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Do consumers choose the right credit contracts?

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CFS Working Paper No. 2005/32

Do Consumers Choose the Right Credit Contracts?*

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Abstract:
A number of studies have pointed to various mistakes that consumers might make in their consumption-saving and financial decisions. We utilize a unique market experiment conducted by a large U.S. bank to assess how systematic and costly such mistakes are in practice. The bank offered consumers a choice between two credit card contracts, one with an annual fee but a lower interest rate and one with no annual fee but a higher interest rate. To minimize their total interest costs net of the fee, consumers expecting to borrow a sufficiently large amount should choose the contract with the fee, and vice-versa.
We find that on average consumers chose the contract that ex post minimized their net costs. A substantial fraction of consumers (about 40%) still chose the ex post sub-optimal contract, with some incurring hundreds of dollars of avoidable interest costs. Nonetheless, the probability of choosing the sub-optimal contract declines with the dollar magnitude of the potential error, and consumers with larger errors were more likely to subsequently switch to the optimal contract. Thus most of the errors appear not to have been very costly, with the exception that a small minority of consumers persists in holding substantially sub-optimal contracts without switching.

JEL Classification: G11, G21, E21, E51

Keywords: Consumption-Saving, Borrowing, Consumer Finance, Consumer Credit, Credit Cards, Banking

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1. Introduction

A number of studies have pointed to various mistakes that consumers might make in their consumption-saving and financial decisions (e.g., Thaler and Shefrin, 1988). However, it remains unclear how systematic and costly such mistakes are in practice. Studies of consumer decision-making in actual market environments are rare. Among the few such studies, DellaVigna and Malmendier (2002) find that consumers systematically choose sub-optimal membership plans at health clubs, but Miravete (2003) finds consumers' choices of telephone billing plans to be closer to optimal.

The quality of consumers' decision-making might of course vary across different types of decisions.[1] This paper studies a central economic decision, the decision to borrow and choose between different credit contracts. We utilize a unique market experiment conducted by a large U.S. bank. Through 1996 all credit card holders at the bank were charged annual fees. In late 1996, however, in response to industry trends away from using annual fees, the bank started offering new credit card customers a choice between two pre-specified credit card contracts: one with an annual fee but a lower interest rate (APR) and one with no annual fee but a higher interest rate. To minimize their total interest costs net of the fee, consumers expecting to borrow a sufficiently large amount should choose the contract with the annual fee, and vice versa. We utilize an administrative dataset that records the contract choice and subsequent monthly borrowing behavior of over a hundred thousand credit card holders at the bank from 1997-1999. This dataset allows us to determine which account-holders chose the ex post sub-optimal contract, given their subsequent behavior, and if so how costly was their mistake. Further, the

[1] DellaVigna and Malmendier (2004) discuss a range of consumer markets. See also Gabaix and Laibson (2004) and Waldfogel (2004).

account-holders had the option to later switch contracts, so we can also study whether they learned from and corrected their mistakes.

Credit cards play an important role in consumer finances, so they are a good test-case for analyzing the quality of consumers' financial decision-making. In the mid-to-late 1990s (the start of our sample period), about 20 percent of aggregate personal consumption was being purchased using credit cards (Chimerine, 1997). Moreover, for most households credit cards, in particular bankcards (*i.e.*, Visa, Mastercard, Discover, and Optima cards), represent the leading source of unsecured credit. About two-thirds of households at the time had at least one bankcard, and of these households at least 56 percent were borrowing on their bankcards, that is paying interest not just transacting (Survey of Consumer Finances (SCF), 1995).[2] Conditional on borrowing, the typical bankcard account was borrowing about $2000, with the account-holder having roughly another $5000 of balances on other cards. These are large magnitudes relative to typical household balance sheets. They are also large in the aggregate: total credit card balances now amount to about $800B (Federal Reserve Board, 2005).

The stakes involved in making optimal consumer-credit decisions are therefore potentially quite large. Also, whether to borrow or not on a credit card is a decision that most households make on a monthly basis, and so is a familiar decision, and the choice between the two credit contracts that we study is relatively simple. Hence the results should be interpreted as a minimal test of the quality of consumers' financial decision-making.

After rationalizing some salient aspects of consumers' credit card usage, Gross and Souleles (2002) highlight two more puzzling aspects. First, why does such a large fraction of consumers hold substantial credit card debt? Conventional buffer-stock models calibrated using

estimated income processes have difficulty rationalizing so much borrowing at high credit card interest rates (Laibson *et al.*, 2002; Angeletos *et al.*, 2001). Second, why do many credit card borrowers simultaneously hold low-yielding assets (both illiquid and even liquid)? For example, Gross and Souleles document that about one-third of credit card borrowers have substantial assets in checking and savings (beyond levels reasonably needed for normal cash-transactions), apparently in violation of no-arbitrage conditions.

