubs. Nonlinear pricing schedules have received much attention in the literature, particularly from researchers who consider welfare theoretical problems (for a review, see Sundararajan 2004). Their fundamental assumption is that consumers have no tariff-specific preference and attempt to maximize their consumer surplus. That is, on average and over time, consumers choose the tariff that leads to the lowest billing rate for a given amount of usage. 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 2006; Nunes 2000) show that consumers who would save money with a pay-per-use tariff often prefer a flat rate. This preference has been dubbed the "flat-rate bias" (Train 1991). Fewer studies observe a "pay-per-use bias"—that is, 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 the tariff that leads to the lowest billing rate for a given amount of usage.

Evidence of existence, causes, and consequences of tariff-choice biases is scarce. There are few insights into consumers with flat-rate and pay-per-use biases, the magni-

*Anja Lambrecht is a visiting assistant professor, Anderson School of Management, University of California, Los Angeles (e-mail: al@anjalambrecht.com). Bernd Skiera is a professor, School of Business and Economics, Johann Wolfgang Goethe University Frankfurt am Main (e-mail: skiera@skiera.de). The authors are grateful to former editor Dick Wittink and to the two anonymous *JMR* reviewers for their detailed comments. The authors also gratefully acknowledge many helpful comments from Katja Seim; Koen Pauwels; Peter Leeflang; Jan-Stefan Lambrecht; Sonja Gensler; Agnieszka Prokopowicz; Martin Spann; and seminar participants at Dartmouth College, University of California, Davis, University of California, Los Angeles, Stanford University, Tilburg University, and the Vienna University of Economics and Business Administration.

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tude of these biases, and the regularity and time persistence of these biases. In addition, the effects of potential causes of tariff-choice biases have not been explored comprehensively, and little research has addressed the impact of tariff-choice biases on tariff switching and churn and on customer profitability and customer lifetime value.

Consequently, the objective of this article 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 using transactional and survey data in the context of Internet access. Furthermore, we use transactional data to evaluate bias regularity and time persistence. In two surveys, we use multi-item scales to measure simultaneously the impact of the four potential causes on flat-rate and pay-per-use bias. 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 and on customer profitability and customer lifetime value.

We organize the remainder of the article as follows: We begin with a review of previous work on the existence, causes, and consequences of tariff-choice biases. Next, we report the results of four empirical analyses. The first analysis provides evidence of the existence of tariff-choice biases. The second analysis focuses on causes of the flat-rate bias. The third analysis validates causes of the flat-rate bias and explores causes of the pay-per-use bias. The fourth analysis 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, McFadden, and Ben-Akiva (1987) are among the first to report evidence of the flat-rate bias; their study analyzes 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 versus a pay-per-use tariff. Other researchers (Hobson and Spady 1988; Kling and Van der Ploeg 1990; Mitchell and Vogelsang 1991; Train, Ben-Akiva, and Atherton 1989) 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) observe the pay-per-use bias. Kridel, Lehman, and Weisman (1993) find that approximately 65% of customers who selected flat rates would have saved money if they had purchased local measured service. Only 10% of customers who selected local measured service would benefit from switching to the flat rate. Kridel, Lehman, and Weisman 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 these studies rely on survey data (Nunes 2000; Prelec and Loewenstein 1998). In contrast to these 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.

Although researchers use different methods to measure a flat-rate bias, most find that consumers tend to choose a flat rate or a tariff with a higher fixed fee and an allowance that is not explained by usage volume. Yet current studies do not analyze in detail (1) the relative importance of flat-rate and pay-per-use biases, (2) the time persistence and regularity of tariff-choice biases, and (3) the additional expenditures that consumers incur due to tariff-choice biases.

