MANAGEMENT SCIENCE
Vol. 59, No. 9, September 2013, pp. 2019–2035
ISSN 0025-1909 (print) | ISSN 1526-5501 (online)

http://dx.doi.org/10.1287/mnsc.1120.1694

Do Customers Learn from Experience? Evidence from Retail Banking

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We study customers' adoption and subsequent switching decisions with regard to a menu of three-part tariff plans offered by a commercial bank. Using a rich panel data set covering 70,510 fee-based checking accounts over 30 months, before and after the introduction of the plans, we find that most customers adopt non-cost-minimizing plans, preferring plans with large monthly allowances and high fixed payments. Furthermore, after adoption, customers who exceed their allowances and consequently pay overage fees are more likely to switch to plans with larger allowances than customers who do not experience such fees. Notably, after switching, these overage-paying customers pay *higher* monthly payments than before. In contrast, switching customers who did not pay overage payments before switching pay less after switching. Our findings, unlike those of previous research on experience-based learning, suggest that the behavior of experienced customers does not converge to the predictions of neoclassical models. We propose that "overage aversion," which is closely related to loss aversion and mental accounting, is the most plausible explanation for our findings.

Key words: tariff choice; nonlinear pricing; switching; learning; flat rate
History: Received July 12, 2012; accepted November 23, 2012, by John List, behavioral economics. Published online in *Articles in Advance* April 22, 2013.

1. Introduction

Economic models of rational behavior assume that individuals attempt to make optimal choices, that is, choices that maximize their utility. When choices involve uncertainty or are computationally difficult, economists typically consider learning through experience to be an important driver of such optimization behavior (e.g., Roth and Erev 1995). The interest of researchers in the sources and the consequences of customer experience has increased in recent years, because a large body of literature has shown that individuals exhibit various types of biases when making decisions, and that firms exploit these biases when setting prices or designing contracts (e.g., DellaVigna 2009; DellaVigna and Malmendier 2004, 2006; Lacetera et al. 2012). If customer experience can mitigate initial customer biases, it is likely to limit the effectiveness of firms' attempts to take advantage of such biases. Hence, a central question in the behavioral economics literature is to what extent customers learn from experience with contracts that are likely to exploit behavioral biases and subsequently improve upon their initial choices. In their review of the behavioral economics literature, Levitt and List (2008, p. 910) write that "exploring how markets and market experience influence behavior represents an important line of future inquiry."

Despite the importance of individual learning, only a few studies have used microlevel field data to explore the consequences of customer experience (List 2003, 2004; Miravete 2003; Agarwal et al. 2006, 2011; Miravete and Palacios-Huerta 2013; Haselhuhn et al. 2012; Ketcham et al. 2012). The scarcity of such analyses is probably due to the unique nature of the data they require. A main insight that has emerged thus far in these studies is that, as predicted by the neoclassical economic theory (e.g., Becker 1976), experience does lead to better outcomes and can ameliorate initial biases. In this paper, we provide novel evidence that, in contrast to what the existing literature would suggest, a specific type of customer experience—namely, overage payments—can systematically result in *worse,* rather than better, economic outcomes for customers. We use the term "overage aversion" to refer to this unique role of overage payments in customers' decision making.

Our research setting is the retail banking industry, and we focus specifically on customer choice from a menu of three-part tariff plans. A three-part tariff plan consists of a *fixed fee*, an included *allowance* of units for which the marginal price is zero, and a positive marginal price for additional usage beyond this allowance. The additional expense for this additional usage is termed *overage payment*. Prime examples of

this pricing method are subscription plans in the cellular, Internet, car leasing, and banking industries.

The empirical analysis makes use of a rich data set obtained from a large commercial bank operating in a developed Organisation for Economic Co-operation and Development (OECD) member country. The data comprise detailed monthly information on about 70,000 checking accounts. The data span 30 months, starting six months before the bank introduced a menu of three-part tariff plans. After the introduction of the new plans, bank customers could select a plan from the new menu or by default continue to be charged according to the existing pay-per-use pricing scheme.

We begin our empirical analysis by examining customers' plan adoption decisions. We first document strong evidence for flat-rate bias, that is, customers typically chose plans with allowances that were larger than the allowances of their cost-minimizing plans (DellaVigna and Malmendier 2006, Goettler and Clay 2012, Lambrecht et al. 2007, Lambrecht and Skiera 2006, Train et al. 1987). We also find that only 17% to 18% of account holders adopted their cost-minimizing plans, based on their account usage before and after the adoption of the plans, respectively. Had all plan adopters chosen their cost-minimizing plans, their monthly payments would have been 30% lower, on average, than the actual monthly charges they incurred following adoption. However, in fact, our panel data estimates, controlling for account usage, indicate that customers who adopted plans experienced an average increase of 9% in their monthly payments to the bank (as compared with their payments prior to plan adoption).

Having shown that the average customer's initial plan choice is not the cost-minimizing choice, we next examine customers' switching decisions. Specifically, we investigate whether adopters of three-part tariff plans, who later switched to a different three-part tariff plan, improved upon their initial choices. Because we follow customers over a period of more than two years, and since customers did not face any contractual or monetary switching costs, our data provide a unique opportunity to evaluate the sources for and the implications of these switching decisions. Our first finding with regard to switching decisions is that only a small fraction of customers actually switched plans, while the vast majority of customers retained their initial plan choices. Our analysis also indicates that, at the aggregate level, customers who did switch plans paid less after switching. Notably, however, the outcome of the switching decision was heterogeneous across plan switchers. In particular, we find that customers who paid overage payments before switching tended to switch to plans with larger allowances, and that their subsequent monthly payments ended up exceeding their average monthly charges before switching. Our panel data estimates indicate that these customers pay, on average, 6.5% more to the bank after switching plans than prior to switching. In contrast, plan switchers who did not pay overage payments prior to switching were more likely to choose plans with smaller allowances and reduce their overall costs.

We suggest that these findings are driven by *overage aversion*; that is, customers incur excess disutility from paying overage payments, leading them to replace overage payments with higher monthly fixed payments. To provide a quantifiable measure for the disutility incurred by overage payments, we estimate a discrete choice model that allows us to evaluate customers' relative sensitivity to fixed payments as compared with overage payments. Our estimates suggest that customers' disutility from paying \$1 as overage payment equals that of roughly \$3.5 in fixed monthly payments.

We propose that loss aversion coupled with mental accounting (Tversky and Kahenman 1991; Thaler 1985, 1999) constitute a plausible explanation for our findings. Loss aversion means that individuals have a propensity to prefer avoiding losses to obtaining gains. Kőszegi and Rabin (2006, 2007) further develop the concept of loss aversion and suggest that customers construct reference points based on their rational expectations about outcomes, and that gains and losses are constructed around these reference points. In the context of three-part tariff plan choice, we propose that customers distinguish between expected "within-budget" payments (fixed monthly fees) and other "unexpected" payments (overage payments). Loss aversion occurs only with respect to the uncertain overage payments, which accrue only if the customer exceeds the plan's allowance. We thus postulate that a customer subscribes in advance to a three-part tariff plan with an allowance that is likely to exceed his or her needs, thereby reducing the likelihood of experiencing the psychological costs associated with exceeding the allowance of the chosen plan. In other words, customers who choose among three-part tariff plans treat fixed fee payments and overage payments as separate mental accounts, and they associate different levels of disutility with paying from these different accounts.

Our study also adds to the literature on nonlinear pricing, and specifically on three-part tariffs. Despite the prevalence of three-part tariff plans in practice, little research has been done on customer choice from a menu of such pricing schemes. The few existing studies on customer choice from a menu of three-part tariff plans investigated customer plan choice for new services, where customers' knowledge about the services and their benefits was preliminary and limited.

These studies focused, for example, on Internet and cellular services, using data collected at a time when such services were relatively new (Ascarza et al. 2012, Grubb 2009, Grubb and Osborne 2012, Lambrecht et al. 2007, Lambrecht and Skiera 2006). Accordingly, customer choice biases in these studies were typically attributed to customer uncertainty regarding the benefits of the new service and customers' biased beliefs about their future usage. In contrast, in our setting of retail banking, we expect that customers will have lower uncertainty regarding the benefits of the service and their levels of usage. We expect low uncertainty among the bank customers in our data set both because, in general, customers are likely to be familiar with checking accounts, and because, specifically, we analyze customers' decisions with regard to accounts that they have been using for some time, with average account tenure of 14 years. Furthermore, because of data limitations, previous studies did not thoroughly examine how customers' behavior changed as they gained experience with the new services and the new pricing plans. Our unique data enable us to focus on customers' switching decisions and directly explore how the experience gained while being subscribed to a three-part plan affects customer choices and consequent payoffs.

