Choosing the Wrong Calling Plan? Ignorance and Learning

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Abstract

It is commonly believed that consumers make frequent mistakes when subscribing to telephone calling plans. The fact that consumers show a strong preference for flat rate options has been frequently interpreted as evidence of irrational behavior. Such a choice is generally thought not to be cost minimizing *ex–post*. My results, obtained using data from the 1986 Kentucky tariff experiment, contradict these views and provide strong evidence in favor of the rationality of consumers' choices. I find that expectations regarding future consumption play an important role in the choice of calling plan. But more importantly, the evidence shows that there exist important learning effects that induce consumers to switch plans. Switching occurs in order to minimize the magnitude of monthly bills even in the short term and in response to very small differences in cost. JEL: D42, D82, L96.

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1 Introduction

When a firm offers several tariff options to its customers, the possibility arises that they will make an *ex–post* mistake in tariff choice. This occurs since consumers cannot commit to a certain purchase level at the time they subscribe to the service option, and thus, they might find out later that a different choice of tariff could have resulted in a lower payment for their actual level of consumption. This is a common feature of increasingly important subscriptions markets, in which buyers and sellers maintain long term, non–anonymous relations and where learning induces interesting dynamics. On the one hand, buyers may learn their taste over time, thus making the right choice as times goes by; on the other hand, the seller may design options to identify the "type" of each buyer and, if possible, to extract a higher proportion of their consumer surplus by offering tariff options that are better tailored to the profile of the consumer. This paper focuses on the first type of learning. In turn I document buyer behavior in a subscriptions market using data from a tariff experiment run by South Central Bell (SCB) in Kentucky during the second half of 1986.

The most frequently studied case of subscriptions markets is the choice among Optional Calling Plans (OCPs) in the telephone industry. This paper shows that, contrary to the conventional wisdom among field experts and some recent contributions by behavioral economists, customers of local telephone service make, on average, the right tariff choice conditional on their actual realized consumption. I show that individual expectations on future telephone usage play a critical role in the subscription decision. Furthermore, I show that the behavior of local telephone customers is not characterized by a biased taste for a flat tariff option. Most consumers that subscribe to such an option are high use consumers, with correspondingly high expectations about future local telephone use. For these consumers subscribing to the flat tariff option is both *ex–ante* and *ex–post* optimal. Finally, I show that consumers often switch tariff options with the explicit goal of minimizing the cost of their service, and they do so in the short term and in response to small differences in billing cost.

Most economists, perhaps with the exception of behavioral economists, view the possibility of *ex–post* mistakes as a transitory aspect of a dynamic process in which customers eventually learn what is the least expensive option for their demand profile. Surprisingly, many economists and field experts argue that there are important "particularities" in these markets that make them an exception to the principle of rationality. Some of the suggested "particularities" include uncertainty about future consumption and rates; monthly variation in individual usage; explicit preferences for flat tariffs; and more importantly, persistent misperception of actual consumption [Mitchell and Vogelsang (1991, §8.2.2) and Taylor (1994, §7.1)]. Subscription markets include local telephone, long distance, wireless, electricity, cable, internet, and others. It is disturbing that we have to conclude that frequent decisions made by millions of customers in these markets are "anomalies" that cannot be explained by common economic principles. A first question to answer is, do they really make so many mistakes?

I use individual level data from SCB's 1986 local telephone tariff experiment, which was conducted in two cities in Kentucky. I focus on Louisville where customers were given a choice among tariff options. The evidence reported in this paper contradicts most common interpretations of the tariff choice puzzle in telecommunications. In particular, it shows that the choice among OCPs is not an exception to the theory of rational choice. The evidence substantiates not only the argument that preferences for a flat tariff are the result of rational behavior by usage intensive consumers, but also that among consumers who made the incorrect choice, those who chose the optional measured service generated most of the additional revenues from the introduction of optional tariffs. The paper also documents for the first time that consumers respond to small cost differences between options and, as a result, switch services to minimize their monthly bill.

The econometric analysis in this paper benefits from the richness of the data set. First, these data contain a partial indicator of consumers' own usage expectations. Thus, I can explicitly analyze the role of expectations in the choice among tariff options. Second, the data include individual usage information for a three month period previous to the tariff experiment, when all customers subscribed to the mandatory flat tariff. Therefore, telephone usage is not price sensitive over that period, which allows me to obtain individual

forecasts of the maximum potential savings from switching to the measured service when the option became available. Thus, I can also study the role of potential savings on the decision to subscribe to a particular tariff option.

Within the telecommunications literature it is commonly argued that the small difference in cost between each alternative justifies careless behavior by consumers regarding the choice of optional tariff.[1] It may appear, then, that the interest in the study of OCPs can be confined to telecommunications pricing. However, this question opens a much broader discussion that exceeds the limits of telecommunication pricing. Should we ignore rational choice theory when the price difference between alternatives is small? How large does the price difference need to be to justify the use of rational choice theory?

Taking into account computation costs might help explain why consumers make systematic choice mistakes. Even rational consumers facing numerous and complex tariffs might not find it optimal to evaluate all options in detail. This rational behavior could lead to the result that consumers do not choose the option that minimizes costs. Fortunately high computation costs can be ruled out in the present study as consumers must choose between only two options, one of which is a flat tariff. The flat tariff consists of a fixed monthly payment for unlimited and non–metered local telephone use. The measured option includes elements of peak–load pricing, offering discounts depending on the time of use (peak *vs.* off–peak), in addition to a monthly allowance of calls for a monthly fee, *i.e.*, use is not measured until it exceeds some threshold. Therefore, marginal consumers only need compare the fixed monthly fees of each tariff option, something that is easily observable by consumers. This minimizes any objection to the conclusions based on potential complexity in evaluating tariff options.