Causes of Tariff-Choice Biases

Much behavioral research focuses on how consumption is affected, for example, by sunk costs (Arkes and Blumer 1985; Thaler 1980, 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 Nunes's (2000) and Prelec and Loewenstein's (1998) behavioral work, some economists working on telephone service usage also 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 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 greater-than-average usage (Miravete 2002b; Train 1991; 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 find an option value of $9.49. Train, Ben-Akiva, and Atherton (1989) claim that the results of their telephone service analysis 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, as 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 set up and work with 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 because consumers attribute the cost and, thus, the pain of paying to consumption at the time of usage. In contrast, paying a flat fee decouples consumption from payment because 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) asked people whether they would enjoy themselves more if they paid a fixed fee or if they were charged for actual use, and they 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 believe that choosing among optional tariffs is inconvenient and therefore might try to avoid the effort of identifying alternative tariffs and calculating the respective expected billing rate (Winer 2005). 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 needing 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 toward 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., as a result of 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. He calculates this ratio as the difference between the highest expected usage and the breakeven usage divided by the difference between the breakeven usage and the lowest expected usage. The subjective likelihood of using more than the breakeven volume increases with the ratio. Thus, consumers who perceive maximum and minimum usage as particularly high are more likely to choose a flat rate. Nunes also provides empirical evidence of the overestimation effect.

Conclusion. Although some research has empirically examined causes of tariff-choice biases, the results do not provide a comprehensive picture. Each study focuses on different causes, and none measures empirically the impact of all causes at one time. Thus, a comparison of results from different studies is difficult. Studies that use transactional data allow only for limited conclusions about consumers' attitudes; thus, some of the results might also be due to effects other than those stated. 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 his or her future income might prefer a pay-per-use tariff, even if it is more costly on average than a flat rate. However, 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, because of the quasi-experimental setting, consumers were particularly aware of choosing the least costly tariff. In the context of health clubs, DellaVigna and Malmendier (2006) 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 run, 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 various results regarding the existence, causes, and consequences of tariff-choice biases, more-detailed knowledge of tariff-choice biases is required to derive insights into consumer behavior and practical implications. Therefore, the objectives of our empirical studies are as follows:

- We examine whether tariff-choice biases exist, whether they occur in a regular and time-persistent manner, and how much consumers overpay.
- We test whether insurance, taxi meter, convenience, and overestimation effects simultaneously lead to a flat-rate bias, and we obtain indications on causes of the pay-per-use bias.
- We examine whether tariff-choice biases result in higher tariff switching and churn and how this affects customer lifetime value.

We focus on consumers who choose tariffs to obtain access to the Internet. The results are based on three data sets: (1) transactional data of a representative sample of 10,882 customers of a European Internet service provider for a sample period of up to five months, (2) a first survey on tariff choices and causes of tariff-choice biases conducted with a convenience sample of 241 MBA students, and (3) a second survey of 1078 customers of the Internet service provider that provided the transactional data. We match the responses for 941 customers to their transactions. This enables us to measure tariff-choice biases and the overestimation effect with real-world data. It should provide additional support for the validity of the results, while avoiding common method variance (i.e., the overstatement of the relationship between dependent and independent variables that can result when both variables are measured with the same method; Kline, Sulsky, and Rever-Moriyama 2000; Mazursky and Geva 1989).

RESULTS OF THE EXISTENCE OF TARIFF-CHOICE BIASES

Data and Method

In the first analysis, we 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. Then, we validate the results in a tariff-choice experiment.

Transactional data. The Internet service provider's customers chose among three different tariffs for digital subscriber line Internet access: (1) Tariff 1 has a fixed fee and a monthly allowance, and there is a usage price charged per megabyte (MB) transferred for any usage exceeding the allowance; (2) Tariff 2 has a higher fixed fee and a higher allowance than Tariff 1, but it has the same usage price for

usage exceeding the allowance; and (3) 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 data set, we considered a flat-rate bias to have occurred if a consumer regularly chose a tariff with a higher fixed fee and allowance even though he or she would have saved money on a tariff with a lower fixed fee and allowance. We considered a pay-per-use bias to have occurred if a consumer regularly chose a tariff with a lower fixed fee and allowance even though he or she would have saved money on a tariff with a higher fixed fee and allowance. We used two criteria to determine empirically whether a consumer regularly chose a suboptimal tariff: (1) The consumer chose a tariff that did not minimize his or her billing rate in sum over all billing periods analyzed ("overall wrong"), and (2) the consumer chose a tariff that did not minimize his or her billing rate in every single billing period ("always wrong"). Consequently, Criterion 2 is more stringent than Criterion 1.