2. Industry Background and Data

2.1. Economic Environment

We use data on the introduction of three-part tariff plans by a large commercial bank that operates in a developed OECD member country. The banking industry in the country we analyze is highly concentrated, and in the analyzed time period there were three large banks that controlled about 85% of the market. Furthermore, over the years of data collection, relatively few bank customers switched between banks. The introduction of the new pricing scheme that we study followed a public outcry over the complexity of banks' payment schemes. The bank from which we obtained the data is a leading bank in the country and was the first to offer the new pricing scheme to its customers. Throughout the paper, we convert the local monetary unit into nominal dollars.

2.2. Data

2.2.1. Three-Part Tariff Plans. The new three-part pricing plans provided an alternative to an "old" pricing scheme that had been the only system used in the banking industry of the analyzed market at the time of introduction. The "old" pricing scheme calculated customers' commission payments according to the number and types of their transactions. The cost for a specific transaction could range from a few cents to as much as \$7. When the new three-part tariff plans were introduced, customers had the option of continuing to use the old pricing scheme, or choosing one of the new plans. Continuing with the old pricing scheme was the default option and required no active choice on the customer's part. After choosing one of the new service plans, customers could switch to a different plan or go back to the old scheme (we refer to this as "quitting") at any time. A customer could join a plan, switch to a different plan, or return to the old scheme by calling his or her bank branch or the bank's call center. The customer was not required to arrive in person, sign documents, or pay any switching fees.

Customers who chose to adopt three-part tariff plans were no longer charged according to the type and number of their transactions, but were instead given monthly allowances for three types of transactions. These three transaction types included check deposits, transactions through direct channels (e.g., Internet or using a touch-tone telephone), and transactions that involve interaction with a clerk at a bank's branch or through a call center.[1] Any transaction above one's allowance entailed overage payment above the basic plan cost. The overage payments depended on the channel used for the extra transaction (\$0.3 for the check and direct channels and \$1.2 for the channel involving human interaction) but were the same across different plans. In Table 1, we present the details of two three-part tariff plans: the least expensive plan (plan 1)—the plan with the lowest allowance; and the second most expensive plan (plan 5)—the plan with the next to the highest allowance.[2] Throughout the analysis, the number of the plan is an indication of the size of the allowance (e.g., plan 2 has a larger allowance than plan 1 and entails a higher fixed payment).

2.2.2. Sample and Data. Our data consist of information on a sample of 70,510 checking accounts out of a list of about one million accounts that the bank identified as potential candidates for the service. This initial list of potential accounts was reduced to include only accounts that were active for at least six months at the time that the new service was introduced and that were considered the primary accounts of the

[1] Note that three-part tariff plans for cellular service also typically include three types of allowances: voice, text, and data.

[2] In the month when the new plans were introduced, bank customers could choose from a menu of four three-part tariff plans. Nine months after the first four plans were introduced, two new plans were added to the existing set of plans. After plans had been offered to customers, they remained available throughout the investigated timeframe, with two exceptions: one plan from the set of the four initial plans was removed from the choice set nine months after its introduction, and another plan was altered such that its allowance for direct channels was reduced (customers who chose these plans before these changes could still use them afterward).

Table 1 Example of Three-Part Tariff Plans

		Overage payment ($)		Allowance		
Plan no.	Monthly payment ($)	Clerk-assisted activities	Direct activities/ check deposits	Clerk-assisted activities	Direct activities	Check deposits
1	4.75	1.2	0.30	0	7	7
5	9.50	1.2	0.30	7	Unlimited	12

account holders. In addition, accounts held by very young customers and accounts for which certain indicators, such as the age or the address of the customer, were missing, were also excluded. To construct the actual sample of accounts we used a layer sampling procedure based on the plan adoption time. That is, all accounts were ordered according to the date on which the account holder adopted a three-part tariff plan. Nonadopting customers were randomly ordered. We then selected every 10th account for the final sample. The data were collected over the course of 30 months (from 6 months before service introduction until 24 months after introduction).

The account-level data include information on the plans used in each month, as well as additional detailed monthly level information for every account. In particular, we have monthly information on the three types of transactions: check deposits, transactions through direct channels, and transactions through personalized clerk-assisted channels. The data also cover each customer's monthly volume of information inquiries and information regarding other characteristics associated with the account, including general characteristics (e.g., account tenure and Social Security payments made to the account), financial characteristics (e.g., income and the monthly levels of savings and loans), and demographic characteristics (e.g., customer age and sociodemographic index[3]). Another unique characteristic of our data is the inclusion of the number of direct marketing calls directed at each customer to introduce the possibility of choosing from the menu of new plans. To protect customers' privacy, each account number was encrypted in a way that still enabled us to track that account through the entire research data set (for a further discussion of the data, see Landsman and Givon 2010). In our sample, 32,394 customers adopted one of the six investigated three-part tariff plans. Of those customers, 2,268 eventually switched to one of the other three-part tariff plans, while 2,160 opted to return to the old payment system.

Table 2 presents the summary statistics for plan adopters and nonadopters for the data variables, based on customers' preadoption usage. On average, adopters pay higher monthly bank commission charges than nonadopters do ($7.30 versus $3.69), and show more active involvement in managing their accounts (e.g., 3.33 versus 1.7 direct transactions). Nonadopters are typically older, which probably explains why they have higher savings and smaller loans. Finally, adopters received, on average, four times more marketing calls per month than did nonadopters. Overall, these summary statistics suggest that customers engage in a sorting behavior. A customer with high usage volume (measured by preadoption payments) is more likely to adopt one of the new plans. In contrast, low-volume customers tend to prefer the old pricing plan, which does not require a high fixed monthly bank payment.

3. Analysis

In this section, we first examine whether customers tend to choose their cost-minimizing plans. We then explore whether, as found by previous studies using data on a menu of plans, customers exhibit a flat-rate bias when choosing among a menu of pricing plans. Next, we examine whether customer learning ameliorates these initial biases, as predicted by the neoclassical theory. In particular, we investigate the factors that trigger plan switching among customers, and analyze the nature and consequences of these switching decisions.

3.1. Initial Plan Choice

3.1.1. Optimality of Initial Plan Adoption Choices. We start by computing the percentage of account holders whose plan choices were the cost-minimizing plans, given their account usage before or after adopting a plan. Tables 3(a) and 3(b) present the distribution of optimal pricing plans against the chosen pricing plans (including the old pricing scheme) for each of the available plans, based on account usage three months before (i.e., ex ante approach) or three months after (ex post approach) adoption, respectively.[4] For example, the number in the second column of the

[3] A scale of 1 to 10. Higher values indicate a higher sociodemographic status for the address of the customer.

[4] In the online appendix (available at https://www.dropbox.com/s/rlxyvv8br562k36/Online%20Appendix.pdf), we provide more details on the calculations used for the optimality assessment.

Table 2 Descriptive Statistics: Adopters vs. Nonadopters

Variable	Nonadopters mean (SD)	Adopters mean (SD)
Account tenure (*years*)	14.7 (10.4)	13.21 (9.33)
Age of account holder	51.5 (17.7)	43.94 (13.87)
Number of owners	1.48 (0.58)	1.44 (0.51)
Parental Social Security benefits	0.01 (0.05)	0.04 (0.09)
Elderly Social Security benefits	0.16 (0.25)	0.08 (0.22)
Number of salaries	0.70 (0.73)	0.75 (0.77)
Socioeconomic measure of residence of account holder (*scale of* 1–10)	5.73 (2.25)	5.17 (2.23)
Monthly mean number of account information inquiries[a]	4.81 (10.24)	6.59 (11.48)
Monthly mean number of clerk-assisted transactions[a]	0.57 (0.87)	0.94 (1.22)
Monthly mean number of transactions through direct channels[a]	1.70 (2.40)	3.33 (3.66)
Monthly mean number of check transactions[a]	1.66 (3.16)	3.56 (5.07)
Monthly mean number of marketing calls[b]	0.02 (0.05)	0.08 (0.077)
Preadoption commission charges	3.69 (2.74)	7.30 (3.42)
Mean monthly overspending compared to minimum payment[a]	0.62 (1.58)	2.24 (2.15)
Customers	38,116	32,394

Notes. Throughout the paper, monetary variables are in U.S. dollars, except the Social Security benefits, loans, and savings variables, which are in thousands U.S. dollars. Because of confidentiality concerns, we are not allowed to reveal the summary statistics for the following variables: *salary, loans, savings, monthly mean positive balance, monthly mean negative balance*, and *monthly mean of bank commission payments*. We use these variables in the regression analysis.

[a]For adopters, this variable is calculated based on three months before adoption; for nonadopters, this variable is based on the three months before the introduction of the new plans.

