# Do Customers Learn from Experience? Assessing Experience-Based Choices among Three-Part Tariff Plans

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Gaining experience can result in worse economic outcomes. We use a rich panel data covering 70,000 checking accounts over 30 months, before and after a commercial bank introduced a new three-part tariff plan, to study customers' plan choices and subsequent switching decisions. We find that most customers do not adopt their cost-minimizing plans, preferring plans with large monthly allowances and high fixed payments. This tendency is stronger for customers with lower socio-demographic background, who have more children and who perform fewer information inquiries about their account. We also find that after plan adoption, customers who exceed their plan allowances and consequently pay overage fees are more likely to switch to plans with larger allowances than customers who do not. Notably, controlling for usage, these customers pay *higher* monthly payments after plan switching. Conversely, plan switchers who have not paid overage fees prior to switching plans reduced their monthly bank payments. We propose that mental accounting can explain these patterns because customers are less sensitive to payments from the 'fixed fee account' than they are to payments from the 'overage fees account'. To quantify this effect we estimate a discrete choice model and find that customers are 3.5 times more sensitive to overage fees than to monthly fixed payments.

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## I. Introduction

Customer learning through experience is often used to motivate individual optimization behavior that can explain many economic models of rational behavior. For instance, theoretical models have shown that customer learning can mitigate informational market imperfections and to discipline firms' pricing and product quality decisions. The interest of economists in the sources and the consequences of customer experience has heightened in recent years as 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 customer contracts (e.g. DellaVigna 2009; DellaVigna and Malmendier 2004, 2006; Lacetera, Pope, and Sydnor 2012). If customer experience does mitigate initial customer biases, then the effectiveness of firms' attempts to take advantage of such biases can become rather limited. Hence, a central question in the behavioral economics literature is to what extent customers' experience with contracts that are likely to exploit their behavioral biases leads them to learn about their initial mistakes and to correct for these biases.[1]

Due to data limitations very few studies have used micro data field data to explore the sources and consequences of customer experience (Miravete 2003, Agarwal, Driscoll, Gabaix and Laibson 2011, Haselhuhn et al. 2012). A main message of these studies is that experience leads to better outcomes and can ameliorate initial mistakes or choice anomalies. In this paper we aim to contribute to the literature by providing evidence from the retail banking industry that customer experience can, and in most cases does, result in *worse*, rather than better, economic outcomes.

More broadly, the main objectives of this paper are threefold: (1) to document evidence for flat-rate bias in three-part tariff plan choice, which implies that customers tend to have insufficient usage to warrant the costs of their chosen plans (DellaVigna and Malmendier 2006; Goettler and Clay 2012; Lambrecht, Seim, and Skiera 2007; Lambrecht and Skiera 2006; Train et al. 1987); (2) to test whether customer learning through experience indeed leads customers to alter their decisions and correct for the aforementioned behavioral bias; and (3) to characterize conditions under which such a correction might occur.

Our focus is 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

[1] Levitt and List (2008) write: "exploring how markets and market experience influence behavior represents an important line of future inquiry."

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. Such pricing schemes have become common in recent years, as advances in technology have enabled both firms and customers to track usage levels over billing periods.

In the empirical analysis, we use a rich data set comprising detailed monthly data on about 70,000 checking accounts. The data span 30 months, starting 6 months before the introduction of the three-part tariff menu. This new pricing scheme was offered to existing bank customers, together with the option of continuing to be charged according to the previous pay-per-use pricing scheme. Our data allow us to evaluate the decisions of both adopters and non-adopters of the new three-part tariff plans, and to assess the optimality of their adoption decisions based on usage either before or after adoption. Because we follow customers' choices over a period of more than two years, and since customers did not face any contractual or monetary switching costs, our data allow us the unique opportunity to evaluate customers' dynamic switching behavior and to investigate the potential sources and implications of this behavior.

Our analysis of the initial plan choices reveals that in only 17% to18% of these initial choices, the chosen plan was in fact acost-minimizing plan for the customer. These estimates are based on usage patterns before and after the adoption of the plan, respectively. In addition, and in line with prior studies that documented a flat-rate bias, we find that the vast majority of customers chose three-part tariff plans in which consumption allowances were larger than those offered in the plans that would have minimized costs.

The analysis of customers' post-choice switching decisions indicates that overage payments that are associated with the initially-chosen plans are strongly associated with subsequent switching decisions, and specifically, with decisions to switch to plans with larger allowances. We also find that the majority of plan switchers do not switch to the plans that minimize their costs. In particular, we find that switching decisions that follow overage payments result in *higher* payments to the bank. This finding contrasts the typical assumptions of economic models, whereby new information gained through experience improves choice outcomes (Becker 1976), as well as empirical evidence in the context of other choice biases that documents improvements in customers' states after gaining experience (e.g. List 2003, 2004; Miravete 2003; Ketcham et al. 2012, Agarwal, Driscoll, Gabaix and Laibson 2011, Haselhuhn et al. 2012). We also find that when customers who

have not paid overage payments switch plans, they are more likely to choose plans with smaller allowances, and end up reducing their overall costs.

We term this unique role of overage payments in customers' decision making '*overage aversion*', and suggest that 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 non-monetary cost created by overage payments, we estimate a discrete choice model that allows us to evaluate customers' relative sensitivity to fixed payments as compared to 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 suggest that the psychology of *mental accounting* might provide an explanation for the nature of decisions we witness, both for initial plan choices and for the subsequent post-choice decisions. This theory implies that individuals conceptually group expenditures into categories ('mental accounts') and do not treat money in each category as fungible. 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'. This view is also related to the theory on *loss aversion*, which is an essential element of mental accounting (Prelec and Lowenstein 1998; Thaler 1999). Loss aversion refers to individuals' propensity to prefer avoiding losses to obtaining gains. Koszegi 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 (overage payments), and that loss aversion occurs only with respect to the uncertain overage payments. Therefore, customers try to avoid such 'unexpected' payments by choosing plans with higher expected monthly payments.[2]

A few papers have investigated the question of experience-based decisions in various choice settings (Agarwal et. al 2006; Agarwal, Driscoll, Gabaix and Laibson 2011, Grubb and Osborne 2012; Ketcham et al. 2012; List 2003, 2004; Miravete 2003; Miravete and Palacios-

[2] Theoretically, choosing plans with too large allowances compared with those of the cost-minimizing plans can also be consistent with risk aversion behavior. Yet, Rabin (2000) has shown that risk aversion consideration can only explain decisions involving large-scale risks and does not apply to contexts involving modest stakes as is the case in our data.

Huerta 2011). These papers suggest that market experience does mitigate customers' initial choice biases. List (2003, 2004), for example, compares experienced and inexperienced collectors of sports memorabilia and trading cards and finds that individual behavior converges to the neoclassical prediction as market experience increases. Miravete (2003) analyzes adoption and switching decisions among customers facing two-part tariff plans and finds evidence that customers who switch reduce their overall payments to the firm. To the best of our knowledge, our paper is the first to thoroughly investigate the sources and consequences of customer learning in the context of three-part tariff plan choice. More importantly, our findings, unlike previous research on experience based learning, suggest that customers undergo a learning process that is inconsistent with traditional theoretical learning models.

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' experience with the service and its benefits is 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, Lambrecht, and Vilcassim 2011; Grubb 2009; Grubb and Osborne 2012; Jiang 2011; Lambrecht, Seim, and Skiera 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 their biased beliefs about their future usage. Due to data limitations, these studies did not thoroughly examine experience-based decisions, i.e., customers' post-choice behavior and the extent and nature of choice modifications by experienced customers. In this paper, we investigate plan choices made by experienced customers in a setting where uncertainty is expected to be lower, i.e., bank checking accounts. We expect low uncertainty among the 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, our analysis focuses on customers' switching decisions after gaining experience with the chosen plan, which helps us gain a better understanding of the factors affecting learning processes among customers and the consequences of such processes. In addition, switching decisions, as opposed to initial choices, allow us to focus on a subset of customers who are more likely to be informed and attentive and, therefore, even less likely to be affected by uncertainty in their choice behavior.

Our findings also add to the literature on the saliency of information (Camacho, Donkers, and Stremersch 2011; Finkelstein 2009; Haselhuhn et al. 2012; Stango and Zinman 2011). These studies have shown that customers' perceptions of the salience of particular pieces of information can affect their decision-making processes. In the context of three-part tariff plan choice, we claim that customers attach greater salience to information on actual overage payments than to information on fixed payments. This greater salience, in turn, can explain why customers who paid overage payments are more likely to switch plans, and in particular to switch to plans that are less likely to involve making such payments (i.e., plans with larger allowances).