Data from Survey 1. In Survey 1, we asked 241 MBA students to imagine that they had an average monthly Internet usage of 30 hours. We varied minimum and maximum usage to create four choice situations (minimum: 0 hours and 20 hours; maximum: 40 hours and 60 hours), and we asked participants to choose between a flat rate and a pay-per-use tariff in all four different situations. We adapted this setup from the work of Nunes (2000). We divided participants into two subgroups. For Group 1, the flat rate was priced at €30, and the pay-per-use tariff was priced at €1 per hour. Thus, for an average usage of 30 hours, the billing rate under both tariffs was equal. If consumers did not have a preference for a flat rate, half of them should choose the flat rate, and the other half should choose the pay-per-use tariff. For Group 2, the flat rate was priced at €34, which exceeded the average cost of the pay-per-use tariff. In this case, all consumers should choose the pay-per-use tariff, unless they had 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 columns list the chosen tariffs, and the rows list the optimal tariff in terms of lowest billing rate. Thus, in each quadrant, the diagonal represents customers who chose a tariff that minimized their billing rate. Consumers in the lower-left-hand corner of each quadrant have a flat-rate bias, and consumers in the upper-right-hand corner of each quadrant have a pay-per-use bias. For example, 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 for most consumers, the flat-rate bias occurs regularly (i.e., each month), whereas the pay-per-use bias occurs only irregularly. The analysis over five months shows that according to Criterion 1, up to 46.4% 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; up to 29.3% of consumers have a flat-rate bias, but less than 1% have a pay-per-use bias. Thus, Criterion 2 confirms the regularity of the flat-rate bias and the irregularity of the pay-per-use bias. In addition, the analysis of five 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 paid 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 paid at least 20% more than they would have paid on the least costly tariff. This confirms that most consumers do not just deviate slightly from the least costly tariff.

Data from Survey 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 chose 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%) chose 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 chose the flat rate, indicating a flat-rate bias. This confirms the previous result that the flat-rate bias occurs more frequently than the pay-per-use bias.

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

The following section presents our second analysis. Here, we aim to test whether insurance, taxi meter, convenience,

Table 1
EXISTENCE OF TARIFF-CHOICE BIASES: TRANSACTIONAL DATA

		Criterion 1: Overall Wrong			*Criterion 2: Always Wrong*		
		Best Tariff			*Best Tariff*		
	Chosen Tariff	*Tariff 1 (%)*	*Tariff 2 (%)*	*Flat Rate (%)*	*Tariff 1 (%)*	*Tariff 2 (%)*	*Flat Rate (%)*
Three months (N = 10,882)	Tariff 1	**93.7**	5.3	1.0	**98.7**	1.2	.1
	Tariff 2	48.1	**43.4**	8.5	37.6	**61.1**	1.3
	Flat rate	19.8	8.4	**71.8**	17.5	7.8	**74.7**
Five months (N = 7559)	Tariff 1	**94.5**	4.7	.8	**99.6**	.4	.0
	Tariff 2	46.4	**47.8**	5.8	29.3	**70.4**	.3
	Flat rate	14.3	12.0	**73.7**	10.5	10.5	**79.0**

Notes: Bolded numbers represent customers who chose a tariff that minimized their billing rate.

and overestimation effects simultaneously lead to a flat-rate bias.

Data and Method

Insurance, taxi meter, and convenience effects. We used multi-item scales to measure the constructs for the insurance, taxi meter, and convenience effects; we retained ten items (see the Appendix). In a survey (Survey 1) of 241 MBA students, we measured attitudes with regard to tariff choice.

Overestimation. As we previously explained, consumers in Survey 1 chose 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 assessed whether different amounts of perceived minimum and maximum usage affect tariff choice for a constant average usage. 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 assessed whether a higher value of the ratio (maximum usage – breakeven usage)/(minimum usage – breakeven usage) increases the likelihood of choosing a flat rate (Nunes 2000).

Tariff choice. We also analyzed whether the constructs for insurance, taxi meter, convenience, and overestimation effects explain tariff choice in addition to the price of the tariff.