[b]For adopters, this variable is calculated based on all months before adoption; for nonadopters, this variable is based on all observations.

row that corresponds to plan 5 in Table 3(a) indicates that the optimal plan for 4.6% of the adopters of plan 5 is plan 2. The diagonals (in bold) in Tables 3(a) and 3(b) represent the percentage of customers who chose their cost-minimizing (optimal) plans. As can be easily observed in the tables, the vast majority of nonoptimal plan choices were for plans with larger allowances than the allowance offered by the cost-minimizing plan (i.e., there is a large concentration of choices below the diagonal of Tables 3(a) and 3(b)). As already mentioned, the tendency to choose plans with allowances larger than the allowances of the cost-minimizing plans, known as flat-rate bias, has been documented in various industries. If we aggregate

Table 3(a) Choice Optimality Ex Ante for All Customers

	Optimal (%)							
Chosen	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	No plan	
Plan 1	**51.6**	0.3	2.8	0.3	0.1	0.0	44.8	100.0
Plan 2	55.8	**2.5**	0.0	1.1	0.1	0.0	40.5	100.0
Plan 3	55.5	0.0	**16.3**	0.0	1.0	0.0	27.1	100.0
Plan 4	51.3	2.2	0.0	**4.2**	0.7	0.0	41.7	100.0
Plan 5	67.0	4.6	2.8	9.6	**3.7**	0.1	12.3	100.0
Plan 6	62.7	7.0	1.2	11.4	6.8	**1.9**	9.1	100.0
No plan	24.6	0.0	4.4	0.0	0.5	0.1	**70.3**	100.0

Notes. The numbers represent the percent distribution of optimal plans across plan adopters for each of the available plans. Each row presents the distribution of optimal plans for the customers who chose the particular plan represented in that row. For adopters, optimality is calculated based on three months before adoption; for nonadopters, this variable is based on three months before the introduction of the new plans. When we aggregate over all adopting customers, we find that 17% chose their cost-minimizing plan. Further details are provided in Online Appendix A.

Table 3(b) Choice Optimality Ex Post for All Customers

	Optimal (%)							
Chosen	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	No plan	
Plan 1	**56.3**	0.3	2.2	0.3	0.2	0.0	40.8	100.0
Plan 2	59.5	**3.9**	0.0	1.4	0.1	0.0	35.2	100.0
Plan 3	62.3	0.0	**13.0**	0.0	0.7	0.0	24.0	100.0
Plan 4	54.6	3.0	0.0	**4.3**	0.7	0.0	37.4	100.0
Plan 5	69.7	5.1	2.9	8.9	**3.0**	0.2	10.1	100.0
Plan 6	64.3	7.7	1.0	10.4	5.9	**2.3**	8.3	100.0
No plan	24.8	0.0	4.8	0.0	0.5	0.1	**69.8**	100.0

Notes. The numbers represent the percent distribution of optimal plans across plan adopters for each of the available plans. Each row presents the distribution of optimal plans for the customers who chose the particular plan represented in that row. For adopters, optimality is calculated based on three months after adoption; for nonadopters, this variable is based on three months before the introduction of the new plans. When we aggregate over all adopting customers, we find that 18% chose their cost-minimizing plan. Further details are provided in Online Appendix A.

over adopting customers, we find that only 17% to 18% of plan adopters actually chose the plans that minimized their payments to the bank, based on the usage patterns three months before and after the adoption of the plan, respectively.[5] Comparing customers'

[5] When we performed the same calculation, considering only three-part tariff plans in the optimality analysis (i.e., we did not consider the possibility of nonadoption in this analysis), we find that 29% of plan adopters chose the plans that minimized their payments to the bank (based either on their ex ante or ex post approach). Once we expand the calculation time window for optimality calculation (see Online Appendix A), the range of optimality percentages is between 14% and 19%, corresponding to a six-month window before and after plan choice, respectively. Furthermore, these qualitative results do not change once we focus on late adopters and hence are able to extend the timeframe to 12 and 18 months before these customers adopted a three-part tariff plan.

actual payments with the payments that they would have paid had they chosen the cost-minimizing plan (based on an ex ante optimality assessment), we find that, on average, plan adopters could have reduced their monthly payments by nearly 30% had they chosen their optimal plans.

We also carried out a logit regression analyses to further explore the characteristics of customers who are likely to experience a flat-rate bias. Our results show that account holders who are characterized by higher sociodemographic indices or longer account tenure and who perform more information inquiries are less likely to experience flat-rate bias. Interestingly, the number of marketing calls, which has a strong effect on the initial adoption decision, has no effect on the tendency to experience a flat-rate bias (see Online Appendix B for a full report of the logit regression estimation results).

3.1.2. Panel-Data Analysis of Customer Adoption Decision. The analysis above focused on the comparison between the chosen plan and the cost-minimizing plan. To provide direct evidence on the consequences of the adoption decision, we estimate the following panel data fixed-effect regression:

$$\begin{aligned}\log(Payment_{it}) &= \beta_0 + \beta_D D_{\text{Adoption},\,it} + \beta_A \log(Activity_{it}+1) \\ &\quad + \beta_X \log(X_{it}+1) + \alpha_i + \eta_t + \varepsilon_{it}, \qquad (1)\end{aligned}$$

where the dummy variable $D_{\text{Adoption},\,it}$ equals 1 if customer i has adopted a three-part tariff plan by time t and 0 otherwise. $Activity_{it}$ is a matrix that includes for each account i the number of clerk-assisted and direct transactions, and the number of checks deposited in month t; and X_{it} includes account-level characteristics that can vary over time, such as salary, number of account owners, number of salaries, social insurance payments, loans, and savings. We implement log-transformation for all the variables that are not binary variables. Finally, we also include account (α_i) and time (η_t) fixed effects to control for unobserved differences across customers and unobserved time trends. We also cluster our standard errors at the individual account level. The regression results, reported in column (1) in Table 4, indicate that following plan adoption the monthly payment by adopting customers increased by 9.1%.

In the next section, we turn to the main analysis and focus on switching decisions, which we consider as an indication of learning. This analysis allows us to test whether customer learning leads to lower customer payments, as the traditional theory predicts.

3.2. Switching

Most customers who adopted a three-part tariff kept their initial choice. Only 2,268 customers switched to other three-part tariff plans after initially adopting a plan. This pattern may have been driven by inertia or nonpecuniary switching costs, or it might simply indicate that customers were satisfied with their initial choices, even if the chosen plan was not the cost-minimizing plan. In this section, we focus on the group of customers who did switch plans and show that their switching decisions also exhibit a pattern of flat-rate bias. We further show that customers who exceeded the allowance of their three-part tariff plan and consequently paid overage payments were more likely to switch plans. In particular, these customers were more likely to switch upward, that is, to plans with higher allowances, and consequently pay higher monthly payments.

3.2.1. Optimality of Switching. As in the adoption analysis, we first assess the optimality of the switching decisions. Tables 5(a) and 5(b) present results of the analyses evaluating the optimality of switching decisions based on switching customers' account usage before and after switching, respectively. In both cases, aggregating over all switchers, we find that only 14% of the switchers made the optimal cost-minimizing switching choice. The percentage of optimal choices is even smaller than that in the initial choice analysis. Furthermore, the observed choice patterns in these tables suggest that switching customers also experience a flat-rate bias. Next, we investigate the effect of overage payments on customers' decision to switch plans and on the consequences of these decisions.

3.2.2. The Effect of Overage Payments on Switching. Customers who switched to other plans paid, on average, the highest overage payments under their initial plans compared with all other plan adopters ($1.06 per month for plan switchers, compared with $0.62 and $0.3 for plan quitters and plan adopters who kept their initial plans, respectively). Consistent with this finding, while using their initial plans, switchers exceeded their plans' allowances for clerk-assisted and check transactions more frequently than did other plan adopters (29% and 15% of months with excess clerk-assisted transactions and check transactions, respectively, for switchers, compared with only 9% and 6% of months with excess clerk-assisted and check transactions, respectively, for nonswitchers).