I also rule out the argument that risk aversion plays a role in tariff choice on the basis that the *ex–post* loss from making the wrong choice is on average only about $4.88 out of a representative $1,600 *per capita* monthly income (1986 dollars). The difference in cost between each alternative may appear insignificant. The evidence reported in this paper shows that consumers respond in the very short term to small cost differences by

[1] See for instance Clay, Sibley, and Srinagesh (1992) and Srinagesh (1992).

choosing the cost minimizing tariff option for their usage profile. Furthermore, I also find evidence that they switch options to achieve this goal, in particular by changing from the measured service back to the flat tariff. This provides very strong evidence that telephone customers behave rationally, and therefore, by extension, it supports the applicability of rational choice theory even in cases where differences in the cost of alternatives are small.[2]

As was previously mentioned, some economists have documented that consumers make frequent mistakes choosing between tariff options. They have concluded that the fact that most customers prefer a flat tariff option whenever it is available supports the idea that they are irrational, regardless of whether these mistakes are just a transitory feature associated with learning. This is the argument, for instance, of MacKie–Mason and Lawson (1993), who use the same data set as the present study. Many studies in telecommunications examining choice among tariff options make use of the Subscriber Line Usage Survey (SLUS) collected at the time when optional local measured service was introduced. Using this data, Hobson and Spady (1988) and Kling and van der Ploeg (1988) report that a majority of customers in Michigan appear to show a bias towards subscribing to a flat tariff option. Kridel, Lehman, and Weisman (1993) document that one third of customers in Arkansas and Missouri who subscribe to a flat tariff option do not generate enough use to justify their subscription. Although the use information of these studies is comprised of long panels and numerous consumers, the demographic information included in SLUS is not rich. This dramatically reduces the number of useful observations and thus brings into question the validity of the results. However, using a longer panel that does not suffer from such sample selection constraints, Train, McFadden, and Ben–Akiva (1987) also argued that telephone customers switch tariff options less frequently than would be expected from a pure cost minimization perspective.

The paper is organized as follows. Section 2 briefly describes the tariff experiment carried out in Louisville and studies the relationship between expected and actual local telephone use. Section 3 tests whether actual or expected use better explains the choice of tariff. Section 4 studies the role of potential savings in the choice of tariffs, as well as

[2] The present value of the savings could still represent a substantial amount. The distinction is important because many of these optional tariffs become long term contracts.

whether misperception of future consumption is responsible for making *ex–post* mistakes in tariff choice. Section 5 concludes.

2 Data: Expected and Actual Consumption

In 1984, right after the break up of AT&T and the creation of the Regional Bell Operating Companies, South Central Bell (SCB), one of the "Baby Bells", requested permission from the Kentucky Public Service Commission (KPSC) to introduce optional measured service rates. At that time there were serious concerns about the impact such a service would have on local telephone customers. Although most people agreed that optional measured service would probably increase economic efficiency by bringing marginal rates closer to marginal costs, the net effect was unknown and difficult to evaluate as local telephone service had never been metered before.

In order to help decide whether the introduction of optional measured service should be approved, the KPSC asked SCB to conduct a tariff experiment in two Kentucky cities (Bowling Green and Louisville) during the second half of 1986. The tariff experiment affected the whole population of these two local exchanges, but in addition SCB conducted a telephone survey during the spring of 1986 to collect socioeconomic and demographic data on about five thousand households among the customers included in the experiment. SCB also recorded the local monthly telephone use information of those households for March, April, and May before the start of the experiment. This data collection was very detailed and included the total number of calls and minutes of conversation by time of day, day of week, and distance bands within the local exchange as defined by the tariffs that would later be introduced at the beginning of July.

I will focus on the Louisville sample. While customers in Louisville paid $18.70 for monthly access and non–measured calls in the first half of 1986, during the second half of the year they had the choice of keeping the same flat tariff scheme or switching to measured service. The measured option included a $14.02 monthly fee and distinguished between peak, shoulder, and off–peak time bands, as well as two distance bands from the caller's

location within the local exchange area. In distance band "A", the setup and duration prices were equal: 2 cents during peak, 1.3 cents during shoulder, and 0.8 cents during off–peak time. Setup charges were the same for distance band "B", but duration charges were doubled. Peak time included weekdays from 8 p.m. to 5 p.m., shoulder between 5 p.m. and 11 p.m. on weekdays and Sundays, while any other time was considered off–peak. After a three month period of adjustment, SCB collected monthly individual telephone use information as well as actual tariff choices in October, November, and December.[3]

There is evidence of choice biased sampling that needs to be adjusted at the empirical stage. There is a clear disproportion between the percentage of customers that chose the measured service in the sample, 30 percent, and the proportion that chose the measured service in the population, only 10 percent. SCB selected the sample during the spring of 1986, before the introduction of tariff options. Thus, the divergence can only be explained by SCB having targeted a particular group of customers that, based on its previous knowledge of their calling profiles, were more likely to later choose the measured option, as they actually did. This sampling strategy served the interest of SCB, which could argue in favor of the optional measured rate on the basis of its widespread acceptance.

Observations on non–active customers (those who did not make a single phone call in any of the spring or fall months) and households that did not report all relevant information were excluded. This omission does not produce biased results as few households were excluded and those that were are balanced conditional on demographics. Around 14 percent of households did not report their income. In these cases I assigned an estimated average annual income level of $19,851 and included a dummy variable to index these cases.[4]

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[3] An interesting feature of the Louisville tariff is that it included a $5.00 allowance under the measured option. Thus, all customers who, in accordance with the measured option price schedule, made use of the telephone worth $5.00 or less were charged nothing in addition to the $14.02 monthly fee. For at least a range of telephone use (very much determined by individual habits) consumers faced an effective zero marginal charge. A critical additional second of communication could, however, cost them $5.00 extra.

[4] The transformation of the reported income categories into a continuous income indicator is based on a parametric density estimation of a displaced gamma distribution for income. See Appendix 3 of Miravete (2002) for more information about this estimation procedure.

Table 1 describes all variables and presents basic descriptive statistics for the sample. It is remarkable that in addition to demographic data, SCB also asked consumers about the average number of telephone calls that they made during a week. This information was collected during the spring months of 1986, when the marginal tariff was zero for all customers (as it had always been in the past). Thus, the reported expected number of weekly calls can be interpreted as consumers' own estimates of their usage satiation level free of any price effect.[5]

Table 1 shows that there are no major differences between demographics conditional on tariff choice, perhaps with the exception of households with teenagers and/or those that receive benefits. Households with these characteristics are most likely to subscribe to the flat tariff option. It is more likely to find households where the head holds a college degree among those that subscribe to the measured option. Table 1 also shows that, contingent on the spring consumption profile (with zero marginal tariff), most households would save money by remaining in that option instead of switching to the measured service. This fact may explain why 90 percent of the population (70 percent of the sample) remained under that option after the introduction of an optional measured service.