Some of the most common potential explanations for these puzzles are based on problems of commitment and self-control. For example, Laibson *et al.* (2002) show that consumers with hyperbolic discount functions, which generate time-inconsistency and commitment problems, would be more likely than consumers with standard exponential discount functions to borrow at credit card interest rates, and to simultaneously hold illiquid assets.[3] An innovative paper by Ausubel (1991) considered a related hypothesis as a potential explanation (among others) for the "stickiness" of credit card interest rates: consumers might repeatedly underestimate the probability that they will borrow (e.g., perhaps because they are unable to commit not to borrow), and so might be relatively insensitive to borrowing rates. Ausubel (1999) distinguishes promotional (temporarily low) "teaser" interest rates, and concludes that consumers

[2] As noted by Gross and Souleles (2002), this figure probably understates the fraction of households borrowing on their bankcards, because SCF households appear to underreport their bankcard debt. This paragraph draws heavily on Gross and Souleles (2002). See also Yoo (1998).

[3] In analyzing the second, portfolio puzzle, it is important to distinguish between liquid and illiquid assets. In the absence of additional frictions like transactions costs or mental accounts, hyperbolic consumers would not violate no-arbitrage conditions, and so would not simultaneously hold credit card debt and liquid assets. However, other models with related self-control problems can potentially generate such outcomes. For instance, under "planner-doer" models (Thaler and Shefrin, 1988), some people might undertake costly actions to constrain their "impulse" spending or spending by their spouses. By not fully paying off their credit card balances, such people can reduce their liquidity and thereby reduce the temptation of available credit (see e.g., Bertaut and Halliasos, 2001). Gross and Souleles also consider additional explanations for the two puzzles. E.g., borrowers planning to file for bankruptcy have an incentive to hold some assets, up to the amounts protected by the bankruptcy exemption rules (see e.g., Lehnert and Maki, 2002).

are overly sensitive to such rates, possibly because they underestimate the probability that they will later borrow at higher, post-teaser rates.[4,5]

The experiment that we study is ideally suited for analyzing such issues, because consumers' choices between the two credit contracts at issue should critically depend on their expectations regarding their future borrowing. If consumers systematically underestimate their probability of borrowing, we should find that many fail to pay the annual fee even though they later borrow substantial amounts. Conversely, it is also possible that some consumers overestimate their probability of borrowing, and needlessly pay the fee even though they do not borrow enough. With stochastic income and spending needs (e.g., medical emergencies, auto break-downs, etc.), some consumers will of course find ex post that they have chosen the sub-optimal contract, even if their decision-making was ex ante perfectly rational (e.g., Souleles, 2004). Hence, we will investigate the role of ex post shocks and, more importantly, we will focus on exploring the limits of the mistakes consumers make. In particular we will examine whether mistakes are less likely as the potential dollar loses increase in magnitude, and whether larger mistakes tend to be subsequently corrected.

Previewing the main results, we find that on average consumers chose the credit contract that ex post minimized their total interest costs net of the annual fee. A substantial fraction of consumers (about 40%) still chose the ex post sub-optimal contract, with a few non-fee-paying consumers incurring hundreds of dollars of readily avoidable interest charges. These sub-optimal

[4] Gross and Souleles (2002) find significant elasticities of credit card spending and debt to changes in credit card APRs, even small, non-promotional changes. These results do not imply, however, that the card holders respond optimally to the APRs. Among other potential explanations for APR stickiness, Ausubel (1991), Calem and Mester (1995), and Calem, Gordy, and Mester (2005) point out that switching costs could also make consumers relatively less sensitive to the APR on a given credit card, *ceteris paribus*.

[5] A few recent papers provide theoretical models of lending to consumers and entrepreneurs with various degrees of imperfect rationality or imperfect information. E.g., see Manove and Padilla (1999) and Bond, Musto, and Yilmaz (2005). There is a larger literature empirically examining consumers' portfolio choices, e.g., Odean (1998) and

outcomes appear not to be entirely due to ex post shocks. Nonetheless, the probability of choosing the sub-optimal contract declines with the dollar magnitude of the potential error. Further, while relatively few consumers switched contracts, those who made larger errors in their initial contract choice were more likely to subsequently switch to the optimal contract. Thus most of the errors appear not to have been very costly, with the noteworthy exception that a small minority of consumers persists in holding substantially sub-optimal contracts without switching.