The remainder of the paper is organized as follows. In section II we describe the industry we analyze and the data we use. In section III we present the empirical analysis and our findings regarding initial plan adoption decisions, switching decisions, and their consequences for the customer's overall payment to the firm. In section IV we present the estimation results of the logit model for customer choice, and in section V we discuss and conclude.

## II. Data and Industry Background

### II.*A. Data*

We use data on the introduction of three-part tariff plans by a commercial bank to its active customers. The new pricing plans provided an alternative to an 'old' pricing system that had previously been the only system used in the banking industry of the analyzed market at the time of introduction. The 'old' system 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. Under the 'old' system, in addition to paying according to the type and volume of their activity, customers also paid a fixed amount per transaction (i.e., for each row in their account statement), and a fixed monthly amount. When the new three-part tariff plans were introduced, each of the bank's customers had the option of continuing to use the 'old' service system, or choosing one of the new plans. Continuing with the 'old' system 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' system (we refer to this as 'quitting') at any time. A customer could join a plan, switch to a different plan, or go back to the 'old' system 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 (see Landsman and Givon (2010) for a further discussion of the data).

*Three-part Tariff Plans*,—Customers who chose to adopt a three-part tariff plan 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 through personalized channels that involve interaction with a clerk at a bank's branch or through a call center. Any transaction above one's allowance entailed overage payment above the basic plan cost. The additional payment depended on the channel used for the extra transaction, and overage fees for each type of transaction were the same across different plans. In Table 1, we present the details of two three-part tariff plans, which represent the least expensive - lowest allowance - plan (plan 1), and the next to most expensive – largest allowance - plan (plan 5). For the two plans with the largest allowances (plans 5 and 6), the bank also offered an additional benefit that could amount to a yearly gain to the customer of up to $10. 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 the exception of one plan from the set of the four initial plans, which was removed from the choice set nine months after its introduction (customers who chose the removed plan before its removal could still use it after its removal from the set).[3] Throughout the analysis, the number of the plan is an indication of the size of the allowance (e.g., Plan 2 is more expensive and has a larger allowance than Plan 1).

*Data*.—We use panel data on individual plan choices of a sample of 70,000 customers out of a list of one million customers whom the bank identified as potential candidates for the service. Our sample's population includes customers who had been managing active accounts for at least six months at the time that the new service was introduced; moreover, the data set

[3] 18 months after the first four plans were introduced five new plans were added to the existing set of plans. These five new plans were each similar to one of the previously-introduced plans in terms of transaction allowance and overage fees. However, each of the five new plans was more costly and offered the option of account-level interest offsetting, a feature that was not available in any of the other plans. In our sample, 2440 customers chose one of these "interest offsetting" plans as their initial plan, and 8,771 customers who initially chose one of the regular plans subsequently switched to one of the "interest offsetting" plans. Our current data do not allow us to fully investigate how much each customer gained from the possibility of offsetting or to compare this gain to the additional cost that this feature entailed. Therefore, we focus our analysis only on the first six three-part tariff plans and do not consider the optimality of plan choice for users of plans that offer the possibility of offsetting.

did not include very young or inactive customers. The data were collected over the course of 30 months (from six months before service introduction until 24 months after introduction).

The data include information on the plans used by each customer in each month, as well as additional detailed monthly-level information for every customer. In particular, we have detailed information on each customer's monthly account activity according to 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 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 socio-demographic index[4]) of the account. 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 dataset.

### *B. Economic Environment*

The banking industry in the country we investigate is highly concentrated. In the analyzed time period, there were three large banks that held more than 85% of the market of individual bank accounts. 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 was the first to offer the new pricing scheme to its customers. Throughout the paper, we convert the local monetary unit into nominal dollars.

## III. Analysis

In our sample, 32,599 customers adopted one of the six investigated three-part tariff plans. Of those customers, 2,268 eventually switched to one of the other five three-part tariff plans, while 2,160 opted to return to the 'old' payment system.

### *A. Initial Plan Choice*

[4] A scale of 1 to10. Higher values indicate a higher socio-demographic status for the address of the customer.

*Which Customer Chooses a Three-part Tariff Plan?*—Table 2 presents the summary statistics for plan adopters and non-adopters for the data variables.[5] On average, adopters pay higher monthly bank commission charges than non-adopters (7.30 vs. 3.69), and show more active involvement in managing their accounts. They perform, on average, more information inquiries regarding their account compared with non-adopters (6.59 vs. 4.81 monthly information inquiries for adopters and non-adopters, respectively). The number of transactions is also higher among adopters, who carry out, on average, 0.94 clerk-assisted transactions, 3.33 direct transactions, and 3.56 check deposits per month, compared with 0.57 clerk-assisted transactions, 1.70 direct transactions, and 1.66 check deposits by non-adopters. Non-adopters 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 non-adopters. In column 1 in Table 3 we present the results of a logit regression for plan adoption. An observation in this regression is a customer, and the dependent variable equals one if the customer chose a three-part tariff plan during the investigated timeframe and zero otherwise. In general, the regression results are consistent with the summary statistics presented in Table 2. For example, age and savings correlate negatively with plan adoption, whereas the account holder's mean commission payment under the 'old' payment system, salary, number of children below the age of 18 (implied by the amount of the parental social security benefits), and the number of marketing calls correlate positively with plan adoption. In addition, the number of account owners, the customer socio-demographic index and the number of account information inquiries are each negatively associated with adoption.

Overall, these findings suggest that customers with high usage volume (measured by their pre-adoption payments) are more likely to adopt one of the new plans, whereas low-volume customers tend to prefer the 'old' pricing plan, which requires lower fixed monthly bank payments.

*Optimality of Initial Plan Choices*.—We define a customer's optimal plan as the plan (including the 'old' pay-per-use payment option) that minimizes the customer's payments to the bank given his or her usage profile. A customer might choose a plan that is not optimal for

[5] Due to confidentiality concerns we are not allowed to reveal the summary statistics for the following variables: salary, loans, savings, monthly mean positive balance, and monthly mean negative balance. We use these variables in the regression analysis.

his or her past usage behavior yet could be optimal given a behavioral change (i.e., if after choosing the plan, the customer alters the way he or she manages the account). We therefore assess the optimality of customers' plan choices using both an ex-ante approach (i.e., by evaluating pre-choice usage behavior) and an ex-post approach (i.e., evaluating post-choice usage behavior). In Appendix A we elaborate on the various calculation schemes used for the optimality assessment.

Comparing customers' actual payments to the payments that they would have made had they chosen their optimal plans (based on ex-ante optimality assessment), we observe that plan adopters paid, on average, $2.24 more per month than they would have under their optimal plans. In relative terms, adopting customers could have reduced their monthly payments by nearly 30% had they chosen their optimal plans. In a non-reported panel data regression on customer monthly payments with month and account fixed effects, we find that the monthly payments by adopting customers increased by 9% following plan adoption.[6] Thus, we find not only that adopting customers did not lower their monthly payments (i.e., by choosing their optimal plan) but also that their plan choices led to higher monthly payments after plan adoption. Customers who chose not to adopt one of the three-part tariff plans, paid, on average, $0.6 more per month than they would have had they chosen their optimal plans.

To better understand the extent to which account holders make optimal choices, we computed the percentage of account holders whose plan choices were optimal. We present this analysis first for the entire sample of account holders—adopters and non-adopters. Tables 4 and 5 present the distribution of optimal plans across plan adopters for each of the available plans. Each row in these tables presents the distribution of optimal plans for the customers who chose the particular plan represented in that row. For example, the number in the second column of row 5 in Table 4 indicates that the optimal plan for 4.6% of the adopters of Plan 5 is Plan 2. The diagonals in Tables 4 and 5 represent the percentage of customers who chose their cost-minimizing (optimal) plans. In Table 4, optimality is derived according to customers' usage during the three months before adoption (i.e., ex-ante optimality), and in Table 5 optimality is determined according to customers' usage after plan choice (i.e., ex-post adoption optimality).[7] If we aggregate over all customers according to either the ex-ante or the ex-post criterion, roughly 45% of account holders chose the optimal plan. Aggregating

[6] These results, which are available upon request, are for a regression that includes all plan adopters throughout the timeframe, before and after adoption.

[7] In both ex-post and ex-ante analysis we use the month of introduction as a reference month for the calculation of choice optimality among non-adopters.

over adopters, 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 3 months before and after the adoption of the plan, respectively.[8] In addition, the vast majority of non-optimal 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 4 and 5).