Differences are important, however, when we consider telephone use and expectation related variables. Observe that the average of SAVINGS is in both cases negative. This means that given their average consumption during the spring months, consumers would be better off subscribing to the flat tariff option regardless of their tariff choice. For those who kept the flat tariff, the average potential loss of switching to the measured service was \$14.72, while for those who subscribed to the measured service the potential loss of staying with the flat tariff was only \$6.15. This evidence is consistent with consumers choosing, on average, the right tariff. Consumers that chose the measured service made a significantly lower number of weekly calls than those that remained in the flat tariff option (22 *vs.* 38), and made smaller prediction errors about future consumption; their actual number of calls minus expected calls was only 2 as compared to 8 for those who subscribed to the flat

[5] Strategic answering can also be ruled out, because the interviewed customers were not aware of the future tariff experiment to be held during the second half of 1986. However, as I discuss in the following section, this is only a partial indicator of expected future usage, since telephone use also includes other dimensions such as duration of calls, their time profile, and the distance of calls within the local exchange.

tariff option. The distribution of forecast errors however, is quite different conditional on the choice of tariff. For those who subscribed to the flat tariff option, the distribution of prediction errors is balanced: 20 percent of them underestimated future use by more than 20 percent, and 25 percent overestimated it by the same magnitude. However, among those who subscribed to the measured option, only 7 percent underestimated future use by more than 20 percent, while 39 percent of them overestimated future consumption by more than 20 percent. Many of the consumers who chose the measured service based on their expectation of low future use made the right decision since their actual use did not even exceed their already low expectation. On the contrary, those who subscribed to the flat tariff option based on their high consumption expectation chose right since in general their actual consumption exceeded their expectation. These are the hypotheses to be confirmed in the following two sections by means of a more detailed analysis of the data using discrete choice models.

3 Choosing Tariffs: The Role of Expectations

In this section I study consumer tariff choice in Louisville during the second half of 1986. In particular, I focus on the role of expectations in choosing between tariff options. If consumers' information sets are substantially different at the time they choose the tariff from when consumption decisions are made, expectations regarding future local telephone use should help explain actual tariff choices. Consider the following general model:

$$Y_i = \alpha P(\theta_i^0, \theta_i^1) + \beta X_i + \delta S_i + \epsilon_i, \tag{1}$$

where $Y_i = 1$ when household i subscribes to the optional measured service in October, and zero otherwise. Equation (1) is the most general version of the model. Potential regressors may include a vector of time–invariant individual demographics, X_i; a quadratic polynomial $P(\cdot)$ in expected, θ_i^1, and actual, θ_i^0, household specific average weekly calls during the spring months of 1986;[6] as well as potential predicted savings, S_i, from switching

[6] It would be incorrect to include the contemporaneous use during the fall months, because telephone consumption then depends on the particular choice of tariff (selection effect) and/or the particular marginal rate that individual consumers face given their accumulated consumption (price or suppression effect). Overall we would encounter serious endogeneity problems in estimating such a model.

to measured service based on individual use in the spring. Finally ϵ_i is an error term, which is assumed to be normally distributed.

Provided that consumers' information sets differ significantly between the time of subscription to the tariff and the time of consumption, we can distinguish two components in the individual satiation usage level θ^0: the expected satiation level θ^1 and a demand shock θ^2 that moves θ^0 around θ^1. Local telephone use is however multidimensional and defines consumers' profiles by the number of calls, the duration of calls, and their distribution over time. Ignoring these dimensions, θ^0, θ^1, and θ^2 (*i.e.*, SWCALLS, EXPCALLS, and SWBIAS as defined in Table 1, respectively), can be identified to some extent by the actual and expected number of weekly calls during the spring months of 1986. I focus on this single index of telephone consumption because it is the only usage statistic available both *ex–ante* and *ex–post*. Information about the expected duration of calls, for example, is not included in the survey. Since SCB explicitly requested customers' own estimates of the average number of weekly calls, this information, available for most households in the sample, can be later compared with the actual number of weekly phone calls for every month in the study. When restricted to the spring sample, these two measures are free of any price or selection effect, and thus they provide good indicators of the actual and expected satiation levels θ^0 and θ^1, respectively. The polynomial $P(\cdot)$ also includes two more indicators, LOW–EXPCALLS and HIGH–EXPCALLS, to identify individuals at the tails of the distribution of expectations.[7]

I estimate three nested specifications of the model given in equation (1). Table 2 reports probit estimates of the probability a consumer subscribes to the measured tariff option in October.[8] The first column of Table 2 estimates the tariff choice model for the particular case where $\beta = \delta = 0$, thus making the choice of tariff only a quadratic function of the actual and expected number of calls in the spring. This specification accounts for the effect of consumers' own expectations regarding use as well as the actual number of calls

[7] In particular, HIGH–EXPCALLS equals one when a consumer's expectations exceed the sample average of EXPCALLS plus its standard deviation. LOW–EXPCALLS is defined accordingly on the other tail of the distribution.

[8] See Miravete (2000a) for a consistent random effects probit estimation that combines both the static tariff choice and the possibility of switching options over time.

made during the spring months. Including the individual–specific spring–based consumption avoids any chance that the results are exclusively driven by the misrepresentation of telephone use due, perhaps, to heterogeneity across households when responding to the questionnaire. The estimates indicate that choosing the optional measured service is far less likely for usage intensive households. This effect holds both if we account for actual intensive usage (a negative sign on SWCALLS) or expected intensive usage (a negative sign on HIGH–EXPCALLS). On the contrary, consumers with very low expectations about future use are more likely to subscribe to the optional measured service (a positive sign on LOW–EXPCALLS).

The second column of Table 2 includes demographics so as to account for observable household heterogeneity. Households with different demographics may show distinctive local telephone use patterns that makes them more prone to subscribe to one tariff option over the other.[9] Households with higher than average incomes tend to subscribe to the optional measured service, a relationship that is decreasing in income.[10] Large households are more likely to subscribe to the flat tariff option while those with a head that holds a college degree are more likely to subscribe to the optional measured service.[11]

As before, the second column of Table 2 also includes indicators of expected demand. Observe that the negative effect of actual consumption on the probability of subscribing to the measured option is robust to the existence of individual heterogeneity as accounted for by the available demographics. Again, conditional on demographics, usage intensive consumers are more likely to subscribe to the flat tariff while consumers with low expectations of future use tend to subscribe to the measured service. This confirms that

[9] Consumers may also account for expectations along other consumption dimensions such as the distribution of the average duration of their calls, the time of the call, and the distance of the call destination within the local exchange. Although individual data is available for actual use along all these dimensions, individual expectations were only collected on the number of weekly calls. Alternatively, we can think of demographics as accounting for the effect of expectations along these additional dimensions.