The rest of the paper is organized as follows. Section 2 describes the dataset. Section 3 begins by analyzing the consumers that did not switch contracts, the bulk of the sample, and Section 4 then focuses on the switchers. Section 5 offers concluding remarks.

2. Data

We use a unique, proprietary panel dataset from a large U.S. bank that issues credit cards nationally. The dataset had been previously created for other purposes internal to the bank, but it contains the information that we need to study the contract choice of interest here. The dataset includes a representative sample of about two hundred thousand credit card accounts open as of December, 1999. It contains a rich set of variables describing the behavior of these accounts month-by-month from August, 1997 through December, 1999, a total of 29 months.[6] The bulk of the data consists of the main billing information listed on each account's monthly statement, including debt and the credit limit. Note that credit cards can be used for both transactions and

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Heaton and Lucas (2000). Compared to the assets side of consumers' balance sheets, there has been much less analysis of the liabilities side, partly for lack of data.

[6] Because the sample is representative of accounts open in 12/99, it does not include accounts that closed before 12/99, but it does include accounts that entered the portfolio between 8/97 (the start of the dataset) and 12/99. (Since the bank began offering the contract choice in 10/96, the dataset does not record the first few months of activity for the accounts opened between 10/96 and 8/97.) We use all of the available account-months in the reported analysis

borrowing purposes. Our debt variable includes only interest-incurring balances that are rolled-over, not transactions balances that are paid off. Also available are the accounts' credit risk scores, which are used by card issuers as summary statistics for the fundamental risk/profitability characteristics of each account.[7]

Critically, the dataset includes a variable indicating which of the two credit card contracts the consumer chose. The annual fees on the cards ranged from $10-24, and the increments to the annual APR in the absence of the fee ranged from 2.15%-4.15% (percentage points). The particular magnitudes of the fee and APR increment depended on the administrative subportfolio in which the bank opened the account, as described below. Within each subportfolio, every consumer received the same choice of credit terms (*i.e.*, the same fixed annual fee and APR increment), so there was no pre-selection involved. After initially being required to choose one of the two contracts, the account-holders subsequently had the option to switch to the other contract. Only about 4% did so during our sample period, so we will begin by first studying the consumers who did not switch contracts, and later we will turn to the "switchers".[8]

The sub-portfolios are based on the bank's general classification of the account-holders' relationship with the bank. In addition to distinguishing special relationships like employee accounts, the bank classified account-holders according to the magnitude and type of assets held at the bank as of the time the credit card account was opened. Hence the dataset includes an

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below. Our main results are qualitatively similar across the entrant (opened after 8/97) and original (before 8/97) accounts.

[7] The credit risk scores come from the credit bureaus, and so summarize the account-holders' credit activity across all of their credit cards and other debt. Our dataset does not include any other credit bureau data, nor any demographic characteristics of the account-holders. Nonetheless, because the account-holders had to choose between the two offered contracts, we can analyze the optimality of their choices even without additional information regarding the rest of their credit cards. For an analysis of credit risk including credit bureau data, see Gross and Souleles (2002a) and Musto and Souleles (2005). Domowitz and Sartain (1999) also analyze consumer bankruptcy.

[8] Miravete (2002) and DellaVigna and Malmendier (2002) also find relatively few people switching across calling and health plans, respectively.

indicator variable distinguishing account-holders with initial financial assets (combining CDs, IRAs, mutual funds, etc., as well as liquid assets) at the bank greater than $25,000 and liquid assets (combining checking, savings, MMMF, etc.) greater than $5000. While we do not know which account-holders with fewer assets at this bank have substantial assets elsewhere, it is clear that consumers with over $25,000 of financial assets and $5000 of liquid assets are relatively wealthy and liquid compared to the typical consumer in the U.S. Hence we will refer to their accounts as the wealthy accounts.[9]

We exclude from the sample accounts that were delinquent, bankrupt, or otherwise frozen; and the few accounts (about 300) that were offered a low teaser rate at any time within the sample period. The treatment of these accounts is determined by factors outside the contract choice at issue here. We also drop employee and student accounts, since they too were treated differently.[10] The resulting sample contains over 150,000 accounts.

Table 1 presents key summary statistics, cross-sectionally across the sample accounts. Column (1) refers to all accounts, while columns (2) and (3) distinguish the accounts that pay and do not pay the annual fee. We refer to these accounts as "payers" and "non-payers", respectively. About 56% of accounts are payers and 44% non-payers. Since the account-holders were required to actively choose one of the two contracts, and about half chose each contract, this suggests that their contract choice was quite possibly a deliberate decision (assuming they were not randomizing). In this first table the sample includes all accounts, including those that subsequently switch contracts, based on their initial contract choice. The results are very similar on dropping the relatively few switching accounts.