Results

We used 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 effects both have a positive impact on choice of the flat rate. In addition, greater 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 United States, where the flat rate is common for telecommunications services, such as local telephone calls or Internet access, Europe does not have a long history of flat rates. Therefore, consumers who believe that it is more convenient to choose a "default tariff" might choose either the flat rate or the pay-per-use tariff. Furthermore, we tested the stability of our model by eliminating nonsignificant 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 estimated a similar model with the ratio (maximum usage – breakeven usage)/(breakeven usage – minimum usage) instead of minimum and maximum usage (Nunes 2000), but the corresponding result is slightly worse than the previous result (the 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 OF 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

Table 2
ANALYSIS OF CAUSES OF FLAT-RATE BIAS, SURVEY DATA 1 (DEPENDENT VARIABLE: CHOICE OF FLAT RATE)

			Tariff Choice Situations with Minimum Usage Equal to …	
	All Tariff-Choice Situations		*0*	*20*
	Model 1	*Model 2*	*Model 3*	*Model 4*
Intercept	–4.435 (1.364)***	–4.367 (1.357)***	–8.409 (1.891)***	2.602 (2.036)
Flat rate	–.106 (.040)***	–.105 (.040)***	.031 (.053)	–.285 (.063)***
Taxi meter	.332 (.101)***	.328 (.101)***	.405 (.139)***	.265 (.150)*
Insurance	.297 (.104)***	.310 (.101)***	.288 (.136)**	.330 (.161)**
Convenience	.050 (.097)		–.056 (.131)	.186 (.149)
Usage Estimation				
Minimum	.109 (.009)***	.109 (.009)***		
Maximum	.102 (.009)***	.102 (.009)***	.096 (.011)***	.116 (.015)***
Log-likelihood	–479.224	–479.357	–263.013	–207.369
Pseudo R^2	41.9%	41.9%	27.8%	32.3%
Correct classification	74.6%	74.8%	73.9%	79.0%
MCC	56.5%	56.5%	62.8%	75.9%
PCC	50.9%	50.9%	53.2%	63.4%
	N = 241 × 4	N = 241 × 4	N = 241 × 2	N = 241 × 2

Descriptives of Scales	*M (SD)*
Taxi meter	3.262 (.963)
Insurance	2.722 (.975)
Convenience	2.738 (.858)

*$p < .1$.
**$p < .05$.
***$p < .01$.
Notes: Standard deviations are in parentheses.

based on real-world behavior. We matched transactional and survey data of the Internet service provider's customers and measured the impact of potential causes on real-world tariff-choice biases. In addition, we measured whether consumers overestimate their usage.

Data and Method

Participants and data. In Survey 2, approximatley 12,000 of the Internet service provider's customers were e-mailed and asked to participate in an online survey. Customers could win one of five gift certificates from an online shop. The Internet service provider sent a reminder 20 days after the first notification, and 1078 completed responses were received. For 941 customers, we matched usage data to survey data. We compared customers who participated in our survey with customers who did not participate. Average usage did not differ significantly between the two groups. Participating customers were only .9 years younger than customers who did not respond (significant at $p < .01$). Thus, we conclude that nonresponse bias does not affect our results.

Taxi meter, insurance, and convenience effects. We measured taxi meter, insurance, and convenience effects using the multi-item scales (see the Appendix).

Overestimation of usage. To measure real-world overestimation, we combined transactional and survey data. Respondents classified their estimated average, minimum, and maximum usage into one of nine categories: 0 MB–1000 MB, 1000 MB–2000 MB, 2000 MB–3000 MB, 3000 MB–4000 MB, 4000 MB–5000 MB, 5000 MB–6000 MB, 6000 MB–7000 MB, 7000 MB–8000 MB, and more than 8000 MB. Next, we calculated respondents' actual average, minimum, and maximum usage over three months. We classified the results into the nine categories. The difference between estimated and actual usage indicates goodness of estimation, a positive value indicates overestimation, and a negative value indicates underestimation of usage. For 513 of the 941 respondents, we also calculated goodness of estimation on the basis of five months of usage. The high correlation between both measures (average usage = .940, maximum usage = .924, minimum usage = .923) confirms its validity.

