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Consumer Adoption of Online Banking: Does Distance Matter?

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This paper tests whether consumer adoption of online banking is affected by the distance to one's bank branch. During the last decade, rapid diffusion of the Internet has dramatically changed the ways consumers conduct every-day businesses. An important trend in the rapid increase of Internet use among U.S. households is the use of the Internet for accessing financial accounts and paying bills. I estimate a logit model for online banking use with household level data from the U.S. for 1998 and 2001. In order to correct for the possible endogeneity of distance to one's bank, I use instrumental variables in a logit framework by following the control function approach suggested by Petrin and Train (2002). I find that distance to the closest bank branch does not affect the likelihood of online banking use by a household. The type of financial account that one has with her financial institution, however, is a significant predictor of online banking use, implying that households are likely to use the online provision more for some accounts than others. The results suggest that online channels may be viewed as a supplement to other more traditional channels. I also find that the impacts of various individual and bank-specific characteristics on online banking use have changed from 1998 to 2001. This is not surprising given the rapid diffusion of the Internet in the late 1990s, and the corresponding rise in the availability, acceptance and familiarity of the Internet as an additional business channel.

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1 Introduction

This paper studies whether consumer adoption of online banking is affected by the distance to one's bank branch. If online banking is seen as a substitute for more traditional channels of banking, like branch visits, then the distance to one's branch will be an important determinant of online banking use. However, if online banking is viewed as a supplemental channel that is used in conjunction to other channels, regardless of the attributes of the other channels like the geographic distribution of bank branches, then the distance to one's branch may not have a significant impact on adoption. Internet banking provides the convenience of banking any time from one's home or work, without having to incur some of the costs associated with a branch visit, like going to the branch and waiting on lines. Many financial transactions can now be done online instead of at a branch, for example, opening an account, changing account types or settings, applying for loans, various investment transactions involving CDs, money market accounts and mutual funds, and so on. A branch visit, however, may still be necessary for some transactions, like withdrawing cash and making deposits. The type of financial account will also play an important role in determining which channels one decides to use. This is because the type of financial account will determine the menu of transactions that one needs to perform, and the menu of transactions in turn will determine which the most convenient channels are for an individual.

I estimate a logit model for online banking use with U.S. household level data from 1998 and 2001. In order to correct for the possible endogeneity of distance to bank branch, I use instrumental variables in a logit framework by following the control function approach suggested by Petrin and Train (2002). I find that distance to the

closest bank branch does not affect the likelihood of online banking usage by a household. The type of financial account that a household has with its financial institution, however, is a significant predictor of online banking use, implying that households are likely to use the online provision more for some accounts than others. The results suggest that online banking may be perceived as a supplemental channel to more traditional channels like branch visits. This is not surprising given that other studies have made similar suggestions (Radecki et al, 1997, Patrikis 1997).

My findings also suggest that demographic characteristics, like age, education, income, and technical and financial sophistication levels of a household affect the likelihood of online banking use. Finally, I find that the effects of the individual and bank-specific characteristics on online banking use have changed between 1998 and 2001. This structural shift is not surprising given the rapid diffusion of the Internet in the late 1990s, and the corresponding rise in the availability, acceptance and familiarity of the Internet as an additional business channel.

During the last decade, there has been a rapid diffusion of computers and the Internet that has dramatically changed the economic landscape we live in, and the ways consumers conduct every-day businesses. According to the Online Banking Report, about 50% of U.S. adults used a PC at home or work in 1995 whereas by 2001 50% of the adults in the U.S. had made an online purchase. An important trend in the rapid increase of Internet use among U.S. households is the use of the Internet for accessing financial accounts and paying bills.[2] According to reports published by the technology research firm, Gartner Inc., number of U.S. adults using online banking increased from about 6 million in early 1998 to about 27 million by early 2000, and this figure is expected to

[2] Source: http://www3.gartner.com/Init

increase to about 75 million by 2005. According to a survey conducted by Jupiter Research Center, nearly one in every three online households used online banking in early 2001. The Internet revolution of the late 1990s has therefore greatly modified the ways in which consumers conduct business with their financial institutions.