[9] The bank also distinguished account-holders with intermediate financial assets (above $10,000) and no financial assets at the bank, however our analysis below that uses wealth only needs to identify a set of relatively wealthy account-holders.

Note that payers receive an average interest rate break of about 3 percentage points (≈ 15.2% - 12.1%), but pay an annual fee averaging about $20. Also note that the payers and non-payers have similar credit scores and credit limits, so based on the information that issuers typically use to characterize accounts, these accounts appear to be relatively similar. However, the accounts that chose to pay the annual fee turned out to accumulate substantially more debt, almost twice as much. (For each account, we first averaged monthly debt over the entire sample period to reduce the influence of temporary debt due to special circumstances, e.g., holiday shopping, taking a long vacation abroad, etc.; and then averaged the results cross-sectionally across accounts.) Qualitatively, these results already suggest the possibility that payers might have paid the annual fee in anticipation of reducing the interest costs on their relatively large future debt. Nonetheless it remains to be seen how many account-holders actually chose the quantitatively optimal contract.

3. Results: Contract Choice

This section examines account-holders' contract choices and subsequent borrowing behavior to determine which account-holders chose the ex-post sub-optimal contract, and if so how costly was their mistake. Most of the analysis is non-parametric, since these issues are conducive to such analysis.

Table 2 reports the distribution of debt subsequent to the contract choice, distinguishing the payers and non-payers. (The sample omits the switching accounts, since they will be studied separately later. The results including the switchers are quantitatively very similar, as noted below.) As in Table 1, column (1) shows that payers generally borrow more. In particular,

[10] E.g., employees were not charged annual fees, and student credit limits were limited to under $400 on average with no annual fees reported in the dataset.

conditional on paying the fee, over 31% of payers carry debt of more than $1200 per month on average over the entire sample period, a substantial amount. In the second column, non-payers borrow less, with over 50% of them not borrowing at all over the entire sample period. On the other hand, almost 24% of the payers did not borrow at all yet still paid the annual fee. It is possible that they overestimated the probability that they would borrow, at least ex post. Conversely, over 12% of non-payers borrowed over $1200 per month. Had they paid the fee, the resulting interest savings would have more than covered the fee. It is possible that they underestimated the probability that they would borrow, at least ex post.

It is important to remember, however, that the account-holders that ex post chose the incorrect contract might still have made the optimal choice ex ante. Ex post, their borrowing needs might have happened to turn out different than expected. For instance, some of the potential "underestimators" might not initially have expected to borrow, with good reason, but might have subsequently been hit with adverse shocks, such as unexpected unemployment, that ex post prompted them to borrow. Conversely, some of the potential "overestimators" might initially have expected to borrow, but might have subsequently benefited from positive shocks. With stochastic income and spending needs, we expect some of both "type I" and "type II" contract errors ex post. Further, bringing in risk-aversion, some account-holders might pay the annual fee for insurance purposes, even if the probability that they will need to borrow a lot is small.

While it is generally difficult to test ex-post shock explanations (Souleles, 2004), we can make some progress by comparing the results to those in column (2) for just the wealthy account-holders, who are known to have over $25,000 of financial assets. Only 22% of the wealthy account-holders paid the annual fee, less than the 55% incidence of payers in the overall

sample (bottom row). This is not surprising since wealthy account-holders should have less need than others to borrow on their credit cards in the first place. However, conditional on not paying the fee, 10% of the wealthy non-payers nonetheless borrow over $1200 per month. This result is broadly similar in magnitude to the fraction of the total sample of non-payers that borrows that much. Given the wealth and liquidity of these 10% of wealthy non-payers with high debt, it seems unlikely that unexpected bad shocks entirely explain why they borrowed so much on their credit cards. Indeed, borrowing while simultaneously holding substantial assets is the portfolio puzzle highlighted by Gross and Souleles (2002), and so shocks alone appear to be insufficient to rationalize the behavior of these consumers in the context of a conventional model. Conversely, conditional on paying the fee, as before a large fraction of the wealthy payers turned out not to borrow at all, about 40%.

Overall, comparing columns (1) and (2), the pattern of results is broadly similar across the wealthy versus non-wealthy accounts.[11] This is suggestive, although admittedly not conclusive, that ex post shocks alone are not driving these (and later) results.[12] That said, whatever the sources of account-holders' ex post errors, the rest of the analysis focuses on examining the limits of the errors, e.g. whether errors are less likely when the potential loses increase in magnitude, and whether large errors tend to be later corrected.