Tariff-choice biases. We assessed the existence of tariff-choice biases in transactional data on the basis of Criterion 1 (i.e., overall wrong) and a period of three months. We created a categorical variable with the categories flat-rate bias, pay-per-use bias, and no bias, and we used a multinomial logit model to measure the impact of the insurance, taxi meter, convenience, and overestimation effects on the existence of biases. We also assessed the existence of the flat-rate bias on the basis of Criterion 2 (i.e., always wrong). However, the number of customers with pay-per-use bias, according to Criterion 2, was too small to perform the analysis. In addition, we measured the impact of taxi meter, insurance, convenience, and overestimation effects on the magnitude of flat-rate and pay-per-use bias in Tobit models.

Results

We calculated the difference between real and estimated usage to assess the quality of customers' usage estimation. The 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, and 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%. The significance of the coefficients indicates that the taxi meter effect, the insurance effect, and the overestimation of maximum usage explain the real-world flat-rate bias. Again, we find that the convenience effect is not significant. The underestimation of average and maximum usage explains the pay-per-use bias. To analyze the stability of the results, we omitted the nonsignificant variables from the analysis and conducted separate analyses of the flat-rate and the pay-per-use bias. The binomial logit models 2–5 confirm the results for the flat-rate and the pay-per-use bias. Models 6 and 7 assess the flat-rate bias on the basis of Criterion 2 and again confirm the results.

The results of the Tobit models (see Table 4), which we used to explain the magnitude of flat-rate and pay-per-use bias, confirm previous results. They indicate that taxi meter and insurance effects and the overestimation of maximum usage have a positive impact on the magnitude of the flat-rate bias. The usage estimation explains the magnitude of the pay-per-use bias. 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 6–8 lead to negative parameter values and indicate that an underestimation of usage is responsible for the magnitude of the pay-per-use bias.

Discussion

Our measurement of the overestimation effect with 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, a comparison of real and estimated usage indicates that consumers have imprecise usage estimations, particularly with regard to their maximum usage, which they often overestimate.

Both studies show that consumers have different motivations other than price for choosing flat rates. Consumers enjoy their usage more when consumption is decoupled from payment and when cost does not increase with additional usage (taxi meter effect). In addition, consumers want 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), and underestimation leads to a pay-per-use bias. The convenience effect does not lead to a flat-rate bias. However, this result may be influenced by flat rates not being the dominant tariffs to price Internet access in Europe.

RESULTS OF THE CONSEQUENCES OF TARIFF-CHOICE BIASES

In our fourth analysis, we examined consequences of tariff-choice biases on tariff switching and churn. In addition, we investigated whether higher billing rates and, thus, a short-term increase in customer profitability are offset in the long run by higher customer churn and lower customer lifetime value.

Data and Method

Consequences of tariff-choice biases on tariff switching and churn. We used the Internet service provider's transac-

Table 3

CAUSES OF FLAT-RATE AND PAY-PER-USE BIAS IN REAL-WORLD TARIFF CHOICE: THREE MONTHS

	Model 1: Flat-Rate Bias, Pay-Per-Use Bias, No Bias (Criterion 1)[a]	*Model 2: Flat-Rate Bias, No Bias (Criterion 1)*[b]	*Model 3: Pay-Per-Use Bias, No Bias (Criterion 1)*[b]	*Model 4: Pay-Per-Use Bias, No Bias (Criterion 1)*[b]	*Model 5: Pay-Per-Use Bias, No Bias (Criterion 1)*[b]	*Model 6: Flat-Rate Bias, No Bias (Criterion 2)*[b]	*Model 7: Flat-Rate Bias, No Bias (Criterion 2)*[b]
Flat-Rate Bias							
Intercept	–4.721 (.553)***	–4.586 (.529)***				–5.477 (.643)***	–5.179 (.610)***
Taxi meter	.242 (.145)*	.248 (.144)*				.306 (.165)*	.310 (.163)*
Insurance	.358 (.131)***	.379 (.129)***				.303 (.147)**	.336 (.144)**
Convenience	.098 (.130)					.185 (.143)	
Usage Estimation							
Average	.116 (.125)					.095 (.136)	
Minimum	–.125 (.115)					–.154 (.125)	
Maximum	.299 (.069)***	.319 (.052)***				.403 (.074)***	.401 (.055)***
Pay-Per-Use Bias							
Intercept	–3.689 (.612)***		–2.380 (.140)***	–2.298 (.122)***	–2.436 (.137)***		
Taxi meter	.270 (.168)						
Insurance	.121 (.155)						
Convenience	–.013 (.167)						
Usage Estimation							
Average	–.360 (.162)**				–.773 (.100)***		
Minimum	.143 (.125)			–.334 (.085)***			
Maximum	–.578 (.115)***		–.757 (.087)***				
Log-likelihood	–476.156	–268.000	–210.638	–256.926	–223.709	–224.055	–225.682
Pseudo R^2	27.3%	15.5%	25.8%	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 = 941	N = 941 less participants with flat-rate bias	N = 941 less participants with flat-rate bias	N = 941 less participants with flat-rate bias	N = 941 less participants with flat-rate bias	N = 941 less participants with pay-per-use bias	N = 941 less participants with pay-per-use bias
Descriptives of Scales	*M (SD)*						
Taxi meter	3.548 (.991)						
Insurance	2.805 (1.032)						
Convenience	1.968 (.836)						