[10] This is the right choice for these customers, because high income households generally consume less than the average customer. High income levels and small household sizes characterize those customers with low demand for local telephone service. See the results of Hobson and Spady (1988), Kling and Van Der Ploeg (1990), as well as Miravete (2002).

[11] As I explained before, the sample is choice biased. The likelihood function needs to be modified to correct the proportion of consumers choosing each option so that the results are representative of the population. The t–statistics of Tables 2 and 3 are obtained from a sample–weighted covariance matrix as suggested by Manski and Lerman (1977).

reported expected use captures, at least partially, some of the idiosyncracies of consumers' demand profiles. Households are less likely to subscribe to the optional measured service the larger their expected future demand, measured either by the reported or the actual number of calls during the spring. Including indicators related to individual expectations of future consumption avoids misspecification of the model by controlling for the existence of individual heterogeneity linked to intensity of use rather than to demographics and the joint time–distance distribution of usage profiles.

Finally, the last column of Table 2 includes the potential savings that consumers would realize if instead of the mandatory flat tariff they were subscribed to a measured service in the spring while keeping their usage pattern unaltered. The significant positive sign of the estimate of SAVINGS in the last column of Table 2 indicates that, on average, consumers tend to subscribe to the least expensive tariff for their usage pattern. This is a key result that contradicts the common opinion that consumers systematically choose the wrong tariff option for their usage. Therefore on average, consumers minimize the cost of local telephone service when they choose tariff options. The next task is to study whether customers who eventually subscribed to the wrong option given their usage pattern are more likely to make persistent choice mistakes by renewing their subscription to the same tariff option or, alternatively, switch tariff plans. This is the objective of the following section.

4 Cost Minimization and Wrong Tariff Choice

The goal of this section is to study whether the choice of tariff was driven by an explicit attempt to minimize the monthly cost of local telephone service. The evidence presented in this section shows that the desire to reduce the cost of local telephone service does indeed help to explain tariff choice, thus ruling out the idea that consumers have an unjustifiably biased taste for flat tariffs. Actually, subscribers to the optional measured service tend to make more mistakes than those within the flat tariff option, but they also rapidly switch to the flat tariff.

Table 3 presents the results from an analysis similar to the tariff choice of Section 3, but centered now on the decision to switch tariffs between October and December of 1986. Observe that among demographics it does not appear that any particular group of customers is more likely to switch tariff options. Only very large households appear to be more inclined to do so. Usage intensive consumers and those with very high expectations of future consumption are less likely to switch options. These customers are also more likely to subscribe to the flat tariff option as indicated in Table 2. These results are in line with the common belief that most consumers subscribe to the flat tariff option for the long run. Combining the estimates of Table 2 and 3, we conclude that the choice of tariff can be matched with the intensity of usage profile of consumers. Finally, the SAVINGS variable is not significant.[12] This result confirms that most consumers correctly chose their tariff option when the option was first available. Having chosen the correct tariff option for their level of consumption, as indicated by the positive and significant effect of SAVINGS on the tariff choice decision, these consumers are not likely to switch tariffs later on.

The rest of this section addresses whether potential savings play a role in the decision to switch tariffs. I first conduct a detailed descriptive analysis of expected and actual use, current potential savings, and wrong tariff choice for each sequence of tariff subscription decisions. To complement this analysis, I later estimate another probit model to explain *ex–post* mistakes in the choice of tariffs.

4.1 The Role of Savings in the Choice of Tariff

Depending on the actual volume of telephone use, consumers can be classified *ex–post* as having chosen correctly or incorrectly each tariff option. This classification is made contingent on keeping the same usage pattern independent of price responses, which provides an approximate upper bound on the gains of switching to a different tariff option. Consumers who chose the flat option (90 percent of the population in the Louisville exchange) were

[12] It should be noticed again that the SAVINGS indicator refers to potential savings in the spring. This is done to ensure that this regressor is exogenous. Including potential savings for October would add serious endogeneity as well as state dependence problems that would complicate the estimation process and compromise the robustness of the estimates.

not subject to any positive marginal tariff. In turn, telephone use reached its household specific satiation level (different in each month due to the existence of individual stochastic demand shocks). These households most likely made the right choice as previous results have shown. I now extend the analysis to groups of consumers defined by the trajectory of their tariff subscription decision.

Table 4 reports expectation forecast errors, the percentage of households who made the wrong tariff choice, and potential savings for local telephone customers by tariff choice path during the three fall months of 1986. The POPULATION SHARE variable indicates the proportion of each type of household in the population after correcting for choice biased sampling in October. PERCENT BIAS is the prediction error, SWCALLS–EXPCALLS, as a percentage of actual use in the spring. In order to account for the potentially diverse behavior of those who underestimate their future use relative to those who overestimate it, I define two additional dummy variables, $\mathbb{1}(\cdot)$, identifying those who under/overestimated their number of average weekly calls by more than 20 percent. A positive value of POTENTIAL SAVINGS indicates the magnitude of the mistake for those who made the wrong tariff choice. A negative value of this variable means that consumers correctly chose the tariff option for their realized use. I have also defined two additional dummy variables to identify customers that could realize a potential savings/loss that exceeds \$3.74, which is the difference between the fixed monthly fees of the two tariff options. WRONG denotes the proportion of sample households that each month would have saved on their telephone bill had they chosen the alternative tariff plan and their local telephone usage pattern remained the same.

Table 4 provides evidence in support of the hypothesis that potential savings drive the choice of tariff option, particularly for those who mistakenly choose the measured service option. It is easier to monitor whether the choice of tariff is the correct one when subscribing to the measured service. Customers only have to check whether the cost of their use exceeds \$18.70, *i.e.*, the cost of the flat tariff option. Conversely, customers with the flat tariff option must estimate the cost of their use under the measured service since their use is not metered.

Table 4 also reports the forecast error and its value as a percentage of spring use. While on average consumers underestimate their future use (see Table 1), consumers that always remain on the flat tariff option overestimate their already high use. Subscribing to the flat tariff option is therefore *ex–ante* and *ex–post* optimal. Furthermore, the distribution of the prediction errors is skewed to the right, thus further enhancing this effect. About 59 percent of households that always remain on the flat tariff option overestimate their future use by more than 20 percent, while 26 percent of them underestimate future use by the same proportion. The proportions are similar for consumers that follow the other sequences of tariff choice.