In Table 3, the top panel calculates the fractions of account-holders that chose the optimal and sub-optimal contracts ex post, as in Miravete (2003). The first row computes the "potential net savings" from paying the fee, based on the potential gross interest savings from paying net of

[11] The percentages in the table condition on contract choice to facilitate comparisons across the wealthy versus non-wealthy accounts, since different fractions of them pay the fee. The pattern of results is also broadly similar across the columns if the percentages are re-expressed relative to the entire sample.

[12] Recall that wealth is measured only as of the time the credit card account was opened, so could have changed over the sample period. However, given the moderate length of the sample period, wealth is unlikely to have changed very much for most accounts. In particular, the "wealthy" accounts will still on average be wealthier over the period

the fee itself. For the non-payers, it is the interest savings they would have gained if they had paid the fee, net of the fee, using their actual debt levels. If their net savings is positive, they should ex post have paid the fee. For the payers, it is the interest they are already saving, again net of the fee. If their net savings is positive, they were correct ex post to have paid the fee. So in either case, a positive number for net savings implies that the account-holder should ex post have paid the fee. These figures are calculated averaging over the entire sample period, but expressed in annual terms for comparison with the annual fee.

As reported in column (1), for non-payers the average net savings is slightly negative (-$1.9). That is, on average the non-payers were correct not to have paid the fee. In fact, almost 80% of them chose the optimal contract, even ex post; only 21% chose the sub-optimal contract. By contrast, for payers the average net savings is positive, over $22, and so on average the payers were correct to have paid the fee. However, the *median* net savings is negative, so that slightly more than half of payers, about 55%, chose the incorrect contract ex post. Overall, combining both payers and non-payers, the majority of account-holders chose the optimal contract, though a substantial fraction, about 40%, still chose the sub-optimal contract. Again these results are generally similar for the wealthy account-holders in column (2).

For the account-holders who chose the incorrect contract, how significant are their errors? Note that more account-holders erred by incorrectly paying the annual fee than by incorrectly not paying the fee. Nonetheless, for the account-holders who incorrectly paid the fee, the cost of the error is bounded by the fee itself, which is relatively small. By contrast, for the account-holders who did not pay the fee but should have, the potential losses are much larger because they can potentially borrow thousands of dollars. The bottom panel of column (1) shows

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than the "non-wealthy" accounts. Moreover, the similarity of the results across wealthy vs. non-wealthy accounts holds even for the newer accounts for which the wealth measure is more up-to-date.

the distribution of the error costs. For 225 non-payers, the net error is over $200 of avoidable interest payments per year; for 30 non-payers, it is over $300 per year. Since these account-holders had the option to switch contracts, their failure to do so is particularly noteworthy. Also, these figures reflect just one of the credit cards they hold. Since the average account-holder has multiple cards, at the household level the errors could be even larger. Hence, for a small minority of account-holders the costs of their incorrect contract choice appear to be significant.[13]

On the other hand, note that as net potential savings increases in magnitude (moving down the table), the fraction of accounts not paying (as opposed to paying) declines, from 37% not-paying at a net savings of $0-$25, to less than 7% not-paying at a net savings above $300. In other words, as the stakes increase, consumers are increasingly likely to have chosen the cost-minimizing contract. Otherwise the total losses from sub-optimal contracts could have been much larger.

For the wealthy account-holders, in the second panel at the right, the same qualitative patterns appear. Larger fractions of wealthy accounts with high net savings are non-paying, though an error of a given dollar amount might matter less to the wealthy.[14]

4. Results: Contract Switching

We now turn to the account-holders who switched contracts. Only about 6% of the initial payers switched to not-paying during the sample period, and less than 1% of the initial non-payers switched to paying. The fact that so few account-holders switch contracts could partly

[13] As noted below, these large errors persist over time across the sample period.
[14] As already noted, the results in this section are quantitatively very similar on including the switching accounts. In particular, 42% of the resulting total sample of all accounts chose the incorrect contract (compared to 40% in Table 3), with the fractions incorrect conditional on payment status similar to those in Table 3.

reflect transactions costs and inertia.[15] We focus on whether, conditional on switching, the right accounts switched.

Table 4 compares the switchers both before (top panel) and after (bottom panel) they switch. In column (3), (pay, not pay) refers to the accounts that started with the contract paying the annual fee, but later switched to the other contract without the fee. Conversely, in column (4), (not pay, pay) refers to those that switched from the contract without the fee to the contract paying the fee. In columns (1) and (2), (pay, pay) and (not pay, not pay) refer to the accounts that did not change contracts.