The findings presented in Tables 4 and 5 are partially driven by account holders whose default choice, i.e. the 'old' pay-per-usage plan, was also their optimal plan. To focus attention on active plan choices, we repeated this analysis for adopters only, considering only the new three-part tariff plans in the optimality analysis (i.e., we did not consider the possibility of non-adoption in this analysis). Tables 6 and 7 present the distribution of optimal plans across adopters of each three-part tariff plan (represented in each row). Aggregating over all customers, we find that only 29% of plan adopters actually chose the plans that minimized their payments to the bank, based on the usage patterns 3 months before and after the adoption of the plan. Furthermore, we observe that customers' non-optimal plan choices tend to follow a clear pattern: Again, as in the previous analysis, we observe that customers are inclined to choose plans with larger allowances than those of the optimal plans. This pattern is consistent with the phenomenon of "flat-rate bias", discussed above. Because our data cover the periods before and after plan choice, and the service we study is not a new service, we can also show that this pattern is generally not driven by changes in usage following the adoption of a three-part pricing plan.

In Columns 2 and 3 of Table 3 we examine the relationship between the characteristics of plan adopters and the nature of their initial choice (i.e., optimal choice vs. choice of plans with too high or too low allowances). We do this using a multinomial logit regression for customers who choose their optimal plans (the base category), plans with allowances that exceed customers' needs (defined as 'upward choice bias', column 2) and plans with allowances that fall below customers' needs (defined as 'downward bias', column 3). The estimates of these regressions suggest that account holders who are characterized by higher socio-demographic indices and with longer account tenure, and who perform more information inquiries are less likely to experience flat rate bias, i.e. choose plans with allowances larger than the allowances associated with their cost-minimizing plan. In addition,

[8] Once we expand the calculation time window for optimality calculation (see Appendix A), the range of optimality percentages isbetween 14% to 19%, corresponding to a 6 months window before and after plan choice, respectively.

a lower number of young children (as is implied by the parental social benefits) and a larger number of account owners are statistically associated with optimal plan choices. Interestingly, these results also suggest that the number of marketing calls, which had a strong effect on the initial adoption decision, had no effect on the optimality of the adoption decision.[9]

In the next section we focus on switching decisions of adopting customers. This analysis allows us to evaluate the sources and consequences of customer learning through experience. Moreover, as customers who choose to switch have already experienced plan usage for at least one month, we believe that their decisions should be more informed and are thus less likely to be affected by uncertainty than the initial plan choice decision.

*B. Switching*

*Who switches?*—In Table 8 we compare the characteristics of plan adopters who kept their initial chosen plans for the entire timeframe considered in our data set (column 1), plan adopters who switched to other plans after making their initial plan choices (column 2), and plan adopters who quit the new three-part tariff plans altogether (column 3). 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 to only 9% and 6% of months with excess clerk-assisted and check transactions, respectively, for non-switchers). Plan switchers also seem to be more active compared to quitters and non-switchers. For instance, they deposited, on average, 4.06 checks each month compared to 2.92 and 3.32 checks for plan quitters and non-switchers, respectively.

Figure 1 presents the relationship between switching decision and overage payments from another angle, classifying customers in terms of the optimality of their initial plan choices (initial downward bias, initial optimal choice, and initial upward bias). Clearly, in all cases, customers who eventually switched paid higher overage payments under their initial plans

[9] In fact, conversations with bank officials reveal that one of the bank's objectives in introducing the new plans was to induce account holders to switch to direct (e.g., Internet) channels in order to reduce the number of 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.

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 explore the potential triggers for switching, we performed a proportional hazard regression using a semi-parametric estimation procedure that allows for time-varying independent variables. In the first result column of Table 9, we summarize the estimation results of this switching hazard model. We find that the hazard of switching to another plan at time *t* significantly increases with the cumulative amount of overage payment paid by that time. 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 one percent. We also find that the number of owners managing the account, the number and size of the salaries deposited into the account, the size of the loans, and the size of the mean level of positive account balance all raise the hazard of switching to another plan. These latter findings are likely to be related to the increased involvement in plan choice decision in accounts that are managed by more owners and that involve managing more money.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.

*Optimality of Switching*.—Tables 10 and 11 present results of ex-ante and ex-post analyses of the optimality of switching choices among plan adopters who switched to other plans. A comparison of the tables suggests that there is a high resemblance between the ex-ante and ex-post optimality patterns. This suggests that switching is not associated with significant changes in the number or types of activities handled by account holders. Aggregating over all switchers, we find that only 14% of the switchers made the optimal switching choice. In other words, more than 85% of the customers who made a subsequent plan choice did not choose plans that minimized their costs based on their activity either before or after plan switching. Note that the percentage of non-optimal choices is even higher than that in the initial choice analysis. Focusing on the ex-post analysis (Table 11), we see that, as in the adoption choice analysis, customers who switched plans exhibited a strong flat-rate bias. That is, the majority of customers (60%) chose plans with allowances that were higher than those of the optimal plans. Only 1.5% of the non-optimal choices were for plans with smaller-than-optimal allowances, and for the rest (24.9% of the plan switchers) the cost-minimizing option was the ‘old’ payment system.

*The Influence of Overage Payment.*— In the previous sections we presented evidence that customers do not make optimal choices when switching between plans, and that overage payments are associated with the likelihood of switching. We now explore these findings in further detail. We proceed in two steps. First, we show that overage payments are strongly associated with switching to plans with larger allowances. Second, we show that such switching decisions are likely to lead to higher payments and are inconsistent with conventional learning behavior. In contrast, switching decisions by customers who did not face overage payments before switching are more likely to reduce their payments.

Figures 2 and 3 present the percentage of customers who switched to plans with larger allowances (defined as upward switchers) and the percentage of customers who switched to plans with smaller allowances (defined as downward switchers) according to the optimality of their consecutive plan choices. Figure 2 focuses on customers who paid overage fees before the switching decision, and Figure 3 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 are common only among switchers who previously paid overage payments. From Figure 2 we learn that 36% of the customers who switched after paying an overage payment had initially chosen their cost-minimizing plans. Nevertheless, these customers switched to more expensive plans. In fact, 91% of these customers switched to plans with larger allowances. In contrast, as shown in Figure 3, 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 optimal, cost-minimizing, plans. To provide further evidence on the effect of overage payments on customer tendency to switch upward, we carried out a hazard regression analysis. The second result column of Table 9 presents the estimation results of a hazard model for switching to a plan with a higher allowance (‘upward switching’). We find that the choice to switch to a higher plan is significantly associated with overage payments (with an odds ratio of 1.02). This association is even stronger than that for switching in general. We also find, as expected, that an initial downward bias raises the hazard of switching to a plan with a larger allowance.

The hazard analysis and Figures 2 and 3 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 that do not experience paying overage fees are less likely to switch, but those who do switch are more likely to choose an

optimal plan and reduce their monthly bank payments. Below we use panel data analysis to further substantiate this learning pattern as well as quantify its effect.

*The Effect of Switching on Monthly Payments*.—The panel data analysis presented herein 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:

$$(1)\quad Monthly\_payment_{it} = \beta_0 + \beta_A Activity_{it} + \beta_D D_{Adoption,it} + \beta_X X_{it} + \alpha_i + \eta_t + \varepsilon_{it}$$

$$(2)\quad Monthly\_payment_{it} = \beta_0 + \beta_A Activity_{it} + \beta_S D_{Switching,it} + \beta_X X_{it} + \alpha_i + \eta_t + \varepsilon_{it}$$

$Activity_{it}$ is a matrix that includes for each customer *i* the number of clerk-assisted and direct transactions and the number of checks deposited in each month *t*. The dummy variable $D_{Adoption,it}$ in Equation (1) equals one if customer *i* has adopted a three-part tariff plan by time *t*, and zero otherwise. Similarly, $D_{Switching,it}$ in Equation (2) is a dummy variable that equals one if customer *i* has switched plans by time *t* and zero otherwise. $X_{it}$ includes customer-level characteristics that vary over time. We implement a log-transform functional form for all model variables that are not binary variables. Finally, we also include account ($\alpha_i$) and time ($\eta_t$) fixed effects to control for unobserved differences across customers and unobserved time trends.

The regression results are reported in Table 12. In the first column, we report the results of a regression analysis for Equation (1). The sample in this regression includes all plan switchers for all time periods before plan switching (including pre-adoption 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 2 and 3 of Table 12, we report the estimation results for Equation (1), 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 'overage switchers' did not pay more to the bank in the months after adoption and before switching. In contrast, non-overage switchers paid nearly 19% more following adoption and before switching. These findings are consistent with the observation that non-overage switchers had initially chosen plans with excessively large allowances, and consequently did not pay overage payments.