Figure 1 presents the relationship between switching decision and overage payments from another angle, classifying customers in terms of the nature of their initial plan choices: initial downward bias (customers who initially adopted a plan with too small an allowance), initial optimal choice, and initial upward bias (customers who initially adopted a plan with too large an allowance). Clearly, in all cases, customers who eventually switched paid higher overage

Table 4 Customer Payment Regression

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	All adopting customers (over all months)	All switchers (over pre-switch months)	Overage-payment switchers (over pre-switch months)	Non-overage-payment switchers (over pre-switch months)	All switchers (over post-adoption months)	Overage-payment switchers (over post-adoption months)	Non-overage-payment switchers (over post-adoption months)
Postadoption month	0.091***	0.053***	−0.001	0.189***			
	(0.002)	(0.008)	(0.009)	(0.013)			
Postswitching month					−0.032***	0.065***	−0.256***
					(0.006)	(0.006)	(0.011)
Monthly number of clerk-assisted transactions	0.129***	0.156***	0.189***	0.094***	0.138***	0.156***	0.076***
	(0.001)	(0.004)	(0.005)	(0.006)	(0.004)	(0.004)	(0.006)
Monthly number of direct transactions	0.038***	0.038***	0.044***	0.036***	0.010***	0.013***	0.005
	(0.001)	(0.003)	(0.004)	(0.005)	(0.003)	(0.003)	(0.004)
Monthly number of check deposits	0.064***	0.079***	0.092***	0.059***	0.056***	0.067***	0.016***
	(0.001)	(0.005)	(0.005)	(0.006)	(0.004)	(0.005)	(0.005)
Number of owners	0.054***	0.055	0.095*	0.006	0.074**	0.036	0.063
	(0.011)	(0.044)	(0.049)	(0.071)	(0.035)	(0.033)	(0.040)
Parental Social Security benefits	0.34***	0.299***	0.310***	0.250**	0.022	0.063	−0.256**
	(0.023)	(0.064)	(0.074)	(0.112)	(0.053)	(0.059)	(0.102)
Elderly Social Security benefits	0.041***	−0.034	−0.036	0.011	0.089**	0.038	0.235*
	(0.013)	(0.050)	(0.058)	(0.062)	(0.038)	(0.038)	(0.121)
Monthly number of account information inquiries	0.001	0.009***	0.008**	0.008**	0.008***	0.007**	0.005
	(0.001)	(0.003)	(0.004)	(0.004)	(0.002)	(0.003)	(0.003)
Salary	−0.001	0.008	−0.004	0.032*	0.008	0.011	−0.010
	(0.002)	(0.011)	(0.014)	(0.017)	(0.008)	(0.008)	(0.013)
Number of salaries	−0.012***	−0.032**	−0.010	−0.062***	0.013	0.012	0.010
	(0.003)	(0.013)	(0.015)	(0.020)	(0.010)	(0.010)	(0.017)
Mean level of positive account balance	0.001	0.002	0.008	−0.005	0.001	0.008*	−0.012*
	(0.001)	(0.006)	(0.008)	(0.009)	(0.004)	(0.005)	(0.007)
Mean level of negative account balances	0.019***	0.021**	0.042***	−0.011	0.011	0.006	0.012
	(0.002)	(0.011)	(0.013)	(0.013)	(0.008)	(0.008)	(0.013)
Loans	0.165***	0.023***	0.026**	0.025**	0.021***	0.008	0.031**
	(0.002)	(0.009)	(0.011)	(0.010)	(0.006)	(0.006)	(0.013)
Savings	0.132***	0.023***	0.027***	0.013	0.016***	0.016***	0.017**
	0.001	(0.005)	(0.006)	(0.008)	(0.004)	(0.004)	(0.008)
Constant	1.83***	1.648***	1.730***	1.948***	1.860***	1.834***	2.045***
	(0.005)	(0.006)	(0.020)	(0.030)	(0.019)	(0.020)	(0.037)
Observations	923,673	47,371	31,874	15,497	36,006	25,368	10,638
R-squared	0.361	0.135	0.242	0.228	0.197	0.317	0.422
Number of customers	32,394	2,268	1,509	759	2,268	1,509	759

Notes. The dependent variable in all regressions is the (log) monthly payment to the bank. An observation is an account/month. All regressions include individual account and month fixed effects. The regression results in column (1) refer to Equation (1), and the sample includes all adopting customers. The estimation results shown in columns (2)–(4) include only the months before plan switching (including preadoption months; Equation (2)), whereas columns (5)–(7) refer only to the months after plan adoption (Equation (3)). The sample of customers shown in columns (2) and (5) includes all switching customers. In columns (3) and (6), we focus on customers who paid overage payments at least once before plan switching; in columns (4) and (7), we focus on customers who did not pay overage payments before plan switching. Standard errors in parentheses are clustered at the account level.

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

payments under their initial plans than did customers who did not switch. As expected, the mean overage payment of customers with a downward bias is higher than that of all other plan adopters.

To further substantiate our claim that overage payments are a strong trigger for switching, we performed a proportional hazard regression for the duration between the time of plan adoption and the time of plan switching. We estimated this regression using a semiparametric estimation procedure that allows for time-varying independent variables (Cox 1972). A proportional hazard model (PHM) is a commonly used framework to model the duration until an event occurs (e.g., Seetharaman and Chintagunta 2003). According to the PHM, the hazard function is decomposed into two multiplicative components: $h_{it} = h_{0t}\psi(Y_{it})$, where h_{0t} represents the baseline hazard function, which reflects the dynamics of the hazard rate over time, and $\psi(Y_{it})$ represents the effect of the variables composing Y_{it} on the hazard

Table 5(a) Switching Choice Optimality Ex Ante

	Optimal (%)							
Final plan	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	No plan	
Plan 1	**61.8**	0.0	0.4	2.5	0.0	0.0	35.3	100.0
Plan 2	74.6	**2.5**	2.1	1.4	0.0	0.0	19.4	100.0
Plan 3	60.5	0.0	**15.8**	0.0	2.6	0.0	21.1	100.0
Plan 4	48.2	2.0	5.7	**5.0**	0.8	0.0	38.2	100.0
Plan 5	39.7	2.6	13.7	12.0	**9.8**	0.4	21.8	100.0
Plan 6	32.9	2.7	2.7	19.2	21.9	**5.5**	15.1	100.0

Notes. The numbers represent the percent distribution of optimal plans across plan switchers for each of the available plans. Each row presents the distribution of optimal plans for the customers who switched to the particular plan represented in that row. Optimality is calculated based on three months before switching. When we aggregate over all switching customers, we find that 14% of them switched to the cost-minimizing plan. Bold numbers represent the percentage of customers for which the chosen plan is optimal, out of all customers who have chosen the plan denoted in that row. Further details are provided in Online Appendix A.

Table 5(b) Switching Choice Optimality Ex Post

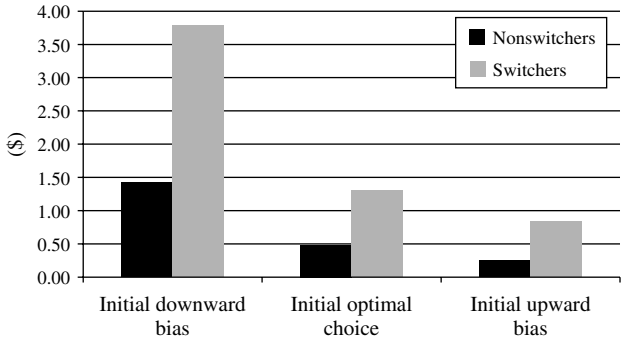
	Optimal (%)							
Final plan	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	No plan	
Plan 1	**63.4**	0.4	0.8	1.9	0.0	0.0	33.5	100.0
Plan 2	79.8	**3.9**	0.8	1.2	0.4	0.0	14.0	100.0
Plan 3	65.5	0.0	**13.8**	0.0	2.3	0.0	18.4	100.0
Plan 4	57.5	2.8	3.7	**3.8**	1.3	0.0	31.0	100.0
Plan 5	55.9	3.9	9.0	8.2	**6.6**	0.0	16.4	100.0
Plan 6	42.3	5.1	5.1	11.5	20.5	**7.7**	7.7	100.0

Notes. The numbers represent the percent distribution of optimal plans across plan switchers for each of the available plans. Each row presents the distribution of optimal plans for the customers who switched to the particular plan represented in that row. Optimality is calculated based on three months after switching. When we aggregate over all switching customers, we find that 14% of them switched to the cost-minimizing plan. Bold numbers represent the percentage of customers for which the chosen plan is optimal, out of all customers who have chosen the plan denoted in that row. Further details are provided in Online Appendix A.

rate; $\psi(Y_{it})$ adjusts h_{0t} up or down proportionally to reflect the effect of the covariates.[6]

[6] The two important advantages of this method, over panel data techniques and over standard regression methods such as ordinary least squares or logistic regression, are, first, its ability to account for right censoring (i.e., some events may occur beyond the end of the observation window), and second, its capability to use both time-invariant control variables (e.g., demography) and time-varying independent variables (e.g., monthly usage level). The semiparametric estimation procedure we use allows the parameters of interest to be assessed without specifying the baseline hazard h_{0t}. In large samples (as in this study), the estimates produced by this approach are consistent and asymptotically normal (Allison 1995). We estimate the PHM on a balanced panel of plan users that have adopted a three-part tariff plan by the 10th time period. For each customer in this panel, we observe 15 postadoption periods starting from the adoption month for that customer. We control for the customer's time of adoption by including this information in Y_{it}. The use of a balanced panel allows us to overcome the uneven postadoption observations in our data for customers who have adopted the plans in different time periods.