In the top panel, for comparison the results for the accounts that did not switch are repeated from Table 3. Their net savings are again first averaged over the entire sample period and expressed in annual terms. For accounts that switched, the potential net savings *before* the switch are averaged over all available months before the switch, and again annualized.[16] Recall that the accounts under (pay, pay) in column (1) have positive net potential savings on average (though slightly more than half of the accounts chose the sub-optimal contract). Contrast this with the accounts under (pay, not pay) in column (3), those that stopped paying the fee. Although they were also initially paying the fee, their net benefits from doing so were negative on average (-$16), and over 90% of them were in the sub-optimal contract at the time. That is, of the account-holders initially choosing to pay the annual fee, those for whom the choice was incorrect

[15] O'Donoghue and Rabin (2001) show that (naïve) hyperbolic discounting can generate substantial procrastination even with small per period transactions costs to acting. In our sample period, no accounts switched more than once. We cannot however tell whether some of the accounts that do not switch within our sample period might have switched before we begin to observe them at the start of the sample period in 8/97, so these reported fractions will somewhat understate the total incidence of switching. As already noted, other studies like Miravete (2002) and DellaVigna and Malmendier (2002) also find relatively little switching.

[16] The results are similar on using only the subset of accounts that switched after the first 12 months in the sample, computing net savings before the switch based on the initial 12 months. More generally, for accounts that switch while carrying debt, the new APR also applies to their pre-existing debt. For accounts that switch out of the contract with the fee, there was no rebating of the pro-rated fee. It would be interesting to see in which month consumers switched contracts, relative to when they pay the fee. Unfortunately our data does not identify the particular month in which the fee is actually booked.

and relatively costly were disproportionately likely to later switch to the other contract. Similarly, compared to the accounts that remained non-paying ((not pay, not pay) in column (2)), who had negative net savings, those that were initially non-paying but later switched to paying ((not pay, pay) in column (4)) had positive and relatively large net benefits from switching. Again, the accounts that switched tended to be the ones with the largest errors to correct.

Switching in response to past errors is appropriate only if past errors are predictive of potential future errors.[17] The bottom panel in Table 4 directly examines the ex post benefits of switching. It computes net savings over all available months *after* the switch, again annualized. In column (3), for those that stopped paying, the net potential savings become even more negative ex post. Over 96% of these switchers ended up in the optimal contract after their switch, whereas 93% of them had been in the sub-optimal contract beforehand. In column (4), for those that started paying, net potential savings become even more positive ex post, almost $50 on average. Over 67% of them ended up in the optimal contract after their switch, whereas 61% of them had been in the sub-optimal contract beforehand. These results are consistent with the switches generally being forward-looking.[18]

Table 5 estimates multivariate logit models determining who switched. In column (1) the sample includes all accounts that were initially paying (i.e., both (pay, pay) and (pay, not pay)), with the dependent variable equal to one for those that subsequently switch to not paying ((pay, not pay)). Similarly, column (2) includes all accounts that were initially not paying, with dependent variable equal to one for those that subsequently switch to paying. All the independent

[17] Account debt is in fact very persistent, with an AR(1) coefficient above .9 (for both switchers and non-switchers).
[18] For non-switchers, it is most natural to compute their net savings averaged from the start of the sample period. Nonetheless, if one compares their first 12 months in the sample with their next 12 months, the results are similar across the two 12-month periods (and so both periods yield similar results to the average results reported in the top panel of Table 4). In particular, the large errors of the minority of non-payers with substantial debt (second panel of Table 3) are also similar (i.e., persistent) across both 12-month periods.

variables are averaged over all months before a switch, again annualized. The credit score and credit limit are used to control for account heterogeneity.

In column (1), which models those who stop paying the annual fee, the coefficient on net savings is significantly negative. Hence, as the ex ante net benefits of paying the fee increase, account-holders are less likely to stop paying the fee (i.e., they are more likely to continue paying the fee), and vice-versa, which is consistent with Table 4. Further, "% Months Borrow" measures the *fraction* of months before the switch in which the account-holder borrowed. This variable has a significantly negative effect. Even controlling for the dollar magnitude of borrowing, the account-holders who had borrowed a greater number of times are less likely to stop paying the fee, and vice-versa. Conversely, column (2) models those who start paying the annual fee. Here net savings has a significantly positive effect. The account-holders with greater ex ante benefits of paying are indeed more likely to start paying.[19] The number of months borrowing has a significantly positive effect, so account-holders who had borrowed a greater number of times are more likely to start paying the fee. Thus, the probability of switching increases with both the size of the past error and with the number of times the account-holder had erred. These results are suggestive of learning.