*$p < .1$.
**$p < .05$.
***$p < .01$.
[a]Multinomial logit.
[b]Binomial logit.
Notes: Standard deviations are in parentheses.

Table 4

CAUSES OF MAGNITUDE OF FLAT-RATE AND PAY-PER-USE BIAS IN REAL-WORLD TARIFF CHOICE: THREE MONTHS

Dependent Variable	*Tobit Model 1: Magnitude of Flat-Rate Bias (Criterion 1)*	*Tobit Model 2: Magnitude of Flat-Rate Bias (Criterion 1)*	*Tobit Model 3: Magnitude of Flat-Rate Bias (Criterion 2)*	*Tobit Model 4: Magnitude of Flat-Rate Bias (Criterion 2)*	*Tobit Model 5: Magnitude of Pay-Per-Use Bias (Criterion 1)*	*Tobit Model 6: Magnitude of Pay-Per-Use Bias (Criterion 1)*	*Tobit Model 7: Magnitude of Pay-Per-Use Bias (Criterion 1)*	*Tobit Model 8: Magnitude of Pay-Per-Use Bias (Criterion 1)*
Intercept	–108.942 (14.697)***	–106.067 (14.255)***	–145.906 (21.102)***	–140.166 (20.274)***	–90.630 (15.282)***	–63.418 (6.936)***	–74.986 (8.410)***	–64.621 (7.230)***
Taxi meter	5.948 (3.032)**	6.155 (3.032)**	8.778 (4.041)**	8.999 (4.028)**	4.818 (3.596)			
Insurance	6.991 (2.811)**	7.564 (2.781)***	6.632 (3.580)*	7.481 (3.545)**	3.234 (3.310)			
Convenience	2.656 (2.834)		4.517 (3.608)		1.935 (3.507)			
Usage Estimation								
Average	2.884 (2.818)		2.957 (3.557)		–13.148 (3.191)	–18.284 (2.177)***		
Minimum	–2.491 (2.526)		–3.509 (3.179)		5.161 (2.537)**		–10.004 (2.529)***	
Maximum	7.308 (1.667)***	8.077 (1.292)***	10.967 (2.206)***	11.496 (1.768)***	–8.436 (2.321)***			–16.328 (2.053)***
Log-likelihood	–645.149	–646.221	–534.814	–536.275	–541.989	–556.686	–596.996	–554.949
Pseudo R^2	6.2%	6.0%	8.5%	8.2%	10.5%	8.1%	1.4%	8.4%

*$p < .1$.
**$p < .05$.
***$p < .01$.
Notes: Standard deviations are in parentheses. N = 941 less participants with pay-per-use bias.

tional data to calculate tariff-switching and churn probabilities for each of the nine combinations of chosen tariff and best tariff. For each tariff, we examined 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 affect tariff switching and churn in more detail, we estimated a nested logit model. On the first level, consumers decided to keep or change the current tariff. On the second level, consumers who decided to stay could either switch to another tariff of the same provider or churn.