In columns 4–6 we report the estimation results of a regression of Equation (2). 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 4 we report the estimation results for the entire sample of switching customers. In columns 5 and 6 we report the estimation results for overage and for non-overage switchers, respectively. The results presented in column 4 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 choices did improve their overall state after gaining experience. Note, however, that this decrease in payments after switching does not compensate for the initial increase in payments due to plan choice. Furthermore, we find evidence for heterogeneity among switchers in terms of payments following the switching decision. Overage payers who switched plans increased their monthly payments by 6.5% on average (see column 5). In contrast, non-overage payers who switched plans reduced their monthly payments by 25.6%. Note that these customers also had larger initial increases in post-adoption monthly payments yet were able to correct for their initial mistakes.

The panel data estimation results, together with the hazard analysis (Table 9), lead to interesting insights regarding the experience-based learning process in three-part tariff plan choice. Our findings imply that customers' experience is more likely to lead them to correct their initial mistakes if it does not include paying overage fees. If, on the other hand, customers experience overage payments, although they become 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 these customers seek to avoid paying overage payments and, in order to achieve this goal, end up paying excessively-high fixed fees.

## IV. Modeling Customers' Choice Process

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

$$U_{ijt} = V_{ijt} + \varepsilon_{ijt} \quad (3)$$

$V_{iij}$ in Equation (3) 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:

$$(4)\quad V_{ijt} = \beta_{ij0} + \beta_{i1} FP_j + \beta_{i2} OP_{ijt} + \beta_{i3} PB_j + \beta_{i4} C_{ijt-1}$$

$\beta_{i1}$ and $\beta_{i2}$ in Equation (4) are payment sensitivity coefficients that capture, respectively, the differential effects of the fixed fee plan of plan $j$, $FP_j$, and the overage fees incurred by customer $i$ in case of using plan $j$, at time $t$, $OP_{ijt}$. 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 towards both payments is 'drawn' from the distribution of these parameters across our population of customers. If indeed a customer is 'overage averse', we expect customer's sensitivity to overage payments to be larger than his or her sensitivity to fixed fee payments (i.e., $\beta_{i1} < \beta_{i2}$).

$\beta_{ij0}$ is a customer–plan-specific effect, capturing the inherent tendency of customer $i$ to choose plan $j$. $PB_j$ in Equation (4) stands for the additional plan benefits provided for the two most expensive plans. Here too we define the effect of these benefits, $\beta_{i3}$, to be customer-specific. Finally, the last component in Equation (4), $\beta_{i4}$, represents 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 Zeckhauzer 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:

$$(5)\quad C_{ijt} = \begin{cases} 1 & \text{if plan } j \text{ is chosen by customer } i \text{ at time } t \\ 0 & \text{otherwise} \end{cases}, \ \forall j = 1,\ldots, J$$

Next, we decompose the individual parameters ($\beta_{i1}$, $\beta_{i2}$, $\beta_{i3}$, $\beta_{i4}$) in Equation (4) according to customer characteristics, in the following manner:

$$(6)\quad \beta_{ki} = \begin{pmatrix} \alpha_{k0} + \alpha_{k1} Num\_owners_i + \alpha_{k2} Salary_i + \alpha_{k3} Num\_salaries_i \\ + \alpha_{k4} Salary_i + \alpha_{k5} Num\_salaries_i + \alpha_{k6} Inf\_trans_i + \alpha_{k7} Age_i \\ + \alpha_{k8} Tenure_i + \alpha_{k9} Social\_kids_i + \alpha_{k10} Social\_old_i + \alpha_{k11} Loans_i \\ + \alpha_{k12} Savings_i + \alpha_{k13} negative\_balance_i + \alpha_{k14} positive\_balance_i + \alpha_{k15} Socio_i \\ + \alpha_{k16} Adopt\_month_i \end{pmatrix} + \upsilon_{ki}$$

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

$$\upsilon_{ki} \sim MVN\left(0, \Sigma_{\beta}\right) \tag{7}$$

Assuming an i.i.d. extreme value distribution for $\varepsilon_{ijt}$ in Equation (3) allows us to use the standard logit formula for plan choice probabilities. Thus, conditional on customer $i$ 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:

$$P_{ijt} = \frac{e^{V_{ijt}}}{\sum_{j=1}^{J} e^{V_{ijt}}} \tag{8}$$

The likelihood function is therefore:

$$l\left(\{\mathrm{B}, \mathrm{A}\}\right) = \prod_{i,j,t} \left(P_{ijt} | \mathrm{B}, \mathrm{A}\right) \tag{9}$$

where B represents the matrix of first-layer parameters ($\beta_{ij0}$, $\beta_{i1}$, $\beta_{i2}$, $\beta_{i3}$, $\beta_{i4}$), and A represents the parameters in the second layers ($\alpha_{k0\text{-}16}$). For the estimation, we used the Hierarchical Bayes Markov Chain Monte Carlo (HB MCMC) estimation procedure. Details regarding the estimation are presented in Appendix B.

Table 13 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, std. = 0.02; $\beta_{i2}$ = -0.46, std. = 0.02). These findings imply that for the average customer evaluating a given plan, $1 paid as overage payment has the same weight as $3.5 paid as part of a fixed plan payment, i.e., 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.

Our second-layer estimates indicate that customers' price sensitivity to the plan 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 ($\beta_{i4} = 3.84$, std. = 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. The other plan benefits provided for the more expensive plans were not found to have a significant influence on plan choice.

## V. Discussion and Concluding Remarks

Several recent studies using real-world data have documented a wide variety of choice biases. Still, many economists consider the practical importance of these biases to be limited, and argue that customer experience eventually reduces or even eliminates such systematic mistakes. In this paper, we aim to contribute to this debate by investigating whether customers who initially choose non-optimal three-part tariff plans learn through experience and correct for their initial mistakes, which would make the long run attractiveness of offering such three-part tariff plans negligible.

We rely on a unique and rich individual-monthly-level data set spanning 30 months, before and after a commercial bank's introduction of a menu of three-part tariff plans. In line with prior research investigating consumer choice among pricing plans, our analysis of customers' initial plan choices provides strong evidence for a flat-rate bias, implying that consumers choose plans that offer larger allowances, and consequently entail higher monthly payments, as compared with the plans that would have minimized costs. Previous studies that have documented evidence for this bias focused predominantly on the uncertainty associated with the introduction of a new service (Goettler and Clay 2012; Lambrecht, Seim, and Skiera 2007; Lambrecht and Skiera 2006) and on self-control and pre-commitment issues as potential explanations for the flat-rate bias (DellaVigna and Malmendier 2004, 2006). We believe that these explanations are less applicable in the settings we investigated (i.e., retail banking), mainly because bank account owners are fairly familiar with their activity profiles and are unlikely to be affected by self-control issues in managing their checking accounts. Furthermore, our analysis of switching decisions further indicates that the choice anomalies we documented do not disappear with the gained experience of using the three-part tariff plans.

Our findings regarding customers'switching decisions reveal that most customers keep their initial plans. We believe that this finding may suggest that the prevalence of learning is limited, a conclusion reinforced by the strong estimated 'stickiness' coefficient in the plan choice logit model. For customers who do alter their initial plan choices, we find evidence for an overage-dependent learning process. That is, we find that customers who were exposed to overage payments were also more likely to alter their choice, and in particular to switch to plans with larger allowances (i.e., plans that reduce the likelihood of paying overage fees). Importantly, for these customers the switching decisions resulted in higher overall payments to the bank. On average, customers who experienced overage payments subsequently increased their overall payments to the bank by more than 6.5%. Customers who did not pay overage payments were less likely to alter their initial plan choice. Yet, when these customers did switch, they were more likely to choose plans with smaller allowances that significantly reduced their monthly payments. Our estimation results of the logit choice model further suggest that, on average, customers are 3.5 times more sensitive to overage payments than they are to fixed plan fee payments.

This paper also provides insight on 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 a simple explanation for the increasingly common use of three-part tariffs in variety of industries (Grubb 2011). Finally, our findings relate to the recent debate on the FCC 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.

This study is among the first to investigate the role of consumer experience in shaping post-choice behavior, and in particular in correcting initial consumer choice biases. Therefore, several future research opportunities arise. First, our findings are specific to the banking industry. However, 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 conclusions can be generalized to other markets in which firms offer three-part tariff plans. Future research in other industries can substantiate this claim.

Second, although the relative magnitude of the estimated effect of overage aversion on customers' payments is large, both for the initial choices and for the subsequent switching decisions, its per-customer manifestation in absolute monetary monthly values is quite low (as compared to the average income and savings in our data set). One can argue that customers are willing to trade overage payments with higher fixed payments, in order to lower the volatility in monthly payments. Future research in similar settings that involve larger payments in absolute values can shed more light on the magnitude of the effect.