5. Conclusion

We use a special dataset of credit card accounts to study a unique experiment that offered consumers a choice between two different credit contracts: one with an annual fee but a lower

[19] To interpret the estimated effect of net savings, in column (1) a $100 increase in net savings would lead to a 3.7 percentage point (p.p.) decrease in the probability of stopping to pay the fee, evaluating from sample means. Relative to the sample average probability of stopping to pay of just under 6%, this corresponds to a 69% relative decline in the probability of switching in this direction, a substantial effect. In column (2), a $100 increase in net savings would lead to a .18 p.p. increase in the probability of starting to pay the fee. While this is a smaller effect, the sample average probability of starting to pay is only about .7%, so the implied effect corresponds to a 24% relative increase in the probability of switching, again a substantial effect.

interest rate and one with no annual fee but a higher interest rate. The optimal contract choice depends primarily on consumers' expectations of their future borrowing, and so represents an ideal test-case for studying the quality of consumer decision-making in an important market context, consumer credit.

We find that on average consumers chose the credit contract that ex post minimized their interest costs net of the annual fee. For consumers that did not pay the fee, on average the potential interest savings turned out smaller than the fee; for consumers that paid the fee, on average the interest savings turned out larger than the fee. However, a substantial fraction of consumers, about 40% overall, chose the sub-optimal contract, at least ex post. While more consumers incorrectly paid the fee than incorrectly failed to pay the fee, the mistakes of the fee-payers are bounded in magnitude by the annual fee itself, which is relatively small. By contrast a few non-fee-payers incurred hundreds of dollars of avoidable interest charges. These sub-optimal outcomes seem unlikely to be entirely due to ex post shocks to income and spending needs, since the pattern of mistakes is similar for wealthy consumers, who should be less likely to need to borrow on their credit cards in response to shocks. Nonetheless, the probability of choosing the sub-optimal contract declines with the dollar magnitude of the potential error. That is, as the stakes increase, consumers are increasingly likely to choose the cost-minimizing contract.

Furthermore, while relatively few consumers switched contracts, those who made larger errors in their initial contract choice were more likely to subsequently switch to the other contract. The probability of switching also increases with the number of times (months) that consumers had erred in the past. Notably, ex post most of the switchers ended up holding the optimal contract after the switch, whereas most of them held the sub-optimal contract before the

switch. These results are generally consistent with learning and the switches being forward-looking.

In sum, most consumers chose the optimal credit contract, and for those who chose the suboptimal contract, most of their errors appear not to have been very costly. A noteworthy exception, however, is that a small minority of consumers persists in holding substantially sub-optimal contracts without switching. We end with some additional caveats. First, the choice between the two contracts studied here is especially simple. As already noted other aspects of consumers' credit card usage are more puzzling, and consumers might have more trouble making decisions in other contexts, especially less simple and less familiar decisions (e.g., Agarwal, Driscoll, and Laibson, 2004). Second, even small deviations from optimal decision-making at the consumer level might still potentially have important aggregate implications (e.g., Gabaix and Laibson, 2004; or analogously for firms, Akerlof and Yellen, 1985).

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Table 1. Summary Statistics

	(1) All Accounts	(2) Accounts Paying Annual Fee ("payers")	(3) Accounts Not Paying Annual Fee ("non-payers")
Annual fee ($)			
mean	11.90	21.14	0.00
s.d.	10.94	4.16	0.00
Interest rate (%)			
mean	13.37	12.09	15.20
s.d.	1.71	0.55	0.86
Credit score			
mean	728	726	729
s.d.	94	96	90
Credit limit ($)			
mean	6,026	6,077	5,961
s.d.	2,957	2,658	3,301
Average Monthly Debt ($)			
mean	801	1,070	455
s.d.	1,442	1,626	1,068
Number of accounts	155,376 (100%)	87,460 (56.2%)	67,916 (43.8%)

Notes: Means and standard deviations (s.d.) are computed cross-sectionally across accounts, after first averaging each variable for each account across the entire sample period ranging from 8/1997 - 12/1999. Fee-paying status is taken as of the beginning of the sample. For accounts subsequently switching contracts, only the period of the initial contract is included.

Table 2. Distribution of Debt, by Credit Contract

Average Monthly Debt	(1) All Accounts		(2) Wealthy Accounts	
	Paying Fee ("payers")	Not Paying Fee	Paying Fee ("payers")	Not Paying Fee
$0	23.4%	50.3%	39.9%	55.4%
$0-100	14.6%	15.2%	12.9%	17.4%
$100-500	16.6%	13.7%	13.8%	11.6%
$500-1200	14.3%	8.7%	10.0%	5.8%
>=$1200	31.1%	12.2%	23.4%	9.9%
total	100.0%	100.0%	100.0%	100.0%
# accounts	82639	67411	6370	22477
% pay vs. not pay	0.55	0.45	0.22	0.78

Notes: Debt is average monthly debt over all months in the sample, 8/1997-12/1999. Wealthy accounts have at least $25,000 of financial assets, including $5,000 in liquid assets, at the same bank. This sample excludes accounts switching contracts.