Consider first those customers that always remained with the flat tariff option (FF–customers). They constitute about 86 percent of the population and realize an average savings between $15.24 and $16.94 relative to the most expensive measured service alternative. Demand increases in December, and thus the percentage of the sample that wrongly chose *ex–post* the flat tariff option decreased from 11 percent to 6 percent. This minority, however, has a very low usage profile. Under the alternative measured option they will never exceed the tariff allowance. This is why the potential savings for those that mistakenly choose the flat tariff option is always $3.74. This small number of consumers, just 5 percent of the population, have been identified by previous studies as the prime evidence of irrationality. These studies have had to rely on a limited set of information. For instance, approximately 77 percent to 82 percent of those who chose the flat tariff option, *i.e.*, about 69 percent of the population, did so correctly since they were consumers whose high use always exceeded the tariff allowance of the alternative measured service.

Now consider those customers who always subscribed to the measured service option during the three months of the sample (MM–customers). They represent only about 9 percent of the population. Relative to FF–customers, MM–customers are less intensive users of local telephone service. On average, however, it appears that about two thirds of them mistakenly subscribed to the measured option. The average cost of this mistake increased from $1.19 in October to $2.66 in December. Errors are more common among those who subscribe to the measured service, although they amount to a lower number of customers than those who mistakenly chose the flat tariff. It should also be noted

that though these customers did not switch tariffs, the magnitude of their mistakes was significantly smaller than the difference of fees between the tariff options. Only about one third of these customers consume beyond the allowance of the measured option. These are the customers, just 3 percent of the population, that some recent behavioral literature [DellaVigna and Malmendier (2001)] claims to have time–inconsistent preferences because they repeatedly fail to limit their consumption by choosing the tariff option that prices by use.

The remaining cases, although representing a much smaller fraction of the population, are useful in helping to identify whether and how consumers learn their usage profiles, as well as to show how they react to incorrect tariff choices. About 4 percent of the population subscribes to the flat option in October and ends up subscribing to the optional measured service in December (FM–customers). They represent about 4.5 percent of those who always subscribed to the flat tariff option. At the other end, just 1 percent of the population switches from the measured service to the flat tariff option between October and December (MF–customers). However, this represents 11 percent of those who always subscribed to the measured service option. In percentage terms, more customers switch from the measured service to the flat tariff option than the other way around.

A previously advanced potential explanation is that it is easier for consumers who are subscribed to the measured service to monitor the cost of their current use than for those who are subscribed to the flat tariff option. This is confirmed by the descriptive statistics in Table 4. Observe that in October, more than a half of FM–customers correctly subscribed to the flat tariff option. Only 11 percent of FF–customers had a significantly low use to justify switching tariff options, but 44 percent of FM–customers could realize savings beyond the fixed monthly fees of these tariffs. These facts argue in favor of the argument that current potential savings (not the exogenous spring time indicators of Table 2) may influence the decision to switch tariffs. However, the percentage of FM–customers choosing the wrong tariff increased from 44 percent in October to 65 percent in December after subscribing to the measured service. Notwithstanding, in both cases, the magnitude of potential savings is very low, indeed smaller than the fixed \$3.74 monthly cost difference

between tariff options. It is possible that FM–customers may have been guided by an explicit attempt to reduce their monthly cost of local telephone service. Unfortunately, the evidence is not conclusive, partly because only three months of observations are available and the last one, December, is characterized by a general increase in demand. This seasonality effect may imply that the mistakes of FM–customers are just transitory.

The remaining set of households, those who switch from measured to flat tariff service between October and December (MF–customers), provide us with the most compelling evidence that consumers switch tariffs in an explicit attempt to minimize the cost of local telephone service. All these customers clearly made the wrong decision of subscribing to the measured tariff in October. These are intensive users. Their actual consumption in the spring exceeded the average use of FF–customers, but contrary to FF–customers, they on average underestimated their future use. Their low expectations explain their initial choice of measured service, but when they realized that the cost of their local telephone use exceeded $18.70 they switched back to the flat tariff option. In October, they faced an average potential savings of $17 if they switched back to the flat tariff. Almost all MF–customers, 98 percent, were intensive enough consumers to exceed the allowance of the measured tariff. These numbers remain quite stable in December (their usage pattern does not vary much over time), but by then these customers all subscribed to the flat tariff option, realizing an average savings of $16.33.

I thus conclude that the evidence reported above does not support the idea that a large proportion of customers systematically prefer flat rates independent of their telephone use. The realization of potential savings under the alternative tariff leads consumers to switch options in the very short term. This effect is clearer for customers that switch from measured to flat service than for those who make the opposite change.

4.2 Expectations and Wrong Tariff Choice

Although consumers appear to learn their calling profile and reduce their monthly payments by switching to their least expensive option, the panel is too short for them to reach a steady–state equilibrium. Evidently, wrong tariff choices are unavoidable given

the nature of telephone demand (seasonality and unforeseen changes in demand) and the fact that consumers must first subscribe to a particular tariff option and then later decide their level of use.

It is not clear from Table 4 that whether potential inaccuracies in expectations are responsible for the wrong choice of tariffs. Those that end up with the flat tariff option may appear to be guessing correctly, since the percentage of wrong choices decreases over time. The opposite result holds for those who end up subscribing to the measured option. But both results may also be explained by the increased use associated with the holiday season in December. In order to disentangle these effects, Table 5 reports the results from estimating a model very similar to that given in equation (1). In particular, I estimate different versions of:

$$Z_{it} = \alpha P(\theta_i^0, \theta_i^1) + \beta X_i + \gamma W_t + \eta \Phi(E_i) + \epsilon_{it}, \tag{2}$$

where $Z_{it} = 1$ when household i subscribes to a tariff choice that turns out to be more expensive *ex–post* than the alternative choice for the realized use during each particular month. The rest of the variables are similar to those of the model in equation (1), except $\Phi(E_i)$, a nonlinear function of households' prediction errors during the spring, and W_t, time dummies to control for potential seasonality effects.

I estimate three versions of this model. The first version includes only the polynomial of actual and expected calls from the spring; the second adds demographics and time dummies; and finally the third includes the percent forecast error. The sign and significance of the estimates varies substantially depending on the particular specification of the model that we consider. Among the few robust results across the different specifications, we find that usage intensive households are less likely to subscribe to the wrong tariff option. Along the same argument, households with very high expectations of future use are also less likely to subscribe to the wrong option, *i.e.*, most of those who subscribed to the flat tariff option, as argued during the discussion of Table 4. On the contrary, those with particularly low expectations of future use are more likely to subscribe to the wrong tariff choice, which in this case is the measured service. Consistent with these results, the estimates also indicate that large households, or those with teenagers, are also less likely to make mistakes in

choosing tariffs. These households are more likely to subscribe to the flat tariff option, as shown in Table 2.