Third, while overage payments constitute a major element in customers' experience that affect their eventual learning, we believe there are other aspects of learning that warrant further investigation. Such aspects include, for example, the pace of customer learning, the extent to which customers adapt their usage levels as they switch plans, and other possible triggers for switching. Finally, other sources of heterogeneity in consumer inclination to learn from experience can also shed valuable light on the investigated phenomenon. We leave these important aspects for future research.

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TABLE 1 – EXAMPLE OF THREE-PART TARIFF PLANS

| ***Plan #*** | ***Monthly payment*** | ***Overage payment*** | | ***Allowance*** | | |
|---|---|---|---|---|---|---|
| | | ***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 |

TABLE 2 – DESCRIPTIVE STATISTICS: ADOPTERS VS. NON-ADOPTERS

| *Variable* | ***Non-adopters*** Mean (Std. Dev.) | ***Adopters*** Mean (Std. Dev.) |
|---|---|---|
| ***Account tenure (years)*** | 14.58 | 13.21 |
| | (10.46) | (9.33) |
| ***Age of account holder*** | 51.97 | 43.94 |
| | (17.85) | (13.87) |
| ***Number of owners*** | 1.48 | 1.44 |
| | (0.58) | (0.51) |
| ***Parental Social Security benefits (for children below age of 18) in thousand U.S. dollars*** | 0.01 | 0.04 |
| | (0.05) | (0.09) |
| ***Elderly Social Security benefits in thousands of US dollars*** | 0.16 | 0.08 |
| | (0.25) | (0.22) |
| ***Number of salaries*** | 0.67 | 0.75 |
| | (0.72) | (0.77) |
| ***Socio-economic measure of residence of account holder (scale of 1–10)*** | 5.70 | 5.17 |
| | (2.25) | (2.23) |
| ***Monthly mean number of account information inquiries***[a] | 4.81 | 6.59 |
| | (10.24) | (11.48) |
| ***Monthly mean number of clerk-assisted transactions***[a] | 0.57 | 0.94 |
| | (0.87) | (1.22) |
| ***Monthly mean number of transactions through direct channels***[a] | 1.70 | 3.33 |
| | (2.40) | (3.66) |
| ***Monthly mean number of check transactions***[a] | 1.66 | 3.56 |
| | (3.16) | (5.07) |
| ***Mean monthly number of marketing calls***[b] | 0.03 | 0.08 |
| | (0.05) | (0.077) |
| ***Pre-adoption commission charges*** | 3.69 | 7.30 |
| | (2.74) | (3.42) |
| ***Mean monthly overspending compared tominimum payment***[a] ***($)*** | 0.62 | 2.24 |
| | (1.58) | (2.15) |
| ***Customers*** | 33689 | 32394 |

[a] For adopters this variable is calculated based on 3 months before adoption; for non-adopters this variable is based on the 3 months before the introduction of the new plans.
[b] For adopters this variable is calculated based on all months before adoption; for non-adopters this variable is based on all observations.

Due to 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.

TABLE 3 – LOGIT REGRESSIONS FOR ADOPTION DECISION

| | (1) | (2) | (3) |
|---|---|---|---|
| ***VARIABLES*** | *Adoption decision regression*[a] | *Upward bias choice*[b] | *Downward bias choice*[b] |
| ***Account tenure*** | -0.002** | -0.006*** | -0.009 |
| | (0.001) | (0.002) | (0.007) |
| ***Age*** | -0.008*** | 0.006*** | -0.008* |
| | (0.001) | (0.002) | (0.005) |
| ***Number of owners*** | -0.125*** | -0.061* | -0.22* |
| | (0.020) | (0.033) | (0.119) |
| ***Parental Social Security benefits (for children below the age of 18) in US $*** | 0.516*** | 0.444** | 1.593*** |
| | (0.154) | (0.196) | (0.482) |
| ***Elderly Social Security benefits in US $*** | -0.200*** | 0.1 | 0.06 |
| | (0.052) | (0.083) | (0.279) |
| ***Salary in US $*** | 0.028* | 0.017 | -0.153 |
| | (0.016) | (0.022) | (0.102) |
| ***Number of salaries*** | 0.211*** | -0.018 | 0.035 |
| | (0.022) | (0.032) | (0.127) |
| ***Socio-economic indicator (scale of 1 to 10)*** | -0.075*** | -0.06*** | -0.012 |
| | (0.005) | (0.007) | (0.027) |
| ***Loans in US $*** | 0.003** | -0.001 | -0.001 |
| | (0.001) | (0.001) | (0.005) |
| ***Savings in US $*** | -0.001*** | 0.002*** | -0.002 |
| | (0.000) | (0.000) | (0.001) |
| ***Monthly mean number of account status inquiries*** | -0.009*** | -0.009*** | -0.001 |
| | (0.001) | (0.001) | (0.005) |
| ***Monthly mean number of clerk-assisted transactions*** | 0.098*** | -0.085*** | 0.352*** |
| | (0.015) | (0.015) | (0.032) |
| ***Monthly mean number of direct transactions*** | 0.041*** | -0.005 | 0.044*** |
| | (0.004) | (0.005) | (0.015) |
| ***Monthly mean number of check transactions*** | -0.053*** | 0.005 | -0.081*** |
| | (0.005) | (0.005) | (0.012) |
| ***Mean level of positive account balance in US $*** | -0.183*** | -0.028* | 0.013 |
| | (0.010) | (0.015) | (0.053) |
| ***Mean level of negative account balance in US $*** | -0.020* | 0.046*** | -0.055 |
| | (0.011) | (0.015) | (0.049) |
| ***Mean monthly number of marketing calls*** | 11.314*** | -0.1 | -0.779 |
| | (0.184) | (0.18) | (0.644) |
| ***Monthly mean of bank commission payments based on the 'old' payment system in US $*** | 0.456*** | 0.001 | 0.073*** |
| | (0.006) | (0.009) | (0.024) |
| ***Adoption month*** | | 0.137*** | -0.027*** |
| | | (0.003) | (0.011) |
| ***Constant*** | -2.044*** | -0.043 | -2.33*** |
| | (0.056) | (0.103) | (0.337) |
| ***Customers*** | 68368 | 32394 | 32394 |

[a] Column 1 shows the results of a logit adoption regression, in which the dependent variable equals one if the customer adopted a three-part tariff plan and zero otherwise. For adopters the control variables are calculated based on 3 months before adoption; for non-adopters this variable is based on 3 months before the introduction of the new plans.

[b] Columns 2 and 3 present the estimation results of a multinomial logit regression in which the choice of a cost minimizing ('optimal') plan is the base category. The dependent variables upward bias choice and downward bias choice are determined relative to the allowance of the optimal plan

*** p<0.01, ** p<0.05, * p<0.1

TABLE 4 – 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% |

For adopters, optimality is calculated based on 3 months before adoption; for non-adopters this variable is based on 3 months before the introduction of the new plans. Further details are described in Appendix A.

TABLE 5 – 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% |

For adopters, optimality is calculated based on 3 months after adoption; for non-adopters this variable is based on 3 months before the introduction of the new plans. Further details are described in Appendix A.

TABLE 6 – CHOICE OPTIMALITY EX-ANTE FOR ADOPTERS AMONG NEW PLANS ONLY

| ***Optimal*** / ***Chosen*** | *Plan 1* | *Plan 2* | *Plan 3* | *Plan 4* | *Plan 5* | *Plan 6* | |
|---|---|---|---|---|---|---|---|
| Plan 1 | **92.8%** | 0.3% | 5.9% | 0.8% | 0.2% | 0.0% | 100.0% |
| Plan 2 | 94.5% | **3.2%** | 0.0% | 2.1% | 0.2% | 0.0% | 100.0% |
| Plan 3 | 74.8% | 0.0% | **23.9%** | 0.0% | 1.2% | 0.0% | 100.0% |
| Plan 4 | 89.2% | 2.4% | 0.0% | **7.5%** | 0.8% | 0.0% | 100.0% |
| Plan 5 | 75.6% | 4.6% | 3.1% | 12.0% | **4.5%** | 0.2% | 100.0% |
| Plan 6 | 69.1% | 7.0% | 1.2% | 12.6% | 7.9% | **2.1%** | 100.0% |

Optimality is calculated based on 3 months before adoption; Further details are described in Appendix A.