The Internet provides an alternative or a supplemental channel for gathering information and conducting every-day business, however, our understanding of whether and how consumers substitute between the different channels is limited. For example, it is not well understood how adoption of an Internet technology is affected by the availability and attributes of alternative channels. Individual adoption decisions enable a new technology to diffuse throughout the economy, and to contribute to productivity and economic growth. Understanding the factors that affect adoption is therefore important both for government policy and business strategies. For a business that wants to provide online services, information on channel substitution as well as on stimulus for adoption is necessary for predicting where online provision is likely to be successful, and for developing marketing and other business strategies. Regarding policy, the Internet currently is not overseen by any centralized authority; however, its rapid expansion has lead to some arguments for the involvement of the government (Wiseman, 2000). Knowledge on consumer adoption behavior as well as how the Internet is used relative to more traditional channels can be helpful for effective policy-making and predictions.

The literature analyzing consumer online behavior relative to more traditional channels is limited. Goolsbee (2001) finds that the likelihood of purchasing a computer on the Internet increases with computer prices at retail stores. This indicates that consumers may view the online channel as an alternative to the retail channels for

purchasing computers. Kaiser (2002) studies the effect of website provision on the demand for women's magazines in Germany, and finds that website provision does not affect the demand for print issues of magazines. His results, however, do not provide much information about the relative substitutability of website and print issues, because the magazine websites he studies contain different information than their hardcopy counterparts. The magazines in his sample primarily use their websites to provide supplemental information and to advertise print issues. Anecdotal evidence suggests that consumers are increasingly using the Internet as a complementary channel for gathering information for buying cars (Morton et. al, 2001). Some studies have looked at the competitive behavior of online retailers relative to their offline counterparts. The evidence is mixed. For example, some studies find that online prices are higher than prices charged in retail stores (Bailey, 1998) whereas others find that online prices are about the same or lower (Brynjolfsson & Smith, 2000, Clay et al, 2001).

In this paper, I study whether a household's decision to use online banking is affected by the distance to its closest bank branch, after controlling for demographic factors, technical and financial sophistication level, learning effects, and type of financial accounts of the household. As I explained in the opening paragraph, the impact of distance on online banking use is likely to give us some information on whether the user perceives the online provision as a substitute or complement to more traditional channels like branch visits. I must admit, however, that this is not the most ideal experiment for testing channel substitution for banking. The ideal data for this paper would include observations on actual customer transactions, and the ideal experiment would identify the effect of an increase in the price for branch visits on the quantity of online banking usage.

The price for branch visit is likely to be a function of distance to the branch as well as the household's valuation for time, the means by which it travels to the branch, traffic density in the area, average waiting time at the branch, and so on. The quantity of online banking usage may be defined by the frequency of use or the number of online transactions in a given period of time. However, such data are extremely difficult to come across. One of the main reasons for limited empirical studies on electronic commerce and the Internet in general is the lack of appropriate data (Goolsbee, 2000). The data used in this paper are useful for studying channel substitution to some degree since I have detailed household level demographics and financial data. In addition, I have data for two periods, 1998 and 2001, during which there was a rapid diffusion of the Internet. As a result, my data will also allow me to test for structural shifts over time.

This paper proceeds as follows: the next section presents a logit model for online banking use. In order to correct for the possible endogeneity of distance to one's bank, I use instrumental variables in a logit framework by following the control function approach suggested by Petrin and Train (2002). Section 3 describes the data which are from the 1998 and 2001 Surveys of Consumer Finances (SCF). Section 4 discusses the potential identification issues, and Section 5 explains the results. Section 6 concludes, and discusses some possible extensions of the paper.

2 A Simple Model of Adoption

I assume that a consumer chooses from two channels of banking: online and in-person branch visits. The conditional utility for consumer i from channel j can be written as:

$$u_{ij} = -p_{ij} + X_i\beta_j + Z_i\gamma_j + \varepsilon_{ij}$$

Here, p_{ij} is consumer i's cost of using channel j, and therefore negatively affect utility. X_i includes observable characteristics of the consumer, and Z_i includes characteristics of the financial institution of consumer i. ε_{ij} is an error term that includes omitted individual and bank characteristics that affect utility.