Figure 1 Average Monthly Overage Payments Among Adopters, Classified According to Switching and Initial Bias Type



In the first result column of Table 6, we summarize the estimation results of the switching hazard model. We find that the hazard of switching to another plan significantly increases with the cumulative amount of overage payment paid by that time.[7] The estimated odds ratio for overage payment is 1.01. That is, an additional dollar in the cumulative overage payments increases the hazard of switching by 1%. We do not find, however, that the optimality of the initial choice is associated with a change in the likelihood to switch to another plan. In other words, customers who did not initially choose their cost-minimizing plans are not more likely to switch than customers whose initial plan choices were optimal. The second result column of Table 6 presents the estimation results of a similar hazard model for the duration between the time of initial plan adoption and the time of switching to a plan with a higher allowance ("upward switching"). We find that the choice to switch to a higher plan is strongly associated with overage payments (with an odds ratio of 1.02). This association is even stronger than that for switching in general.

To illustrate the impact of preswitch overage payments on the nature of the switching decision, Figures 2(a) and 2(b) present the percentage of customers who switched to plans with larger allowances ("upward switchers") and the percentage of customers who switched to plans with smaller allowances ("downward switchers") according to the nature of their consecutive plan choices. Figure 2(a) focuses on customers who paid overage fees before the switching decision, and Figure 2(b) focuses on customers who did not pay overage fees before switching to other plans. The contrast between the two figures is striking. Upward switching decisions were common only among switchers who previously paid overage

[7] Overage payments in this regression are specified as the cumulative amount paid as overage by time t. Our estimation results are also robust to an alternative specification using the mean overage payment at time t.

Table 6 Hazard Regression Analysis for Switching Decision

	Switching hazard regression		Upward switching hazard regression	
Variable	(1) Parameter estimate (SE)	(2) Hazard ratio	(3) Parameter estimate (SE)	(4) Hazard ratio
Monthly cumulative overage payment[a]	0.01*** (0.00)	1.01	0.02*** (0.00)	1.02
Upward initial choice bias[b]	−0.03 (0.08)	0.97	−0.19** (0.09)	0.82
Downward initial choice bias[b]	0.06 (0.15)	1.06	−0.02 (0.15)	0.98
Adoption month[b]	0.12*** (0.01)	1.13	0.12*** (0.01)	1.13
Number of owners[a]	0.17** (0.07)	1.19	0.04 (0.09)	1.04
Number of account information inquiries[a]	7.74E–04 (4.80E–04)	1.00	1.00E–03* (5.86E–04)	1.00
Salary[a]	0.03** (0.01)	1.04	0.03* (0.02)	1.03
Number of salaries[a]	0.07* (0.04)	1.07	0.07 (0.05)	1.07
Account tenure[b]	−9.23E–04 (3.95E–03)	1.00	2.18E–03 (4.73E–03)	1.00
Customer age[b]	−4.04E–03 (3.00E–03)	1.00	−9.37E–03** (3.50E–03)	0.99
Parental Social Security benefits[b]	−7.63E–04** (3.27E–04)	1.00	−6.73E–04 (4.17E–04)	1.00
Elderly Social Security benefits[b]	−7.71E–05 (1.36E–04)	1.00	8.69E–05 (1.65E–04)	1.00
Mean level of positive account balance[b]	7.35E–05** (2.71E–05)	1.00	8.93E–05*** (3.10E–05)	1.00
Mean level of negative account balance[b]	−1.42E–05 (2.69E–05)	1.00	3.93E–05 (3.05E–05)	1.00
Loans[b]	7.55E–03* (4.59E–03)	1.01	4.24E–03 (5.17E–03)	1.00
Savings[b]	−2.12E–04 (3.99E–04)	1.00	2.46E–04 (4.50E–04)	1.00
Socioeconomic indicator[b]	0.02 (0.02)	1.02	0.00 (0.02)	1.00
Initial choice—Plan 2[b]	0.10 (0.08)	1.11	−0.32*** (0.10)	0.72
Initial choice—Plan 3[b]	0.42*** (0.13)	1.52	−1.04*** (0.23)	0.35
Initial choice—Plan 4[b]	0.46** (0.18)	1.58	−13.61 (175.06)	0.00
Initial choice—Plan 5[b]	0.08 (0.18)	1.09	−0.21 (0.21)	0.81
Initial choice—Plan 6[b]	0.38 (0.17)	1.46	−0.17 (0.22)	0.85
Observations[c]	132,135		132,135	

Notes. Columns (1) and (2) present the results of a proportional hazard regression for the duration between the time of plan adoption and the time of plan switching. Columns (3) and (4) present the results of a proportional hazard regression for the duration between the time of plan adoption and the time of upward plan switching. For dummy variables, the hazard ratio represents the ratio of the estimated hazard for observations with a value of 1 to the estimated hazard for those with a value of 0 (controlling for all other model variables). For continuous variables, subtracting one of the hazard ratio gives the estimated percent change in the hazard for each one-unit increase in the explanatory variable.

[a]Time-varying variable.

[b]Non-time-varying variable.

[c]Balanced panel of plan adopters by $t = 10$ (i.e., first 15 months of postadoption observations). The panel does not include eventual quitters.

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Figure 2(a) Nature of Switch for Overage Payers

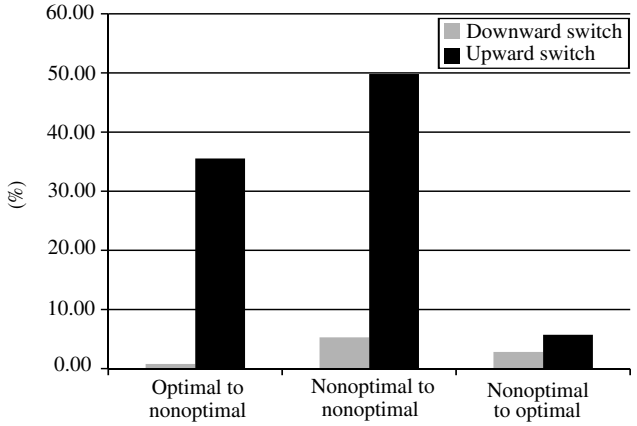
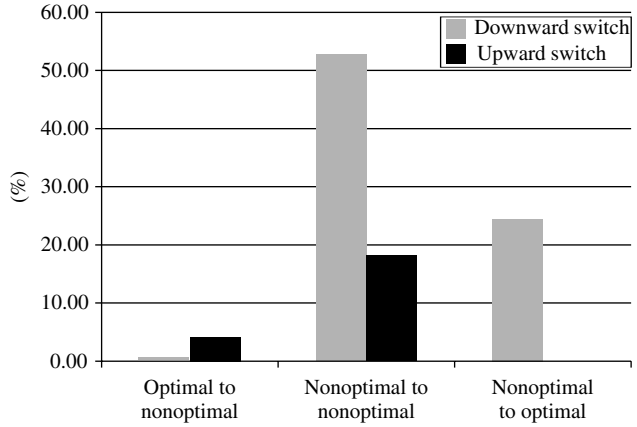


Figure 2(b) Nature of Switch for Non–Overage Payers



Notes. Figures 2(a) and 2(b) present the percentage of customers who switched to plans with larger allowances (upward switchers) and the percentage of customers who switched to plans with smaller allowances (downward switchers) according to the nature of their consecutive plan choices. Figure 2(a) focuses on customers who paid overage fees before their switching decision (1,509 customers), and Figure 2(b) focuses on customers who did not pay overage fees before switching to other plans (759 customers).

payments. From Figure 2(a) we also learn that 36% of the customers who switched after paying an overage payment had initially chosen their cost-minimizing plans yet switched to plans that entailed higher monthly payments. In fact, 91% of these customers switched to plans with larger allowances. In contrast, as shown in Figure 2(b), switchers who had not paid overage payments prior to their switching decisions were more likely to switch to plans with smaller allowances, and nearly 25% of them switched to their cost-minimizing plans.

Figures 2(a) and 2(b) and the results of the hazard model suggest that customers undergo an overage-dependent learning process. Customers who experience paying overage fees show a higher tendency to switch, in particular to plans with higher fixed payments, which are, in most cases, not their cost-minimizing plans. In contrast, customers who do not experience paying overage fees are less likely to switch, but those who do switch are more likely to choose a plan with a lower fixed payment and reduce their monthly bank payments. In what follows we use panel data analysis to further substantiate this learning pattern and quantify its effect.

3.2.3. Panel Data Analysis of Switching Decisions. The panel data analysis exploits the longitudinal nature of our data and focuses on bank customers who adopted one of the three-part tariff plans and subsequently switched to another plan. We estimate the following panel data fixed-effect regressions, similar to Equation (1):

$$\begin{aligned}\log(Payment_{it}) &= \beta_0 + \beta_D D_{\text{Adoption},\,it} + \beta_A \log(Activity_{it}+1)\\ &\quad + \beta_X \log(X_{it}+1) + \alpha_i + \eta_t + \varepsilon_{it},\end{aligned} \tag{2}$$

$$\begin{aligned}\log(Payment_{it}) &= \beta_0 + \beta_D D_{\text{Switching},\,it} + \beta_A \log(Activity_{it}+1)\\ &\quad + \beta_X \log(X_{it}+1) + \alpha_i + \eta_t + \varepsilon_{it}.\end{aligned} \tag{3}$$

The dummy variable $D_{\text{Adoption},\,it}$ in Equation (2) equals one if customer i has adopted a three-part tariff plan by time t and 0 otherwise. Similarly, $D_{\text{Switching},\,it}$ in Equation (3) is a dummy variable that equals 1 if customer i has switched plans by time t and 0 otherwise. All other variables are similar to those presented in Equation (1).