TABLE 7 – CHOICE OPTIMALITY EX-POST FOR ADOPTERS AMONG NEW PLANS ONLY

| ***Optimal*** / ***Chosen*** | *Plan 1* | *Plan 2* | *Plan 3* | *Plan 4* | *Plan 5* | *Plan 6* | |
|---|---|---|---|---|---|---|---|
| Plan 1 | **94.8%** | 0.3% | 4.0% | 0.7% | 0.2% | 0.0% | 100.0% |
| Plan 2 | 93.9% | **4.0%** | 0.0% | 2.0% | 0.1% | 0.0% | 100.0% |
| Plan 3 | 80.4% | 0.0% | **18.7%** | 0.0% | 0.8% | 0.0% | 100.0% |
| Plan 4 | 89.6% | 3.1% | 0.0% | **6.4%** | 0.9% | 0.0% | 100.0% |
| Plan 5 | 77.3% | 5.2% | 3.0% | 10.9% | **3.5%** | 0.2% | 100.0% |
| Plan 6 | 70.8% | 7.7% | 1.1% | 11.6% | 6.4% | **2.4%** | 100.0% |

Optimality is calculated based on 3 months after adoption; Further details are described in Appendix A.

TABLE 8 – DESCRIPTIVE STATISTICS: SWITCHING

| *Variable* | ***(1)*** ***Non-Switcher/Quitters*** Mean (*Std. Dev*) | ***(2)*** ***Plan Switchers*** Mean *(Std. Dev)* | ***(3)*** ***Plan Quitters*** Mean *(Std. Dev)* |
|---|---|---|---|
| ***Mean monthly overage paymentin US $***[a] | 0.3 | 1.06 | 0.62 |
| | (0.89) | (2.02) | (2.22) |
| ***Proportionof months with clerk-assisted transactions above allowance*** [a] | 0.09 | 0.29 | 0.18 |
| | (0.19) | (0.37) | (0.32) |
| ***Proportionof months with direct transactions above allowance*** [a] | 0.01 | 0.01 | 0.003 |
| | (0.06) | (0.09) | (0.04) |
| ***Proportionof months with check transactions above allowance*** [a] | 0.06 | 0.15 | 0.07 |
| | (0.18) | (0.31) | (0.22) |
| ***Monthly mean number of account status inquiries***[b] | 6.31 | 7.67 | 6.40 |
| | (11.18) | (12.83) | (11.29) |
| ***Monthly mean number of clerk-assisted transactions*** [b] | 0.84 | 1.16 | 1.00 |
| | (1.16) | (1.31) | (1.24) |
| ***Monthly mean of number direct transactions*** [b] | 3.27 | 3.20 | 2.12 |
| | (3.59) | (3.61) | (2.60) |
| ***Monthly mean of check assisted transactions*** [b] | 3.32 | 4.06 | 2.92 |
| | (4.91) | (5.22) | (5.23) |
| ***Account tenure*** | 13.25 | 12.75 | 13.10 |
| | (9.35) | (9.17) | (9.58) |
| ***Customer age*** | 44.41 | 43.53 | 45.82 |
| | (14.10) | (13.88) | (15.44) |
| ***Number of owners*** | 1.44 | 1.44 | 1.40 |
| | (0.51) | (0.52) | (0.52) |
| ***Number of salaries*** | 0.74 | 0.72 | 0.57 |
| | (0.78) | (0.79) | (0.69) |
| ***Socio-economic indicator(scale of 1 to 10)*** | 5.21 | 5.14 | 5.16 |
| | (2.24) | (2.18) | (2.24) |
| ***Adoption month*** | 17.07 | 13.71 | 14.61 |
| | (6.34) | (5.48) | (5.45) |
| ***Customers*** | 19835 | 2268 | 2160 |

[a] This variable is calculated based on 3 months before plan switching/quitting. For non-switchers this variable is calculated over all months following adoption.
[b] This variable is calculated based on 3 months before adoption.
The sample of customers does not include customers who originally chose a plan with interest offsetting or customers who switched to such a plan.

TABLE 9 – HAZARD REGRESSION ANALYSIS FOR SWITCHING DECISION

| | *Switching Hazard Regression* | | *Upward Switching Hazard Regression* | |
|---|---|---|---|---|
| ***Variable*** | ***Parameter Estimate (Standard Error)*** | ***Hazard ratio*** | ***Parameter Estimate (Standard Error)*** | ***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 |
| ***Monthly mean number of account status 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 (for children below the age of 18)***[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 |
| ***Socio-economic 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 |

[a]Time-varying variable
[b] Non-time-varying variable
*** p<0.01, ** p<0.05, * p<0.1

TABLE 10 – 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% |

Optimality is calculated based on 3 months before switching; Further details are described in Appendix A.

TABLE 11 – 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% |

Optimality is calculated based on 3 months after switching; Further details are described in Appendix A.

TABLE 12 – SWITCHING CUSTOMER PAYMENT REGRESSION

| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* |
|---|---|---|---|---|---|---|
| VARIABLES | ***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)*** |
| ***Post adoption month*** | 0.053*** | -0.001 | 0.189*** | | | |
| | (0.008) | (0.009) | (0.013) | | | |
| ***Post switching month*** | | | | -0.032*** | 0.065*** | -0.256*** |
| | | | | (0.006) | (0.006) | (0.011) |
| ***Monthly number of clerk-assisted transactions*** | 0.156*** | 0.189*** | 0.094*** | 0.138*** | 0.156*** | 0.076*** |
| | (0.004) | (0.005) | (0.006) | (0.004) | (0.004) | (0.006) |
| ***Monthly number of direct transactions*** | 0.038*** | 0.044*** | 0.036*** | 0.010*** | 0.013*** | 0.005 |
| | (0.003) | (0.004) | (0.005) | (0.003) | (0.003) | (0.004) |
| ***Monthly number of check deposits*** | 0.079*** | 0.092*** | 0.059*** | 0.056*** | 0.067*** | 0.016*** |
| | (0.005) | (0.005) | (0.006) | (0.004) | (0.005) | (0.005) |
| ***Number of owners*** | 0.055 | 0.095* | 0.006 | 0.074** | 0.036 | 0.063 |
| | (0.044) | (0.049) | (0.071) | (0.035) | (0.033) | (0.040) |
| ***Parental Social Security benefits (for children below the age of 18)*** | 0.299*** | 0.310*** | 0.250** | 0.022 | 0.063 | -0.256** |
| | (0.064) | (0.074) | (0.112) | (0.053) | (0.059) | (0.102) |
| ***Elderly Social Security benefits*** | -0.034 | -0.036 | 0.011 | 0.089** | 0.038 | 0.235* |
| | (0.050) | (0.058) | (0.062) | (0.038) | (0.038) | (0.121) |
| ***Monthly mean number of account status inquiries[b]*** | 0.009*** | 0.008** | 0.008** | 0.008*** | 0.007** | 0.005 |
| | (0.003) | (0.004) | (0.004) | (0.002) | (0.003) | (0.003) |
| ***Salary*** | 0.008 | -0.004 | 0.032* | 0.008 | 0.011 | -0.010 |
| | (0.011) | (0.014) | (0.017) | (0.008) | (0.008) | (0.013) |
| ***Number of salaries*** | -0.032** | -0.010 | -0.062*** | 0.013 | 0.012 | 0.010 |
| | (0.013) | (0.015) | (0.020) | (0.010) | (0.010) | (0.017) |
| ***Mean level of positive account balance*** | 0.002 | 0.008 | -0.005 | 0.001 | 0.008* | -0.012* |
| | (0.006) | (0.008) | (0.009) | (0.004) | (0.005) | (0.007) |
| ***Mean level of negative account balances*** | 0.021** | 0.042*** | -0.011 | 0.011 | 0.006 | 0.012 |
| | (0.011) | (0.013) | (0.013) | (0.008) | (0.008) | (0.013) |
| ***Loans*** | 0.023*** | 0.026** | 0.025** | 0.021*** | 0.008 | 0.031** |
| | (0.009) | (0.011) | (0.010) | (0.006) | (0.006) | (0.013) |
| ***Savings*** | 0.023*** | 0.027*** | 0.013 | 0.016*** | 0.016*** | 0.017** |
| | (0.005) | (0.006) | (0.008) | (0.004) | (0.004) | (0.008) |
| ***Constant*** | 1.648*** | 1.730*** | 1.948*** | 1.860*** | 1.834*** | 2.045*** |
| | (0.006) | (0.020) | (0.030) | (0.019) | (0.020) | (0.037) |
| ***Observations*** | 928,570 | 31,874 | 15,497 | 36,006 | 25,368 | 10,638 |
| ***R-squared*** | 0.135 | 0.242 | 0.228 | 0.197 | 0.317 | 0.422 |
| ***Number of customers*** | 2268 | 1,509 | 759 | 2,268 | 1,509 | 759 |

All regressions include individual account and month fixed effects. The estimation results shown in columns 1-3 include only the months before plan switching (including pre-adoption months), whereas columns 4-6 refer only to the months after plan adoption. The sample of customers shown in columns 1 and 4 include all switching customers. In columns 2 and 5 we focus on customers who paid overage payment at least once before plan switching, while in columns 3 and 6 we focuson customers who did not pay overage payments before plan switching.