If consumer i's cost of using channel j, p_{ij}, is affected by factors that are unobserved by the researcher then p_{ij} will be endogenous. Consistent estimation of the parameters of the utility function will therefore require an instrumental variables framework. In this paper, I will follow the control function approach suggested by Petrin and Train (2002). The control function approach corrects for the endogeneity of a regressor by directly controlling for (i.e. conditioning on) the part of the disturbance term that is correlated with the regressor. Consequently, the remaining portion of the disturbance term is mean-independent of the initially endogenous regressor. This approach requires decomposing both the endogenous regressor p_{ij} and the disturbance term ε_{ij} into two parts. This is explained below.

I will assume that p_{ij} can be decomposed into the following two parts: a function of instruments, and omitted characteristics not captured by the instruments:

$$p_{ij} = g(j, w_i) + \zeta_{ij}$$

Correlation of p_{ij} and ε_{ij} implies correlation of ζ_{ij} and ε_{ij}, since the instruments are by definition uncorrelated with ε_{ij}. Because of the correlation between ζ_{ij} and ε_{ij}, ε_{ij} can be decomposed into two parts: a mean conditional on ζ_{ij} and a deviation from the mean.

$$\rightarrow \varepsilon_{ij} = f(\zeta_{ij}) + \xi_{ij}$$

This implies that we can rewrite the conditional utility function as:

$$u_{ij} = -p_{ij} + X_i\beta_j + Z_i\gamma_j + f(\zeta_{ij}) + \xi_{ij}$$

$f(\zeta_{ij})$ is called the control function, since it controls for (i.e. conditions on) the part of the original error term, ε_{ij}, that is correlated with price p_{ij}. So, p_{ij} and the remaining component of disturbance, ξ_{ij}, are orthogonal to each other. Following Petrin and Train (2002) and Villas-Boas and Winer (1999), I will assume that the control function is linear in the residual, i.e., $f(\zeta_{ij}) = \lambda_j\zeta_{ij}$

$$\rightarrow u_{ij} = -p_{ij} + X_i\beta_j + Z_i\gamma_j + \zeta_{ij}\lambda_j + \xi_{ij}$$

The consumer chooses the method that gives her the maximal utility. Assuming that the error terms ξ_{ij} (j = b (branch) or o (online)) are iid and have a type I extreme value distribution, the conditional probability of choosing online banking can be written as (McFadden, 1973):

$$\Pr(i \text{ chooses online}) = \frac{e^{-p_{io}+X_i\beta_0+Z_i\gamma_0+\zeta_{io}\lambda_o}}{\sum_j e^{-p_{ij}+X_i\beta_j+Z_i\gamma_j+\zeta_{ij}\lambda_j}}$$

I will normalize $\beta_b=0$, $\gamma_b=0$, and $\lambda_b=0$. In addition, I will assume that consumer i's cost of branch visit, p_{ib}, can be proxied by a function of the distance to her closest bank branch, and the cost of online banking, p_{io}, is zero. Most financial institutions offer basic

online services for free once a consumer opens an account with them. As a result, there may be a fixed fee for having an account with a financial institution; however, once the account is established, there is unlikely to be an additional fee for using the bank's online service for various transactions instead of in-branch visits.[3] Therefore, the cost of a branch visit incurred by a consumer is the cost of physically going to the branch, and this cost in turn is a function of the distance to the branch. It is noteworthy that a zero cost of using online banking implies that the consumer does not face other costs like internet service provider (ISP) fee. This may not be too unrealistic if the household uses its Internet access for other purposes, or uses the Internet at work.

➔ $p_{ib} = \alpha d_i$ and $p_{io} = 0$

Now, I will normalize each price by subtracting αd_i from each price. This will imply that the normalized prices are:

$p_{ib} = 0$ and $p_{io} = -\alpha d_i$

After substituting for the normalized coefficients and prices, we get:

$$\Pr(i \text{ chooses online}) = \frac{e^{-\alpha d_i + X_i\beta_0 + Z_i\gamma_0 + \zeta_i\lambda_o}}{1 + e^{-\alpha d_i + X_i\beta_0 + Z_i\gamma_0 + \zeta_i\lambda_o}}$$