The estimates indicate that only individuals with small percent prediction errors are likely to subscribe to the wrong option. Those who under or overestimate future use by more than 20 percent of their actual consumption are more likely to subscribe to the least expensive tariff for their use. Finally, once we control for the effect of percent forecast error, only young households appear to be more likely to subscribe to the wrong tariff choice.

Therefore we conclude that the wrong choice of calling plan is more related to the magnitude of households' own expectations of future use than to a particular socioeconomic characteristic. Only those demographics clearly related to the intensity of usage, such as the size of the household or the number of teenagers, appear to matter. Households that clearly under or overestimate consumption choose correctly while those with less biased expectations, and also lower use levels, are among those more likely to subscribe to the wrong tariff option.

5 Conclusions

This paper has presented evidence in favor of the rationality of consumers regarding the choice of optional tariff plans. Using an underlying model of consumer choice with individual stochastic demands, I have used information from Kentucky's 1986 local telephone tariff experiment to estimate a model of tariff choice, as well as to analyze the determinants of wrong tariff choice. Given the panel structure of the data, I have been able to control for unobserved individual heterogeneity at the tariff choice stage and to estimate the effects of commonly available demographics on this control variable.

The results reported in this study reconcile commonly observed tariff choice patterns with the axiom of rationality of consumer behavior in two ways: static and dynamic. From a static point of view, when signing up for a particular tariff option, consumers are guided by their expectations of future telephone use rather than by some sort of pathology. In

addition, from a dynamic perspective we not only care that consumers behave rationally when choosing tariff plans, but also that they learn after making an initial mistake in tariff choice and switch tariffs to minimize their monthly payments for local telephone service. The evidence reported in this paper supports the rationality of consumers and refutes numerous previous interpretations of tariff choice patterns in telecommunication service markets.

There remains one last issue to be addressed in the future through structural analysis of this data: the majority of consumers predict a level of use that would place them above the allowance of the measured service option. We have seen that most of these consumers (86 percent) always choose the flat rate option. This opens the question about whether SCB offered the optimal options. Keeping the optional measured service tariff unchanged, SCB could increase its expected revenues by increasing the magnitude of the flat rate option. SCB could have charged $19.02 for the flat tariff option instead of $18.70. The majority of customers who currently prefer the flat tariff (except perhaps those with a distribution of use narrowly defined around $19.02) would still do so but the monopolist would make an additional $0.32 from each of them. The higher the mean expected consumption level of those currently choosing the flat tariff option the easier it is to increase revenues by further raising the price of the flat tariff option.

References

Clay, K., D.S. Sibley, and P. Srinagesh (1992): "Ex Post *vs.* Ex Ante Pricing: Optional Calling Plans and Tapered Tariff." *Journal of Regulatory Economics*, 4, 115–138.

DellaVigna, S. and U. Malmendier (2001): "Contract Design and Self–Control: Theory and Evidence." Mimeo, Harvard University.

Hobson, M. and R.H. Spady (1988): "The Demand for Local Telephone Service Under Optional Local Measured Service." Bellcore Economics Discussion Paper No. 50.

Kling, J.P. and S.S. van der Ploeg (1990): "Estimating Local Call Elasticities with a Model of Stochastic Class of Service and Usage Choice," in A. de Fontenay, M.H. Shugard, and D.S. Sibley (eds.): *Telecommunications Demand Modelling*. North–Holland.

Kridel, D., D. Lehman, and D. Weisman (1993): "Option Value, Telecommunications Demand, and Policy." *Information Economics and Policy*, 17, 69–75.

MacKie–Mason, J.K. and D. Lawson (1993): "Local Telephone Calling Demand when Customers Face Optimal and Nonlinear Price Schedules." Working Paper. Department of Economics. University of Michigan.

Manski, C.F. and S.R. Lerman (1977): "The Estimation of Choice Probabilities from Choice Based Samples." *Econometrica*, 45, 1977–1988.

Miravete, E.J. (2000a): "Choosing the Wrong Calling Plan? Ignorance, Learning, and Risk Aversion." CEPR Discussion Paper No. 2562.

Miravete, E.J. (2000b): "Quantity Discounts for Taste–Varying Consumers." CEPR Discussion Paper 2699.

Miravete, E.J. (2002): "Estimating Demand for Local Telephone Service with Asymmetric Information and Optional Calling Plans." *Review of Economic Studies*, forthcoming.

Mitchell, B.M. and I. Vogelsang (1991): *Telecommunications Pricing. Theory and Practice*. Cambridge University Press.

Srinagesh, P. (1992): "A Dynamic Stochastic Model of Choice." Bellcore Economics Discussion Paper No. 78.

Train, K.E., D.L. McFadden, and M. Ben–Akiva (1987): "The Demand for Local Telephone Service: A Fully Discrete Model of Residential Calling Patterns and Service Choices." *Rand Journal of Economics*, 18, 109–123.