*** p<0.01, ** p<0.05, * p<0.1, Robust standard errors in parentheses

TABLE 13 – CHOICE MODEL ESTIMATION RESULTS

| | $\beta_1$ - Fixed plan price | $\beta_2$ – Overage payment | $\beta_3$ - Other benefits | $\beta_4$ - 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* | 1.01E-02 | -2.37E-03 | 2.32E-02 | 9.93E-03 |
| *Salary in US $* | 4.45E-07 | -8.40E-08 | 6.54E-07 | 9.95E-07 |
| *Number of Salaries* | -2.22E-03 | 5.07E-05 | 6.25E-03 | 4.75E-03 |
| *Information Transactions* | 3.34E-05 | -1.49E-05 | -1.30E-05 | 4.45E-05 |
| *Age* | **-9.42E-04** | 2.08E-04 | -1.19E-03 | -6.27E-04 |
| *Account Tenure* | 2.68E-04 | -5.04E-06 | **2.02E-03** | 2.46E-04 |
| *Parental Social Security benefits (for children below the age of 18) in US $* | **5.08E-05** | -9.15E-06 | **5.15E-05** | 1.17E-05 |
| *Elderly Social Security benefits in US $* | 7.40E-07 | 3.94E-07 | -1.09E-07 | -7.69E-06 |
| *Loans in US $* | **9.66E-08** | -1.72E-08 | 9.23E-08 | 3.76E-08 |
| *Savings in US $* | **7.74E-08** | -1.67E-08 | 6.00E-08 | 2.11E-08 |
| *Mean level of positive account balance in US $* | **1.88E-06** | -6.64E-07 | -1.40E-06 | **1.84E-06** |
| *Mean level of negative account balance in US $* | **1.38E-05** | **-3.02E-06** | **1.16E-05** | **5.79E-06** |
| *Socio-economic indicator (scale of 1 to 10)* | -1.35E-03 | -1.12E-03 | -3.19E-03 | **7.21E-03** |
| *Adoption month* | **3.50E-02** | **-6.39E-03** | **3.59E-02** | **-2.38E-02** |

* Bold numbers indicate that 0 lies outside the 95% highest posterior density interval of the estimate for the population mean.