The regression results are reported in columns (2)–(7) in Table 4. In column (2), we report the results of a regression analysis for Equation (2). The sample in this regression includes all plan switchers for all time periods before plan switching (including preadoption months). The coefficient on the adoption variable suggests that, on average, switching customers paid 5.3% more after adopting a three-part tariff plan than they did before plan adoption. In columns (3) and (4) of Table 4, we report the estimation results for Equation (2) for switching customers who paid overage payments at least once, and for switching customers who did not pay any overage payments prior to switching plans, respectively. The regression results suggest that, in the months after adoption and before switching, overage switchers did not pay more to the bank than they had prior to plan adoption. In contrast, non–overage switchers paid nearly 19% more following adoption and before switching. These findings suggest that non–overage switchers had initially chosen plans with excessively large allowances and consequently did not pay overage payments.

In columns (5)–(7) of Table 4, we report the estimation results of Equation (3). In these analyses we again investigate only switching customers yet only analyze post-adoption months. Our aim here is to identify the effect of switching on customer payments. In column (5), we report the estimation results

for the entire sample of switching customers. In columns (6) and (7), we report the estimation results for overage switchers and non–overage switchers, respectively. The results presented in column (5) indicate that, on average, customers' monthly bank payments decreased by 3.2% after plan switching. This result indicates that, on average, plan adopters who decided to alter their initial plan choices did reduce their monthly payments. Importantly, we find evidence for heterogeneity among switchers in terms of the change in their payments following the switching decision. Overage payers who switched plans increased their monthly payments by 6.5% on average (see column (6)). In contrast, non–overage payers who switched plans reduced their monthly payments by 25.6%.

The panel data estimation results, together with the hazard analysis, lead to interesting insights regarding the experience-based learning process in three-part tariff plan choice. Our findings imply that customers' experience with new three-part tariff plans can result in lower payments if these customers have not previously paid overage fees. If, on the other hand, customers do experience overage payments, then although they are more likely to switch plans, they are also more likely to choose new plans that increase their overall payments to the bank. Our analysis thus suggests that customers who have experienced overage payments seek to avoid paying such payments and, in order to achieve this goal, end up paying excessively high fixed fees. In the next section, we aim to quantify the sensitivity of customers to overage payments relative to fixed payments.

4. Modeling Customers' Choice Process

In this section, we provide a quantifiable measure for overage aversion. We do so by modeling customers' choice process and by integrating the separate effects of plan payment and overage payments into the plan choice. We define the utility (U) perceived by customer i from choosing a given plan j at time t as

$$U_{ijt} = V_{ijt} + \varepsilon_{ijt}, \tag{4}$$

where V_{ijt} represents the deterministic part of the utility obtained from choosing alternative j. We specify V_{ijt} to be a function of four main elements, as follows:

$$V_{ijt} = \beta_{ij0} + \beta_{i1} FP_j + \beta_{i2} OP_{ijt} + \beta_{i3} PB_j + \beta_{i4} C_{ijt-1}, \tag{5}$$

where β_{i1} and β_{i2} are payment sensitivity coefficients that capture, respectively, the differential effects of the fixed payment associated with plan j, FP_j, and of the overage fees, OP_{ijt}, that customer i would incur by using plan j at time t. The latter variable is calculated individually for each customer according to his or her activity level in each time period and for every available plan at that time and therefore is customer-plan-time specific. We define the two price sensitivity effects to be customer specific. That is, we assume that each customer's sensitivity toward both payments is "drawn" from the distribution of these parameters across our population of customers. If indeed a customer is "overage averse," we expect the customer's sensitivity to overage payments to be larger in absolute value than his or her sensitivity to fixed fee payments (i.e., $|\beta_{i1}| < |\beta_{i2}|$).

The parameter β_{ij0} is a customer-plan-specific effect, capturing the inherent tendency of customer i to choose plan j. PB_j in Equation (5) stands for the additional plan benefits provided for the two most expensive plans.[8] Here, too, we define the effect of these benefits, β_{i3}, to be customer specific. Finally, the last component in Equation (5), β_{i4}, represents a possible state dependence affecting customers' choice (Seetharaman 2004, Seetharaman and Chintagunta 1999). This state dependence can be viewed as "inertia," "stickiness," or a "status quo bias" effect (Rivot and Baron 1992, Samuelson and Zeckhauser 1988) that hypothetically raises the probability that the customer remains in the current state during the next time period. The state dependence is integrated into the model using a brand choice indicator variable:

$$C_{ijt} = \begin{cases} 1 & \text{if plan } j \text{ is chosen by} \\ & \quad \text{customer } i \text{ at time } t, \\ 0 & \text{otherwise.} \end{cases} \quad \forall j = 1, \ldots, J, \tag{6}$$

Next, we decompose the individual parameters (β_{i1}, β_{i2}, β_{i3}, β_{i4}) in Equation (5) according to customer characteristics, in the following manner (variable notations are defined in Table 7):

$$\beta_{ik} = \begin{pmatrix} \alpha_{k0} + \alpha_{k1} Num\_owners_i & + \alpha_{k2} Salary_i & + \alpha_{k3} Num\_salaries_i \\ + \alpha_{k4} Inf\_trans_i + \alpha_{k5} Age_i & + \alpha_{k6} Tenure_i & + \alpha_{k7} Social\_kids_i \\ + \alpha_{k8} Social\_old_i + \alpha_{k9} Loans_i & + \alpha_{k10} Savings_i & + \alpha_{k11} negative\_balance_i \\ + \alpha_{k12} positive\_balance_i & + \alpha_{k13} Socio_i & + \alpha_{k14} Adopt\_month_i \end{pmatrix} + \upsilon_{ki}, \tag{7}$$

with $k = 1, 2, 3, 4$;

$$\upsilon_{ki} \sim \text{MVN}(0, \Sigma_\beta). \tag{8}$$

Assuming an independent and identically distributed extreme value distribution for ε_{ijt} in Equation (4) allows us to use the standard logit formula for plan choice probabilities. Thus, conditional on customer i's

[8] For plans 5 and 6, the bank offered an additional benefit that could amount to a yearly gain of up to \$10.

Table 7 Choice Model Estimation Results

	Variable notation	β_1-fixed plan price	β_2-overage payment	β_3-other benefits	β_4-stickiness
Mean effect		**−0.13**	**−0.46**	−0.34	**3.84**
Intercept		**−5.54E–01**	**−3.69E–01**	**−7.86E–01**	**4.04**
Number of owners	Num_owners_i	1.01E–02	−2.37E–03	2.32E–02	9.93E–03
Salary	$Salary_i$	4.45E–07	−8.40E–08	6.54E–07	9.95E–07
Number of salaries	$Num\_salaries_i$	−2.22E–03	5.07E–05	6.25E–03	4.75E–03
Number of account information inquiries	Inf_trans_i	3.34E–05	−1.49E–05	−1.30E–05	4.45E–05
Age	Age_i	**−9.42E–04**	2.08E–04	−1.19E–03	−6.27E–04
Account tenure	$Tenure_i$	2.68E–04	−5.04E–06	**2.02E–03**	2.46E–04
Parental Social Security benefits	$Social\_kids_i$	**5.08E–05**	−9.15E–06	**5.15E–05**	1.17E–05
Elderly Social Security benefits	$Social\_old_i$	7.40E–07	3.94E–07	−1.09E–07	−7.69E–06
Loans	$Loans_i$	**9.66E–08**	−1.72E–08	9.23E–08	3.76E–08
Savings	$Savings_i$	**7.74E–08**	−1.67E–08	6.00E–08	2.11E–08
Mean level of positive account balance	$Positive\_balance_i$	**1.88E–06**	−6.64E–07	−1.40E–06	**1.84E–06**
Mean level of negative account balance	$Negative\_balance_i$	**1.38E–05**	**−3.02E–06**	**1.16E–05**	**5.79E–06**
Socioeconomic indicator (*scale of* 1 *to* 10)	$Socio_i$	−1.35E–03	−1.12E–03	−3.19E–03	**7.21E–03**
Adoption month	$Adopt\_month_i$	**3.50E–02**	**−6.39E–03**	**3.59E–02**	**−2.38E–02**

Notes. Bold numbers indicate that 0 lies outside the 95% highest posterior density interval of the estimate for the population mean. This table presents the estimation results of the choice model. The overage aversion measure is based on the ratio of β_2 and β_1.

adoption of a three-part tariff plan, the choice probability (P_{ijt}) that customer i chooses plan j at time t is specified as a multinomial logit model:

$$P_{ijt} = \frac{e^{V_{ijt}}}{\sum_{j=1}^{J} e^{V_{ijt}}}. \quad (9)$$

The likelihood function is therefore

$$l(\{B, A\}) = \prod_{i,j,t} (P_{ijt} \mid B, A), \quad (10)$$

where B represents the matrix of first-layer parameters (β_{ij0}, β_{i1}, β_{i2}, β_{i3}, β_{i4}), and A represents the parameters in the second layers (α_{k0-16}). For the estimation, we used the hierarchical Bayes Markov chain Monte Carlo (HB MCMC) estimation procedure. Further details regarding the estimation are presented in Online Appendix C.