Consequences of tariff-choice biases on profit. We calculated profits on the basis of consumers' actual billing rates and the billing rate they would have incurred if they had chosen the least costly tariff, assuming that usage stayed the same. We measured the long-term consequences of higher churn rates on customer lifetime value with a customer migration model (Dwyer 1997). We assumed that consumers with tariff-choice biases could choose among keeping the tariff, switching to the least costly tariff, or churning, and we used the observed switching and churn rates as the probabilities to move from one state to another. We discounted future profits by 10% and compared the customer lifetime value for customers with tariff-choice biases with their customer lifetime value as if they had chosen the least costly tariff from the beginning. To analyze the sensitivity of the results, we also applied discount rates of 8%, 12%, and 14%.

Results of 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 serves as a reference point. We compared the tariff-switching probability of consumers under the same tariff with a flat-rate or a pay-per-use bias with the reference point. According to Criterion 1, the tariff-switching probability of consumers in Tariff 1 who would pay the 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 who would pay the least in the flat rate (and thus have a pay-per-use bias) is 240% higher than that of consumers in Tariff 1 who do not have a tariff-choice bias. These differences are significant.

The overall results for tariff switching with regard to Criteria 1 and 2 show that in Tariff 1, consumers with a pay-per-use bias have a significantly higher probability of switching 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 analyzed the probability of consumers to churn. The probability to churn of consumers for whom a certain tariff is the least costly serves as a reference point. We compared the churning probabilities of consumers with tariff-choice biases with the reference point. The results for churn point in a different direction from the results for tariff switching: Consumers with a flat-rate bias do not have a significantly higher probability to churn. In contrast, monthly churn rates of consumers with a pay-per-use bias are 340%–1040% higher than monthly churn rates of consumers who 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, affect the decision to change the current tariff. When deciding whether to switch or to churn, consumers with a flat-rate bias tended to switch to another tariff of the same provider, whereas consumers with pay-per-use bias were more likely to churn. The results are consistent with those obtained when we compared switching and churn probabilities.

Results of Company's Profit

The flat-rate bias leads to a short-term increase in customer profitability of between 141% (Criterion 1) and

Table 5

TARIFF-SWITCHING AND CHURN PROBABILITIES COMPARED WITH LEAST COSTLY TARIFF

		Criterion 1: Overall Wrong					*Criterion 2: Always Wrong*				
		Best Tariff			*Significance*		*Best Tariff*			*Significance*	
	Chosen Tariff	*Tariff 1 (%)*	*Tariff 2 (%)*	*Flat Rate (%)*	*Flat-Rate Bias*	*Pay-Per-Use Bias*	*Tariff 1 (%)*	*Tariff 2 (%)*	*Flat Rate (%)*	*Flat-Rate Bias*	*Pay-Per-Use Bias*
Tariff switching	Tariff 1	0	+220	+240		***	0	+233	+183		***
	Tariff 2	+150	0	+250	†	†	+67	0	–100	†	†
	Flat rate	0[a]	1[a]	0	†		0[a]	1.1[a]	0	*	
Churn	Tariff 1	0	+340	+1040		***	0	+650	+833		***
	Tariff 2	–25	0	+538	†	***	–50	0	+492	**	***
	Flat rate	+63	+25	0	†		+67	–100	0	†	

*$p < .1$.
**$p < .05$.
***$p < .01$.
† = not significant.
[a]Tariff-switching rates of flat-rate customers for whom the flat rate is the least costly tariff are zero; therefore, we report the actual tariff-switching rates.
Notes: N = 10,882.

Table 6
NESTED LOGIT MODELS FOR TARIFF SWITCHING AND CUSTOMER CHURN

	Criterion 1	*Criterion 2*
Level 1: Choices: Keep or Change		
Intercept	–3.034 (.105)***	–2.936 (.112)***
Existence of flat-rate bias	.153 (.320)	–.208 (.467)
Existence of pay-per-use bias	1.532 (.128)***	2.038 (.287)***
Magnitude of flat-rate bias	–.002 (.011)	.004 (.014)
Magnitude of pay-per-use bias	.001 (.000)*	–.002 (.003)
Inclusive value	.018 (.122)	.078 (.125)
Level 2: Choices: Switch or Churn		
Intercept	2.949 (1.227)***	2.700 (1.243)**
Existence of flat-rate bias	–1.075 (.564)**	–1.299 (.570)**
Existence of pay-per-use bias	.543 (.211)***	.826 (.374)**
Tariff 1	–2.965 (1.228)***	–2.656 (1.246)**
Tariff 2	–1.615 (1.163)*	–1.242 (1.197)
Log-likelihood	–2673.211	–2726.113
Wald test	.000	.000

*$p < .1$.
**$p < .05$.
***$p < .01$.
Notes: Standard deviations are in parentheses.