Table 3. Net Savings and Contract Choice

	(1) All Accounts		(2) Wealthy Accounts	
	Paying Fee ("payers")	Not Paying Fee	Paying Fee ("payers")	Not Paying Fee
Net savings from paying fee				
Mean ($)	22.91	-1.87	9.85	-1.31
% optimal contract	44.5%	79.0%	34.2%	83.8%
% suboptimal contract	55.5%	21.0%	65.8%	16.2%
% optimal/suboptimal overall	60.0%/40.0%		72.9%/27.1	
Distribution of Net savings ($) (# of accounts, % pay vs. not pay)				
< $0	45901	53227	4190	18839
	46.3%	53.7%	18.2%	81.8%
$0-25	10856	6431	935	1871
	62.8%	37.2%	33.3%	66.7%
$25-50	7118	3074	472	705
	69.8%	30.2%	40.1%	59.9%
$50-100	9044	2972	510	721
	75.3%	24.7%	41.4%	58.6%
$100-200	7426	1482	246	313
	83.4%	16.6%	44.0%	56.0%
$200-300	1852	195	17	26
	90.5%	9.5%	39.5%	60.5%
>=$300	442	30	0	2
	93.6%	6.4%	0.0%	100.0%
# accounts	82639	67411	6370	22477
% pay vs. not pay	0.55	0.45	0.22	0.78

Notes: Net savings is the potential savings in interest costs on paying the annual fee (whether or not the account-holder actually paid the fee), net of the fee itself, assuming the same debt levels. It is averaged over the entire sample period, but expressed in annual terms. % suboptimal is the fraction of accounts that chose the suboptimal contract ex post. For non-payers, it is the fraction whose gross savings exceeds the fee. For payers, it is the fraction with gross savings less than the fee. This sample excludes accounts switching contracts.

Table 4. Net Savings and Switching Contracts

(first contract, second contract)	(1) (pay, pay)	(2) (not pay, not pay)	(3) (pay, not pay)	(4) (not pay, pay)
Before switch: Net savings				
mean ($)	22.9	-1.9	-15.9	36.5
% initial contracts optimal	44.5%	79.0%	7.07%	39.41%
% suboptimal	55.5%	21.0%	92.9%	60.6%
After switch: Net savings				
mean ($)			-17.9	47.5
% optimal after switching			96.2%	67.1%
% suboptimal			3.8%	32.9%
# obs	82,639	67,411	4,821	505

Notes: (pay, pay) and (not pay, not pay) include the accounts that do not change contract terms during the sample period. (pay, not pay) includes those that switched from paying to not paying, and (not pay, pay) those that switched from not paying to paying. For accounts that do not switch, net savings (see Table 3) is averaged over the entire sample period, but expressed in annual terms. For accounts that switch, net savings before the switch are averaged over all available months before the switch, again annualized; and net savings after the switch are averaged over all available months after the switch, again annualized.

Table 5. Learning and Switching Contracts

Dependent Variable	(1) Stop Paying the Fee: (pay, not pay) vs. (pay, pay)			(2) Start Paying the Fee: (not pay, pay) vs. (not pay, not pay)		
	coef.	s.e.	p-value	coef.	s.e.	p-value
Net Savings	-0.015	0.002	<.0001	0.004	0.001	<.0001
% Months Borrow	-2.126	0.103	<.0001	2.007	0.150	<.0001
Credit Limit/1000	0.034	0.006	<.0001	0.068	0.013	<.0001
Credit Score/1000	0.378	0.135	0.005	-2.335	0.233	<.0001
Constant	-2.706	0.115	<.0001	-4.592	0.208	<.0001
# obs		87,460			67,916	
Pseudo R2		0.128			0.094	
Log likelihood		-16269.3			-2699.8	

Notes: This table estimates cross-sectional logit models of accounts that switched contracts, with heteroscedasticity-corrected standard errors. In column (1) the sample includes all accounts that were initially paying (i.e., both (pay, pay) and (pay, not pay)), with the dependent variable equal to one for those that switch to not paying (i.e., (pay, not pay)). Similarly, column (2) includes all accounts that were initially not paying, with dependent variable equal to one for those that switch to paying. All the independent variables are averaged over all months before a switch, and annualized. "% Months Borrow" measures the fraction of months before the switch that the account-holder borrowed. For other definitions, see Tables 3 and 4.

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