Table 7 presents the estimation results for the choice model. We find that the mean price sensitivity coefficient for the plan's fixed payment is more than three times smaller than that for overage payment ($\beta_{i1} = -0.13$, SD $= 0.02$; $\beta_{i2} = -0.46$, SD $= 0.02$). These findings imply that for the average customer, \$1 paid as overage payment has the same weight as \$3.5 paid as part of a fixed plan payment, that is, customers overweigh payments outside the allowance. This finding is consistent with our notion of overage aversion, whereby customers prefer plans with large allowances and high fixed payments and further switch to such plans after paying overage payments. This measure is somewhat higher than the loss aversion factor proposed by Tversky and Kahneman (1992), and estimated to be 2.25.

Our second-layer estimates indicate that customers' price sensitivity to a plan's fixed fee increases with customer age, but also decreases with the number of children below the age of 18 as captured by the amount of Social Security parental benefits. We further find that accounts with higher levels of savings, loans, or positive or negative balances are less sensitive to fixed fee payments. Interestingly, we find that customers who adopted three-part tariff plans later after their introduction were more overage averse (i.e., more sensitive to overage payments and less sensitive to price) compared with customers who adopted earlier. We also find that there is a strong stickiness effect leading customers to remain with their previously chosen plans ($\beta_{i4} = 3.84$, SD $= 0.02$). In line with our hazard model estimation results, we find that customers who are later adopters are less likely to stick with their chosen plans.

5. Possible Explanations

Previous studies that documented a flat-rate bias have offered several possible explanations for this bias (e.g., Lambrecht and Skiera 2006). In this section, we discuss these explanations and argue why we think that mental accounting coupled with loss aversion provide the most plausible explanation for our empirical findings.

5.1. Mental Accounting and Loss Aversion

Mental accounting theory implies that individuals conceptually group expenditures into categories ("mental accounts") and do not treat money as fungible across categories. In the context of this paper, we suggest that customers who choose among three-part tariff plans treat fixed fee payments and overage payments as separate mental accounts, and that they associate different levels of disutility with paying from different accounts. In particular, our findings

imply that customers are less sensitive to payments from the "fixed fee account" than they are to payments from the "overage payments account." We further propose that this higher sensitivity is related to the theory on *loss aversion*, which is an essential element of mental accounting (Thaler 1999). Loss aversion refers to individuals' propensity to prefer avoiding losses to obtaining gains. Kőszegi and Rabin (2006, 2007) suggest that customers construct reference points based on their rational expectations about outcomes, and that gains and losses come into play when there is uncertainty. Accordingly, we propose that customers distinguish between expected "within-budget" payments (fixed monthly fees) and "unexpected" payments occurring when customers exceed their plan allowance (overage payments). Because of the unique, nonlinear structure of three-part tariff plans, loss aversion occurs only with respect to the uncertain overage payments. We further assume that customers incur greater psychological costs when paying overage payments compared with the psychological costs associated with the old pay-per-use pricing scheme. This distinction is attributed to the strong role of the fixed plan fees in forming customers' expectations regarding payments. The fixed plan fees are a natural reference point in the minds of customers, and deviations from these expectations are psychologically costly, whereas the old pay-per-use system has no inherent reference point.[9] Therefore, adopting customers try to avoid such unexpected psychologically costly payments by choosing plans with higher expected monthly payments.

5.2. Overestimation of Demand

An alternative explanation for our findings is that customers overestimate their usage levels at the time of plan adoption and consequently adopt plans with large allowances. In addition, customers further interpret experiencing overage payments as a signal of increased usage and subsequently switch to plans with even larger allowances. Previous studies on choice among three-part tariff plans that focused on new services have suggested demand overestimation as a main explanation for flat-rate bias.

Unlike previous papers, we focus on a well-established service in which customers are less likely to overestimate their usage. Moreover, our data allow us to further investigate the explanation of demand overestimation by focusing on the behavior of quitting customers. If indeed customers view overage payments as signals for increased usage, then we expect them to view the old pay-per-use system as an inferior alternative to a more expensive three-part tariff plan. This is because the old payment system implies a linear increase in payment with usage, while a more expensive plan entails a "flat" range in which costs do not increase with higher levels of usage. Thus, under demand overestimation we would expect overage payments to have a negative effect on quitting. Conversely, under the overage aversion explanation both switching upward and quitting might be an optimal response because they lower the possibility of incurring unexpected overage payments.

Furthermore, among customers who decide to switch plans after experiencing overage payments, the customers who initially subscribed to plans with larger allowances have fewer options to choose from compared with customers subscribed to plans with lower allowances. Thus, under the overage aversion explanation we can expect that the larger the allowance of a customer's initial plan, the greater the likelihood that the customer will quit after experiencing overage payments. Table 8 presents the estimation results of two hazard models for quitting. The first model includes overage payments and the current plan number (one for plan 1, two for plan 2 etc.) as explanatory variables. In the second model, we further include an interaction term between the amount paid as overage payment and the customer's current plan number. We find that the hazard of quitting increases with the amount paid as overage payment. Moreover, the effect of the interaction between the amount paid as overage payment and the current plan of the customer is positive and significant. This positive interaction suggests that the larger the allowance of a customer's initial chosen plan, the more likely the customer is to quit following overage payments. This behavior contradicts our expectations under the demand overestimation explanation yet is consistent with the overage aversion explanation for the behavior revealed in our data.

5.3. Pain of Paying

Prelec and Loewenstein (1998, p. 4) propose that customers experience a "pain of paying" (also referred to as the taxi-meter effect) that can undermine the utility they derive from consumption. Paying per use lessens the joy from consumption because at the time of usage, users often experience an immediate pain of paying. Prelec and Loewenstein (1998) emphasize the distinction between payments before versus after consumption and argue that consumption that has been paid for in advance can be enjoyed as if it were free (Prelec and Loewenstein 1998, Thaler 1999). Accordingly, they predict that customers will prefer prepaid fixed pricing plans over pay-per-use pricing schemes.

Although the explanation based on mental accounting and loss aversion (§5.1) and the explanation based on the concept of pain of paying are closely related, we believe that these concepts are not exactly identical. First, Prelec and Loewenstein (1998) emphasize

[9] For a similar argument, see Herweg and Mierendorff (2013).

Table 8 Hazard Regression Analysis for Quitting Decision

	Quitting hazard regression		Quitting hazard regression	
Variable	(1) Parameter estimate (SE)	(2) Hazard ratio	(3) Parameter estimate (SE)	(4) Hazard ratio
Monthly cumulative overage payment[a]	0.02*** (0.00)	1.02	−0.01 (0.01)	.
Initial plan—ordered[c]	−0.17*** (0.03)	0.85	−0.19*** (0.03)	.
Overage payment ∗ *Initial plan choice*			0.01*** (0.00)	.
Upward initial choice bias[b]	0.32*** (0.09)	1.37	0.32*** (0.09)	1.38
Downward initial choice bias[b]	0.75*** (0.18)	2.12	0.81*** (0.18)	2.24
Adoption month[b]	0.02** (0.01)	1.02	0.02** (0.01)	1.02
Number of owners[a]	0.07 (0.07)	1.07	0.07 (0.07)	1.07
Number of account information inquiries[a]	−5.59E–04 (7.09E–04)	1.00	−5.81–04 (7.25E–04)	1.00
Salary[a]	−0.10** (0.05)	0.90	−0.10** (0.05)	0.90
Number of salaries[a]	−0.29*** (0.07)	0.75	−0.29*** (0.07)	0.75
Account tenure[b]	8.08E–05 (3.88E–03)	1.00	2.17E–04 (3.89E–03)	1.00
Customer age[b]	0.01*** (0.00)	1.01	0.01*** (0.00)	1.01
Parental Social Security benefits[b]	−1.09E–03** (5.33E–04)	1.00	−1.11E–03** (5.33E–04)	1.00
Elderly Social Security benefits[b]	6.46E–04*** (1.17E–04)	1.00	6.57E–04*** (1.17E–04)	1.00
Mean level of positive account balance[b]	1.09E–04*** (1.52E–05)	1.00	1.08E–04*** (1.54E–05)	1.00
Mean level of negative account balance[b]	−3.67E–04*** (6.19E–05)	1.00	−3.63E–04*** (6.52E–05)	1.00
Loans[b]	−0.01 (0.01)	0.99	−0.01 (0.01)	0.99
Savings[b]	1.50E–03*** (3.49E–04)	1.00	1.52E–03*** (3.49E–04)	1.00
Socioeconomic indicator[b]	0.01 (0.02)	1.02	0.02 (0.02)	1.01
Observations[d]	181,485		181,485	

Notes. This table shows the estimation results of a proportional hazard regression for the duration between the time of plan adoption and the time of quitting (returning to the old pricing scheme). In the second regression (columns (3) and (4)), we add the interaction between the number of the plan and the cumulative overage payment that the customer paid as an additional control variable. For dummy variables, the hazard ratio represents the ratio of the estimated hazard for observations with a value of 1 to the estimated hazard for those with a value of 0 (controlling for all other model variables). For continuous variables, subtracting one of the hazard ratio gives the estimated percent change in the hazard for each one-unit increase in the explanatory variable.