182% (Criterion 2), and the pay-per-use bias leads 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 ranges from 16% (Criterion 1) to 30% (Criterion 2). The migration model shows an increase in customer lifetime value of customers with a flat-rate bias of between 87% (Criterion 1) and 135% (Criterion 2). Thus, the customer lifetime value of customers with a flat-rate bias is substantially greater than the customer lifetime value of customers who have chosen the least costly tariff. In contrast, in the long run, profits from the pay-per-use bias are 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 ranges from –8% (Criterion 1) to –2% (Criterion 2). An analysis of the sensitivity of the results to a variation in the discount rate of 8%–14% shows that the flat-rate bias increases customer lifetime value by 82%–98% (Criterion 1) and 130%–145% (Criterion 2). In contrast, the impact of the pay-per-use bias is around zero, ranging from –13% to 5% (Criterion 1) and from –8% to 14% (Criterion 2). In total over all customers, both tariff-choice biases taken together result in an increase of customer lifetime value ranging from 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 fewer 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 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: When they become aware of their mistake in tariff choice, they tend to switch to another tariff or to churn.

Overall, the results indicate that though consumers choose their tariff on the basis of the expected billing rate, in general, they prefer flat rates because of tariff-specific characteristics. We believe that these results are true for many other products and services, such as cell phones or fixed-line telephone services, access to wireless local area networks, and car rental. In addition, precommitment for particular goods for which consumers want to predetermine a certain amount of usage (e.g., to exercise twice a week in a health club) might also affect tariff choice (DellaVigna and Malmendier 2006; Nunes 2000; Wertenbroch 1998). Precommitment is likely to occur when consumers need to make a considerable short-term investment (e.g., in terms of physical effort) with the expectation that they will receive long-term benefits (e.g., in terms of better health). Thus, 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, precommitment to low consumption (e.g., cigarettes) might lead to an even stronger pay-per-use bias (Wertenbroch 1998). Whereas precommitment 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 obtaining access to the Internet or using cell phones.

The results enable us to derive recommendations for pricing. Companies should carefully consider pricing decisions that may affect flat-rate customers, such as ceasing to offer a flat rate or offering the customer the option to be billed for

usage according to the least costly tariff. If a company were to bill 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. Managers 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).

In addition to the negative financial effects of the pay-per-use bias, companies may need 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 rather than their own cognitive mistake. Therefore, companies should encourage new customers to use a flat rate and propose to switch existing customers with a pay-per-use bias to a tariff with a higher fixed fee.

There are limitations to our work. We investigated the causes of the flat-rate bias that have previously been proposed in literature. However, we did not conduct an exploratory analysis to identify other potential causes, and we cannot rule out that other effects might also have lead to a flat-rate bias. Our results of causes of the pay-per-use bias are limited to the underestimation effect. Further research could analyze which other effects lead to a pay-per-use bias. In addition, we might have underestimated the share of consumers with tariff-choice biases, given that we observed a tariff-choice bias only if a consumer had chosen a tariff that did not minimize his or her billing rate. A consumer might have had a preference for a specific tariff, but if his or her usage was far below the breakeven quantity of the next available tariff, this preference might not have been strong enough for the consumer to choose the next available tariff.

Additional research might also examine 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 losses due to tariff-choice biases decrease. 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.

APPENDIX

Multi-Item Scales of Insurance, Taxi Meter, and Convenience Effects

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.

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.

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 generated 84 items on the basis of a literature review and our own judgment. Five professors and doctoral students in marketing and behavioral economics conducted the first selection of items. In a pretest, we purified items on the basis of exploratory factor analysis and Cronbach's alpha. A total of 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 chi-square test and the Fornell–Larcker criterion. A simultaneous factor analysis confirms that the factorial structure is identical for both groups.

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