This can be estimated by logit. The control function approach here requires a two-step estimation process. In the first step, price (i.e. distance) is regressed on the instrumental variables using ordinary least squares (OLS) estimation method. The exogenous variables are included as their own instruments in the OLS. The estimated residual from the first step, ζ_{ij}, is then incorporated directly as a regressor in the second step. In the second step, a dummy variable indicating whether a household uses online

[3] For example, opening an account, account balance, transaction history, viewing and downloading account details, changing account settings, transferring money, applying for loans, investment transactions and so on. Some banks however charge a fee for paying bills (See Appendix 1) – I will ignore this in this version.

banking is regressed on distance, the residual from the first step, and individual and bank characteristics in X_i and Z_i using a logit model.

3 Data

The source of my data is the Survey of Consumer Finances (SCF) from the Federal Reserve Board. SCF is a detailed survey of the balance sheet, pension, income, use of financial institutions, labor force participation, and other demographic characteristics of U.S. families. The survey is conducted every three years and is sponsored by the Board of Governors in cooperation with the Department of the Treasury. In this paper I use the survey data from 1998 and 2001. The 1998 SCF interviewed about 4,309 households. The 2001 SCF interviewed about 4,449 households.

The unit of observation in my study is a household. The **dependent variable** in my model is a dummy variable which captures whether a household reports using online services as one of the main ways for conducting business with its main financial institution.

For each household, the survey gathers information for up to six financial institutions. The institution that the household does the most business with is defined as the main financial institution. I focus on the main institution since channel substitution patterns may vary by the relative importance of the bank to the consumer. For example, a customer may not care which method of banking it uses with the financial institution that it views as the least important, since it does not conduct that much business with that institution. Focusing on the main institution controls for such factors.

Price of In-Person Visit (d_i): As I explained previously, I use the following proxy for

price of a branch visit: the distance to the closest bank branch or ATM from home or work of the person in the household who uses it most often.

Consumer Characteristics (X_i): X_i includes three sets of variables: demographic variables including age, income and education; dummy variables that capture whether a consumer is financially and technically sophisticated; and dummy variables that capture whether the consumer is likely to be impacted by learning effects. The financially sophisticated customers are likely to derive greater utility from an advanced service channel like online banking. Consumers who are more technically sophisticated are more likely to use an internet-based application like online banking because they have lower learning cost. Learning effects are likely to lower the cost of online banking use. Studies have found that learning or spillover effects are important in household adoption decision of computers and electronic banking (Goolsbee 2001, Stavins, 2001).

The demographic variables include age of the respondent (dummy for age group 17-40), level of education attained by the respondent (dummies for college graduate, and for post-graduate study), log of household income (defined as the total annual income in the previous year, before deductions for taxes), and dummy variable for the census division of the respondent. I am adding dummy variables for age groups and educational levels, instead of using the continuous variables, because adoption behavior is unlikely to vary with age and education in a linear fashion. Note that data on census division are not publicly available for the 2001 SCF, and therefore is not included in the analysis for 2001.

In order to proxy for the technical sophistication level of a household, I create two dummy variables. The first dummy variable captures if the household reports using

online services or the internet as one of the ways of gathering information on borrowing. The second dummy variable captures if the household uses the internet for gathering information on saving and investment. To proxy for how financially sophisticated a household is, I create a dummy variable that captures whether the household reports using a debit card for purchase.[4]

In order to control for learning effects, I use proxies indicating whether the household shops around quite a bit for the best deals while taking major decisions on investment and loans. If a household shops around quite a bit, they are more likely to gather information from their friends, family and other sources, and therefore are more likely to be affected by learning effect.

Bank Characteristics (Z_i): These include dummy variables for indicating whether the financial account is a checking account, brokerage account, money market account, mutual fund account, CD and/or a saving account. I include a dummy variable for **each** type. So if a household has a checking, savings and money market account with its main institution, then the dummy variables for checking, saving and money market will each be equal to one, and the dummy variables for brokerage, mutual fund and CD will each take the value of zero.