Table 1. Descriptive Statistics

Variable	Description	ALL		FLAT		MEASURED	
SWCALLS	Average number of weekly calls during the spring	33.5246	(36.654)	38.0348	(40.337)	22.4061	(21.738)
EXPCALLS	Expected number of weekly calls during the spring	27.0000	(33.769)	29.7894	(37.855)	20.1236	(18.811)
LOW P.BIAS	(SWCALLS–EXPCALLS)/SWCALLS < -0.2	0.2879	(0.453)	0.2479	(0.432)	0.3865	(0.488)
HIGH P.BIAS	(SWCALLS–EXPCALLS)/SWCALLS > 0.2	0.1667	(0.373)	0.2024	(0.402)	0.0787	(0.270)
MEASURED	Household on measured service this month	0.2886	(0.453)	0.0000	(0.000)	1.0000	(0.000)
SAVINGS	Spring potential savings of switching to measured	-12.2499	(17.294)	-14.7218	(18.734)	-6.1563	(10.923)
INCOME	Monthly income of the household	7.0596	(0.837)	7.0298	(0.869)	7.1332	(0.749)
HHSIZE	Number of people who live in the household	2.5603	(1.484)	2.7056	(1.496)	2.2022	(1.392)
TEENS	Number of teenagers (13–19 years)	0.2503	(0.636)	0.2963	(0.684)	0.1371	(0.481)
DINCOME	Household did not provide income information	0.1511	(0.358)	0.1723	(0.378)	0.0989	(0.299)
AGE1	Head of household is between 15 and 34 years old	0.0934	(0.291)	0.0957	(0.294)	0.0876	(0.283)
AGE3	Head of household is above 54 years old	0.6271	(0.484)	0.6354	(0.482)	0.6067	(0.489)
COLLEGE	Head of household is at least a college graduate	0.2244	(0.417)	0.1841	(0.388)	0.3236	(0.468)
MARRIED	Head of household is married	0.5019	(0.500)	0.5123	(0.500)	0.4764	(0.500)
RETIRED	Head of household is retired	0.2205	(0.415)	0.2197	(0.414)	0.2225	(0.416)
BLACK	Head of household is black	0.1265	(0.333)	0.1404	(0.348)	0.0921	(0.290)
CHURCH	Telephone is used for charity and church purposes	0.1608	(0.368)	0.1705	(0.376)	0.1371	(0.344)
BENEFITS	Household receives some federal or local benefits	0.2938	(0.456)	0.3108	(0.463)	0.2517	(0.435)
MOVED	Head of household moved in the past five years	0.4527	(0.498)	0.4421	(0.497)	0.4787	(0.500)
ONLYMALE	Head of household is single and male	0.1102	(0.313)	0.0966	(0.296)	0.1438	(0.351)
Observations		1,542		1,097		445	

Mean and standard deviations of demographics are for the fall of 1986. Income is measured in logarithm of thousands of 1986 dollars.

Table 2. Subscription to Optional Measured Service

Constant	–1.0842 (8.94)	–5.7517 (3.31)	–5.5939 (3.20)
EXPCALLS [⋆]	0.0408 (0.80)	0.0519 (0.94)	0.0484 (0.88)
EXPCALLS*EXPCALLS [⋆⋆]	–0.0384 (1.66)	–0.0279 (1.18)	–0.0251 (1.08)
SWCALLS [⋆]	–0.1133 (6.20)	–0.0901 (4.31)	–0.0101 (0.35)
SWCALLS*SWCALLS [⋆⋆]	0.0057 (1.01)	0.0081 (1.23)	–0.0027 (0.30)
EXPCALLS*SWCALLS [⋆⋆]	0.0693 (1.82)	0.0003 (0.66)	0.0003 (0.65)
LOW–EXPCALLS	0.2228 (2.29)	0.2520 (2.44)	0.2374 (2.29)
HIGH–EXPCALLS	–0.4317 (2.68)	–0.4826 (2.78)	–0.4864 (2.78)
INCOME		1.6564 (3.14)	1.5896 (2.99)
HHSIZE		–0.7423 (2.82)	–0.7208 (2.65)
TEENS		–0.1090 (0.25)	–0.2790 (0.62)
DINCOME		–0.4422 (4.46)	–0.4252 (4.24)
INCOME*INCOME		–1.3173 (3.24)	–1.2657 (3.09)
HHSIZE*HHSIZE		0.0122 (2.78)	0.0120 (2.76)
TEENS*TEENS		0.0212 (1.13)	0.0267 (1.41)
INCOME*HHSIZE		0.7520 (2.04)	0.7117 (1.86)
INCOME*TEENS		–0.0447 (0.72)	–0.0263 (0.42)
HHSIZE*TEENS		0.0956 (2.83)	0.0964 (2.84)
AGE1		–0.1872 (1.38)	–0.2166 (1.56)
AGE3		–0.0410 (0.47)	–0.0212 (0.24)
COLLEGE		0.3311 (4.23)	0.3395 (4.33)
MARRIED		0.1075 (1.26)	0.1165 (1.36)
RETIRED		–0.0073 (0.07)	0.0305 (0.28)
BLACK		–0.1067 (0.97)	–0.1498 (1.32)
CHURCH		–0.0728 (0.79)	–0.0628 (0.68)
BENEFITS		–0.1372 (1.33)	–0.1443 (1.38)
MOVED		–0.0210 (0.26)	–0.0373 (0.46)
ONLYMALE		0.0217 (0.19)	0.0152 (0.14)
SAVINGS			0.0137 (3.65)
Log–likelihood	–477.87	–456.29	–453.54

The endogenous variable equals one whenever the household chose the measured option in October of 1986. The sample includes 1,542 observations. The estimation method is weighted maximum likelihood (ML). Absolute, choice–biased sampling consistent t–statistics are reported between parentheses. Variables marked [⋆] and [⋆⋆] have been re–scaled by 10^{-1} and 10^{-3}, respectively.

Table 3. Switching of Tariffs

Constant	–1.7900 (8.09)	–8.4934 (2.80)	–8.3842 (2.78)
EXPCALLS [⋆]	–0.0121 (0.18)	0.2769 (2.39)	0.2710 (2.35)
EXPCALLS*EXPCALLS [⋆⋆]	–0.0416 (0.86)	–0.1611 (1.82)	–0.1582 (1.79)
SWCALLS [⋆]	0.1275 (1.57)	0.0987 (1.62)	0.1573 (2.29)
SWCALLS*SWCALLS [⋆⋆]	–0.1677 (2.19)	–0.0972 (2.16)	–0.1204 (2.53)
EXPCALLS*SWCALLS [⋆⋆]	0.1131 (0.86)	0.0002 (0.24)	0.0003 (0.29)
LOW–EXPCALLS	0.0114 (2.44)	0.3323 (1.73)	0.3219 (1.68)
HIGH–EXPCALLS	0.2273 (1.39)	–0.5654 (1.96)	–0.5612 (1.95)
INCOME		1.7379 (1.91)	1.6933 (1.86)
HHSIZE		0.0691 (0.14)	0.0880 (0.17)
TEENS		0.8489 (0.52)	0.7899 (0.48)
DINCOME		–0.2153 (1.20)	–0.1956 (1.10)
INCOME*INCOME		–1.0976 (1.58)	–1.0662 (1.53)
HHSIZE*HHSIZE		0.0204 (2.90)	0.0201 (2.90)
TEENS*TEENS		–0.1636 (0.82)	–0.1626 (0.82)
INCOME*HHSIZE		–0.4694 (0.67)	–0.5007 (0.70)
INCOME*TEENS		–0.1111 (0.52)	–0.1062 (0.49)
HHSIZE*TEENS		0.0281 (0.40)	0.0312 (0.44)
AGE1		0.0434 (0.19)	0.0347 (0.15)
AGE3		–0.0820 (0.56)	–0.0663 (0.45)
COLLEGE		–0.0664 (0.48)	–0.0643 (0.46)
MARRIED		0.1510 (1.03)	0.1580 (1.08)
RETIRED		–0.1243 (0.74)	–0.1082 (0.64)
BLACK		0.2664 (1.65)	0.2480 (1.54)
CHURCH		–0.0822 (0.53)	–0.0719 (0.46)
BENEFITS		0.1159 (0.73)	0.1112 (0.71)
MOVED		–0.0509 (0.38)	–0.0551 (0.41)
ONLYMALE		–0.1649 (0.84)	–0.1648 (0.84)
SAVINGS			0.0080 (1.33)
Log–likelihood	–276.70	–321.23	–320.59