[a]Time-varying variable.

[b]Non-time-varying variable.

[c]The number of the plan, ordered according to the size of the allowance and fixed monthly fee. Plan 1 has the smallest allowance and lowest fixed monthly fee, and plan 6 has the highest allowance and the largest fixed monthly fee.

[d]Balanced panel of plan adopters by $t = 10$ (i.e., first 15 months of postadoption observations). The panel does not include eventual switchers.

$^{**}p < 0.05$; $^{***}p < 0.01$.

the timing of payment, before or after consumption, as a main reason why customers prefer fixed payments to pay-per-use schemes. However, the timing of payment in relation to usage is not likely to have influenced our results, because in our setting, as in many other subscription services that offer menus of three-part tariff plans, fixed payments and overage payments are made at the same time. A second difference concerns the variability in payments. According to the theory of Prelec and Loewenstein (1998),

customers should experience a similar pain of paying when subscribed to the old pay-per-use scheme. We argue, however (see §5.1), that the psychological costs associated with paying arise only for usage above a certain reference point, which we assume is the allowance of a particular plan.

Thus, if indeed customers try to avoid the disutility associated with per-usage payments, we would expect them to also avoid the old pay-per-use payment system. Yet, as shown above (see Table 8), overage payments trigger not only switches to plans with larger allowances but also quitting behavior, that is, reversion to the old pay-per-use option. Thus, unless customers do not associate the old payment system with per-usage payments, this behavior likely contradicts the pain of paying explanation and is more consistent with the loss aversion explanation we propose.

5.4. Plan Benefits

Subscribing to a service plan, and in particular to a plan with a large allowance, can in some cases serve as a social signal, enhancing a customer's image by impressing other individuals. However, in the context we analyze, the particular three-part tariff plan chosen by the customer is typically not observed by others. Hence, we believe that the social benefits that customers derive from choosing larger plans are negligible. In addition, there are no other nonsocial benefits such as better customer service for customers who choose higher plans. Moreover, an enhanced self-image cannot explain the role of overage payments in triggering switching to plans with larger allowances, or quitting the new three-part tariff plans altogether.

5.5. Persuasion and the Role of Sales Agents

Customers' tendency to choose plans with larger allowances can also be attributed to the marketing campaign that accompanied the introduction of the new plans. Also, sales agents could potentially persuade customers who incurred overages to switch to larger plans. Indeed, marketing calls had a large impact on the adoption of three-part tariff plans. Yet, as we also show in Online Appendix B, these marketing calls are not statistically associated with subscribing to larger-than-optimal plans. In fact, discussions with bank managers reveal that the bank's objective in introducing the new plans was to induce account holders to switch to direct (e.g., Internet) channels in order to cut back on the workload for clerks employed in the bank. Thus, if anything, the marketing efforts were aimed at encouraging customers to choose plans with low allowances of clerk-assisted activities. Furthermore, persuasion cannot explain why customers who incurred overage payments were likely to return to the old pricing plan. With respect to switching, we also find that marketing calls are unlikely to have affected switching decisions, because marketing calls were performed to encourage plan adoption, that is, they were targeted at customers who had not yet adopted a plan.

6. Discussion and Concluding Remarks

A growing empirical literature that uses real-world data has documented a wide variety of biases from the standard model of rational choice. Yet the practical importance of such biases can be questioned if customer experience leads to the reduction or even the elimination of these systematic biases. In fact, previous field studies on the role of experience have indeed provided evidence that individuals overcome initial bias after gaining experience. In this paper, we contribute to this debate by investigating whether customers who initially choose nonoptimal three-part tariff plans improve upon their initial choices after gaining experience with these plans.

We rely on a unique and rich individual monthly level data set spanning 30 months, before and after a commercial bank introduced a menu of three-part tariff plans. In line with prior research, our analysis indicates that customers "leave money on the table" and do not initially choose their cost-minimizing plans. We also document strong evidence for a flat-rate bias, implying that customers choose plans that offer larger allowances, and consequently entail higher monthly fixed payments, as compared with the plans that would have minimized costs. More importantly, our analysis of switching decisions indicates that the choice anomalies we document do not disappear as customers gain experience with the new plans. To the best of our knowledge, ours is the first study that uses field data and finds that specific types of experiences can systematically lead customers to worse economic outcomes. In particular, our findings suggest that customers are sensitive to the specific experience of paying overage fees. We suggest that this overage aversion is the source of both the initial flat-rate bias and the bias observed in customer switching decisions. Our estimation results for a logit choice model suggest that, on average, customers are 3.5 times more sensitive to overage payments than they are to fixed plan fee payments.

Our paper is related to theoretical papers on the saliency of information (e.g., Bordalo et al. 2012a, b). These papers offer a conceptual framework that seeks to explain violations of expected utility theory by emphasizing the role of salient information available to the decision maker (e.g., Sydnor 2010). In the context of our study, if customers attach greater salience to information on actual overage payments than to information on fixed payments, they are more

likely to react to overage payments by switching to new plans, specifically, plans that are less likely to involve making such payments (i.e., plans with larger allowances). Similarly, customers may initially adopt plans with large allowances in order to avoid paying these salient overage payments.

This paper also provides insight regarding the impact of three-part tariff plans on firms' profits and can explain why firms choose to offer these types of plans. Because customers consistently choose plans with too-large allowances, offering a menu of three-part tariff plans substantially increases the revenue of the firm. In other words, overage aversion that leads to a flat-rate bias can serve as an additional explanation for the increasingly common use of three-part tariffs in a variety of industries (Grubb 2012). In addition, our findings relate to the recent debate on the Federal Communications Commission bill-shock agreement with U.S. cellular carriers. This agreement, expected to become effective in April 2013, requires cellular carriers to notify subscribers as they near their allowance limit. One potential implication of such notifications is a further increase in the salience of overage payments that can affect not only customers' cellular usage but also their plan choice behavior.

Our findings that customers who paid overage payments updated their initial plan choice by switching to a larger plan could suggest that customers learn about their own overage aversion. The idea that individuals can learn about their own preferences is different from the more common assumption in learning models that preferences are known and that individuals learn about their usage or about the quality of the chosen good. We believe that customers learn both about their usage level and about their sensitivity to the features of the new plan, and, specifically in our setting, about their sensitivity to overage payments. Although all plan adopters undergo a learning process regarding usage, the learning process regarding one's overage aversion is likely to be more pronounced among customers who experience overage payments. An open question is whether customers eventually learn about their true overage aversion (Ali 2011). Future research can formalize customers' learning patterns regarding overage aversion and investigate how these learning patterns are affected by overage payments and by customer characteristics. Future studies could also verify whether our findings can be generalized to other industries in which firms offer three-part tariff plans. Given that several other studies, investigating a variety of other industries, have also documented the existence of flat-rate biases in customer choice, we believe that our findings will indeed be generalizable. Furthermore, although the relative magnitude of the estimated effect of overage aversion on customers' payments is large, its per-customer manifestation in absolute monetary monthly values is arguably not large (as compared with the average income and savings in our data set). Future research in similar settings that involve larger payments in absolute values can shed more light on the magnitude of the effect.

Acknowledgments

The authors are grateful for the comments and suggestions made by Nuno Camacho, Liran Einav, David Genesove, Moshe Givon, Uri Gneezy, Eugenio Miravete, Gal Oestreicher-Singer, Roni Shachar, and Rani Spiegler, and by seminar participants at the 10th Stanford Institute for Theoretical Economics Conference on Psychology and Economics, the Hebrew University, the Tel Aviv University, the Ben-Gurion University, the Interdisciplinary Center Herzliya, the 2011 International Industrial Organization Conference in Boston, and the 2011 Marketing Science Conference in Houston. The authors also thank Irit Fishel for providing excellent research assistance. This research was supported by the ISRAEL FOUNDATIONS TRUSTEES. Remaining errors are those of the authors.

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