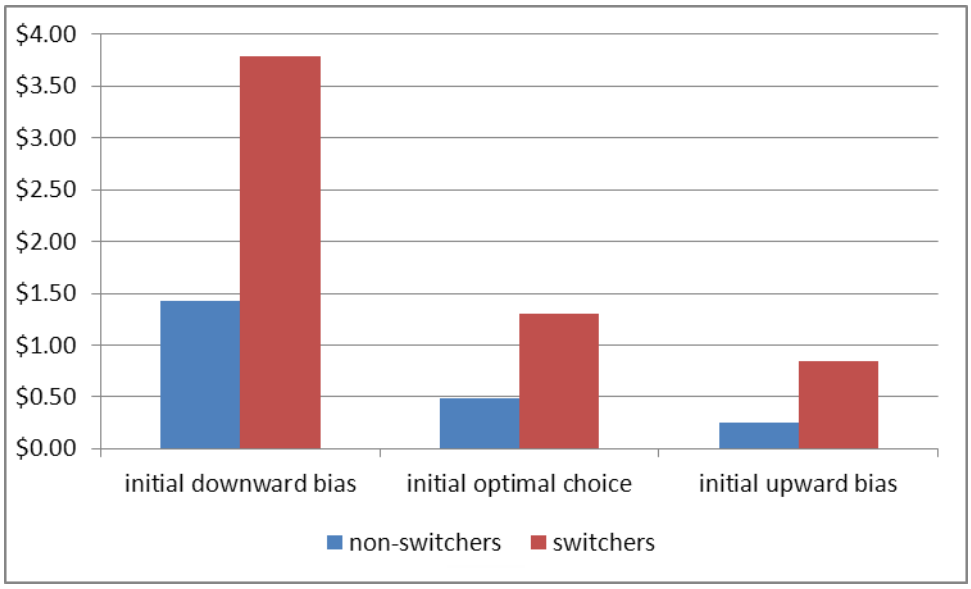


FIGURE 1. AVERAGE MONTHLY OVERAGE PAYMENTS AMONG ADOPTERS, CLASSIFIED ACCORDING TO SWITCHING AND INITIAL BIAS TYPE

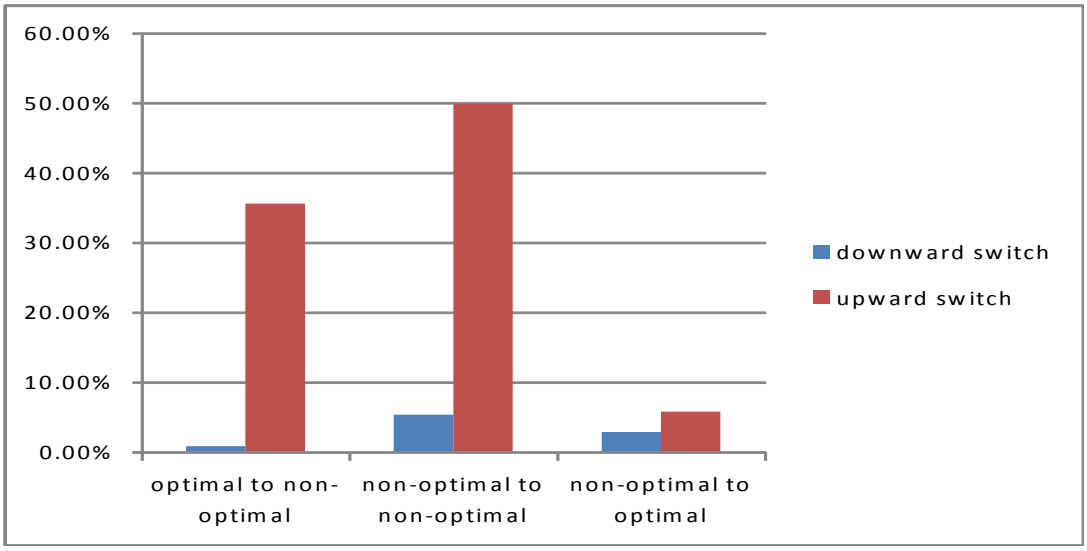


FIGURE 2. NATURE OF SWITCH FOR OVERAGE PAYERS

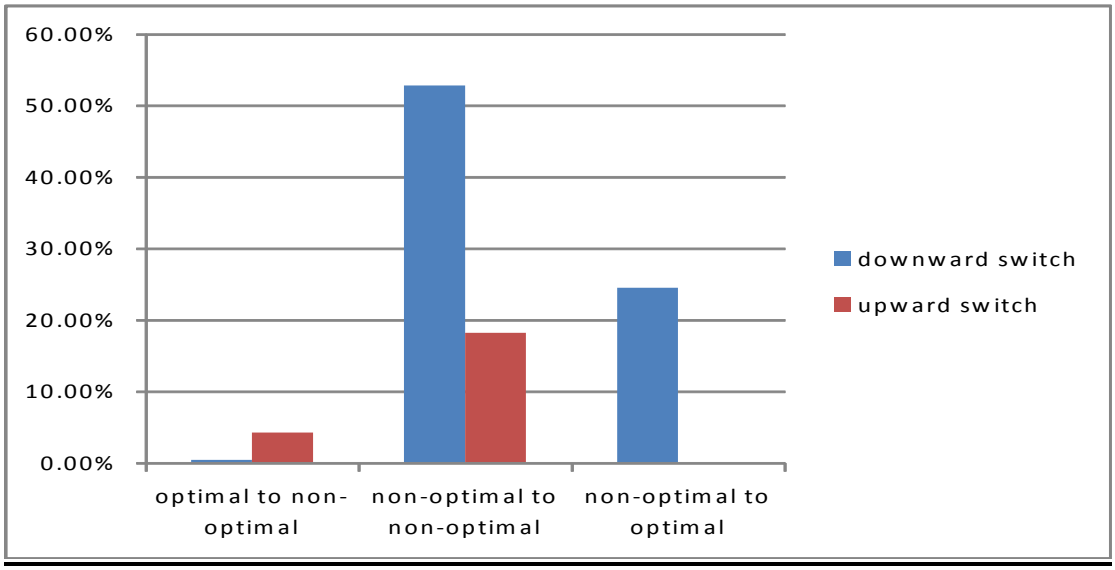


FIGURE 3. NATURE OF SWITCH FOR NON-OVERAGE PAYERS

## Appendix A – Optimality Calculation Schemes

A customer might calculate the cost of a plan in a given three-part tariff plan menu in several ways. For example, customers might consider only their activity in the month of choice while evaluating the plans. Alternatively, they might take into account a longer period of time spanning several months of activity. Moreover, customers might compare the overall payments over the entire time period across all plans based on their activity in each month, or alternatively calculate the payment associated with each plan according to their mean monthly activity level. Because we are not aware of the actual methods used by customers to calculate and compare payments across different plans, we employed several payment calculation approaches to evaluate choice optimality. First, we considered different time periods for the optimality calculation, ranging from one month to six months. Second, we used two calculation schemes to calculate the payment associated with each plan. The first scheme was based on the monthly mean number of transactions (according to each of the transaction types) over the relevant timeframe. The second was based on the overall payment for each plan based on the customer's actual usage over the relevant timeframe. While the latter approach is more accurate in terms of plan optimality, it is more complex to compute. Take, for example, a customer who uses the account heavily only once a year. This customer might do best by choosing a cheap plan with a small allowance and just paying the overage payments during the month of heavy usage. But if that same customer calculates her average monthly activity (taking that month into account), she might conclude that she needs a larger allowance, and she will end up buying a more expensive plan and paying larger amounts each month. Third, a customer might choose a plan that is not optimal for his or her past usage behavior, and yet can be optimal givena behavioral change. We, therefore, assessed the optimality of customers' plan choices using both an ex-ante approach (i.e., by evaluating pre-adoption usage behavior) and an ex-post approach (i.e., evaluating post-adoption usage behavior). The ex-post criterion might be a more accurate criterion for assessing optimality if, at the time of adoption, customers take into account their expected changes in usage behavior. We find that our optimality assessments are rather similar under the different schemes. Therefore, in the paper we present our analysis results based on evaluation of the monthly mean number of transactions over three months (i.e., not the overall payment), either ex-ante or ex-post, depending on the analysis.

In Table A1 we present 24 different optimality calculation schemes used in our plan choice optimality assessment. The optimality calculation schemes differ on three levels: (1) the

length of the timeframe investigated in order to assess optimality, (2) the basis for optimality calculation (i.e., overall payment or mean monthly activity level), and (3) the ex-post or ex-ante assessment. Table A1 presents the 24 different calculation schemes.

TABLE A1 – OPTIMALITY CALCULATION SCHEMES

| | ***Reference time period*** | ***Length of time period*** | ***Calculation basis*** |
|---|---|---|---|
| **1.** | ex-ante | 1 month[a] | overall payment |
| **2.** | ex-ante | 1 month[a] | mean activity level |
| **3.** | ex-ante | 2 months | overall payment |
| **4.** | ex-ante | 2 months | mean activity level |
| **5.** | ex-ante | 3 months | overall payment |
| **6.** | ex-ante | 3 months | mean activity level |
| **7.** | ex-ante | 4 months | overall payment |
| **8.** | ex-ante | 4 months | mean activity level |
| **9.** | ex-ante | 5 months | overall payment |
| **10.** | ex-ante | 5 months | mean activity level |
| **11.** | ex-ante | 6 months | overall payment |
| **12.** | ex-ante | 6 months | mean activity level |
| **13.** | ex-post | 1 month[a] | overall payment |
| **14.** | ex-post | 1 month[a] | mean activity level |
| **15.** | ex-post | 2 months | overall payment |
| **16.** | ex-post | 2 months | mean activity level |
| **17.** | ex-post | 3 months | overall payment |
| **18.** | ex-post | 3 months | mean activity level |
| **19.** | ex-post | 4 months | overall payment |
| **20.** | ex-post | 4 months | mean activity level |
| **21.** | ex-post | 5 months | overall payment |
| **22.** | ex-post | 5 months | mean activity level |
| **23.** | ex-post | 6 months | overall payment |
| **24.** | ex-post | 6 months | mean activity level |

[a] For optimality assessments based on a 1-month period there is no difference in calculatedplan payments between the two calculation bases (overall payment and mean activity level).

Next, we provide an example to illustrate the difference between the optimality calculation schemes. Take, for example, a customer who performed the following numbers of transactions in each of the three transaction types over three months (Table A2):

TABLE A2 – ACTIVITY DESCRIPTION

| | *Clerk-assisted transactions* | *Direct transactions* | *Check transactions* |
|---|---|---|---|
| *Month 1* | 0 | 7 | 10 |
| *Month 2* | 17 | 8 | 8 |
| *Month 3* | 1 | 5 | 11 |
| *Mean activity* | 6 | 6.66 | 9.66 |

Table A3 presents the calculation of the plan payment using the overall payment calculation basis for the four plans that were available in those three months, and for the 'old' pay-per-use payment system. According to Table A3, Plan 1 is the optimal plan because the overall payment for this plan is the lowest.

TABLE A3 – PAYMENT CALCULATION USING OVERALL PAYMENT AS THE CALCULATION BASIS

| | Plan 1 | Plan 2 | Plan 3 | Plan 4 | 'old' system |
|---|---|---|---|---|---|
| ***Month: 1*** | \$5.65 | \$6.25 | \$7.65 | \$14.00 | \$13.51 |
| ***Month: 2*** | \$26.60 | \$27.50 | \$24.55 | \$14.00 | \$ 6.16 |
| ***Month: 3*** | \$7.20 | \$7.80 | \$7.95 | \$14.00 | \$4.78 |
| ***Sum*** | **\$39.45** | \$41.55 | \$40.15 | \$42.00 | \$24.45 |

Table A4 presents the calculation of the plan payment using the mean monthly activity level calculation scheme. According to this calculation scheme the optimal plan is Plan 3.

TABLE A4 – PAYMENT CALCULATION USING MEAN ACTIVITY LEVEL AS THE CALCULATION BASIS

| | Plan 1 | Plan 2 | Plan 3 | Plan 4 | No plan |
|---|---|---|---|---|---|
| *Payment according to mean activity level* | \$13.05 | \$13.75 | **\$11.30** | \$11.50 | \$13.51 |

## Appendix B: HB MCMC Estimation Procedure

For the estimation, we used the Hierarchical Bayes Markov Chain Monte Carlo (HB MCMC) algorithm (Train 2003).

Let {A} denote the parameters in the second layerof the utility equation (for $V_{ijt}$), and let {B} denote the population vectors of *K* random parameters that enter the utility equation. For the random parameters, we assumed a multivariate normal distribution with diffuse priors for the population parameters. Specifically, we used a normal prior distribution with a high variance for the population means and a diffuse inverted Wishart prior distribution for the population variance [*IW(K, I*)], where *I* is the identity matrix. The draws from the conditional posteriors for the Gibbs sampling are as follows.

First, we drew from $f\left(\{\mathrm{B}\}|\overline{\mathrm{B}},\Sigma_{\mathrm{B}},\mathrm{A}\right)\propto\prod_{i,j,t}\left[\Pr\left(C_{ijt}|\mathrm{B},\mathrm{A}\right)\right]\times\Pi\left(\{\mathrm{B}\}|\overline{\mathrm{B}},\Sigma_{\mathrm{B}}\right)$ using the Metropolis-Hastings algorithm. The first element on the right-hand side is the logit probability for plan choice. The second element is the normal density. Second, we drew $\overline{\mathrm{B}}$ and $\Sigma_{\mathrm{B}}$ from $f\left(\overline{\mathrm{B}}|\mathrm{B},\Sigma_{\mathrm{B}}\right)\sim N\left(\frac{\sum_{i}\mathrm{B}}{NI},\frac{\Sigma_{\mathrm{B}}}{NI}\right)$ where *NI* is the number of customers, and from $f\left(\Sigma_{\mathrm{B}}|\mathrm{B},\overline{\mathrm{B}}\right)\sim IW\left(K+NP,\frac{(KI+\bar{S})}{K+NI}\right)$ where $\bar{S}=\sum_{i}\left(\mathrm{B}-\overline{\mathrm{B}}\right)\left(\mathrm{B}-\overline{\mathrm{B}}\right)'$. Third, we drew from the posterior distribution of the second-level parameters in {A}, using the closed-form solution to the standard linear regression coefficients.

We let the chain run for 200,000 iterations and discarded the first 180,000 as burn-in. We then used everytenth iteration to sample from the posterior distribution.