The endogenous variable equals one whenever the household switches tariffs between October and December of 1986. The sample includes 1,542 observations. The estimation method is weighted ML. Absolute, (October)–choice–biased sampling consistent t–statistics are reported between parentheses. Variables marked [⋆] and [⋆⋆] have been re–scaled by 10^{-1} and 10^{-3} respectively.

Table 4. Potential Savings and Tariff Switching

PATH	FF	FM	MF	MM
SAMPLE OBSERVATIONS	953	43	41	375
POPULATION SHARE	0.8611	0.0389	0.0099	0.0901
SWCALLS	30.1605	22.0864	43.9695	21.7560
EXPCALLS	42.7450	18.0465	33.4390	18.6960
SWCALLS–EXPCALLS	12.5845	4.0399	10.5305	3.0600
PERCENT BIAS	–0.1954	-0.0213	–0.0235	–0.2598
$\mathbb{1}$[PERCENT BIAS $< -20\%$]	0.2623	0.2791	0.3171	0.3280
$\mathbb{1}$[PERCENT BIAS $> 20\%$]	0.5939	0.4884	0.6098	0.4880
		OCTOBER		
POTENTIAL SAVINGS	–15.2358	–2.1595	17.0033	1.1859
$\mathbb{1}$[SAVINGS ≥ 3.74]	0.1070	0.5025	0.9756	0.2933
$\mathbb{1}$[SAVINGS < -3.74]	0.7692	0.3721	0.0000	0.4267
WRONG	0.1070	0.4419	1.0000	0.5733
		DECEMBER		
POTENTIAL SAVINGS	–16.9373	3.5827	–16.3323	2.6647
$\mathbb{1}$[SAVINGS ≥ 3.74]	0.0619	0.4186	0.0000	0.3680
$\mathbb{1}$[SAVINGS < -3.74]	0.8185	0.3488	0.9024	0.3333
WRONG	0.0619	0.6512	0.0000	0.6667

PATH denotes the initial and final tariff choices (F=Flat, M=Measured) by households during the October–December period.

Table 5. Analysis of Wrong Tariff Choice

Constant	–0.3221 (3.66)	–3.0642 (2.54)	–2.9035 (2.39)
EXPCALLS [⋆]	0.0813 (2.02)	0.0690 (1.71)	0.0710 (1.57)
EXPCALLS*EXPCALLS [⋆⋆]	–0.0472 (2.16)	–0.0345 (1.67)	–0.0300 (1.50)
SWCALLS [⋆]	–0.1573 (10.96)	–0.1500 (9.57)	–0.1491 (7.40)
SWCALLS*SWCALLS [⋆⋆]	0.0175 (3.13)	0.0204 (3.43)	0.0233 (3.33)
EXPCALLS*SWCALLS [⋆⋆]	0.0442 (1.25)	0.0189 (0.51)	0.0010 (0.03)
LOW–EXPCALLS	0.0486 (0.70)	0.0554 (0.78)	0.9322 (2.56)
HIGH–EXPCALLS	–0.6138 (4.87)	–0.6314 (4.95)	–0.4854 (2.68)
INCOME		0.9371 (2.58)	0.0105 (0.02)
HHSIZE		–0.4983 (2.77)	–0.3674 (5.50)
TEENS		–0.0016 (0.00)	–0.7225 (2.58)
DINCOME		–0.3741 (5.61)	–0.0002 (0.04)
INCOME*INCOME		–0.7276 (2.61)	0.0075 (0.41)
HHSIZE*HHSIZE		–0.0004 (0.09)	0.6341 (2.47)
TEENS*TEENS		0.0115 (0.63)	–0.0362 (0.52)
INCOME*HHSIZE		0.6453 (2.53)	0.0643 (2.31)
INCOME*TEENS		–0.0421 (0.60)	0.1398 (1.46)
HHSIZE*TEENS		0.0731 (2.67)	0.0559 (0.93)
AGE1		0.1221 (1.30)	0.1537 (2.81)
AGE3		0.0475 (0.79)	–0.0585 (0.98)
COLLEGE		0.1627 (2.98)	–0.1310 (1.81)
MARRIED		–0.0571 (0.95)	0.0476 (0.62)
RETIRED		–0.1302 (1.81)	0.0114 (0.19)
BLACK		0.0298 (0.39)	–0.0939 (1.38)
CHURCH		0.0138 (0.23)	0.0279 (0.53)
BENEFITS		–0.0983 (1.45)	0.0017 (0.02)
MOVED		0.0172 (0.33)	–0.0533 (1.00)
ONLYMALE		0.0036 (0.05)	–0.1003 (1.88)
NOVEMBER		–0.0529 (1.00)	–0.0201 (0.51)
DECEMBER		–0.0998 (1.87)	0.0646 (0.91)
PERCENT BIAS			–0.6161 (4.80)
PERCENT BIAS*PERCENT BIAS			–0.0031 (1.40)
$\mathbb{1}$[PERCENT BIAS $< -20\%$]			–0.1981 (2.02)
$\mathbb{1}$[PERCENT BIAS $> 20\%$]			–0.1857 (1.99)
Log–likelihood	–2248.85	–2193.76	–2185.89

The endogenous variable equals one whenever the household chose the more expensive option for its given consumption profile in each month. The sample is always balanced, and includes 1,413 individuals over a three month period. The estimation method is ML. Absolute t–statistics are reported between parentheses. Variables marked [⋆] and [⋆⋆] have been re–scaled by 10^{-1} and 10^{-3}, respectively.