Type of account is likely to be an important determinant of online banking use since the utility from online banking will depend on the type of transactions one is able to perform using online services, and the variety of transactions one needs to perform in turn depends on the type of financial account one has. If a person can conduct most of her business using online banking then she will derive more utility from adoption than if

[4]A debit card can be used for making a purchase, and the amount of money of the purchase is automatically deducted from the money in a financial account, usually a checking account.

she can only perform a small fraction of the transactions. For example, in the case of a bank where a consumer has her checking account, and gets her paychecks deposited, online services could be a complement to regular branch services. This is due to the variety of transactions that the consumer needs to conduct, such as, withdraw cash which could be done at an ATM or a branch; deposit checks, get cashier's checks and so forth which could be done at a branch; check balance, pay bills or transfer money between accounts which could be done online, at an ATM or on the telephone. As a result, the consumer will have to use a bank branch for some services, regardless of whether or not they use online banking, since some of these transactions cannot be done online. On the other hand, in the case of a brokerage firm, online services could potentially be a substitute for in-person branch visits if all the consumer does with the institution is invest money in different mutual funds or stocks.

I drop the observations where the closest bank branch is a foreign location, an online service or a toll-free phone service. I also drop the observations where the type of account with the main financial institution could not be determined. The remaining number of observations in my sample is 3,718 for the 1998 SCF and 3,888 for the 2001 SCF.

4 Identification

A positive and statistically significant α will imply that households are more likely to use online banking as the distance to the nearest branch office increases. However, the geographic distribution of bank branches, and consequently the distance to the closest branch is likely to be correlated with where a person lives. For example, a

city-dweller is likely to face a lower distance than a person who lives in the suburb, since bank-branches or ATM machines are likely to be more densely located in downtown areas or in more urban areas. A person's locality of home or work, on the other hand, is likely to be affected by her characteristics that are unobserved by the researcher. This implies that distance to bank branch is likely to be correlated with omitted factors.

The omitted factors may include the general level of "trendiness" of an individual, beyond what is captured by her observed characteristics. The error term may also include how an individual feels about safety and security. Both of these factors would affect online banking use. They would also affect whether an individual lives in a suburban or urban area. For example, "trendy" people are more likely to live in urban areas, and people who are relatively more concerned about safety are likely to live in suburban areas. So "trendiness" would imply a negative correlation between the error term and distance, since city-dwellers are likely to face denser bank branch network. Safety concerns, on the other hand, would imply a positive correlation between the error term and distance, since suburban residents are likely to face sparser bank branch network.

Since I do not observe the exact geographic location of a household, I cannot control for whether a household lives in an urban or a suburban area. In order to use instrumental variables to estimate the parameters, I need some observable attributes that are correlated with whether a person lives in a suburban or urban area (so with the distance variable) but uncorrelated with the error term or omitted factors. I use the following instruments: a dummy indicating whether a household owns multiple cars, and a dummy indicating whether a household lives in a multiple-unit housing structure. Households with multiple cars are less likely to live in downtown areas, and households

living in a multiple unit housing structure are more likely to be living in an urban area. However, the correlation between these attributes and where a person lives may vary by the region of the country. For example, in New York City or Boston area, a person that owns multiple cars is highly likely to live in the suburb. On the contrary, in the Los Angeles area where public transportation is not as widely available as New York and where driving is more common, a person with multiple cars may very well live in an urban area. The same logic applies for living in multiple housing units. Therefore, I will include dummy variables for whether a household owns multiple cars and lives in a multiple housing unit as well as their interactions with the dummy variable for the household's 9-level census division. Since the date for 2001 do not include the 9-level census division, the interactions are not added in the analysis for 2001.

It is worthy of mention that I am assuming that car ownership and housing structure are not correlated with individual specific unobservables – but if they are, then instruments will not be valid. One alternative IV is region-specific information that are likely to affect the true cost of traveling to bank branch, for example, information on traffic density, and average gas mileage in the household's area. However, I am unable to use this approach since I do not observe the exact location of the household; the only information I have on the household's location is their 9-level census division.

In addition to being correlated with the unobservable individual characteristics, the distance variable may be reported with measurement error. In this case, the reported distance (d_i) is the sum of true distance (d^*_i) and some measurement or reporting error (u_i): $d_i = d_i^* + u_i$. To solve the problem of measurement error, I need an instrument, which is correlated with true distance d^*_i but uncorrelated with the reporting error u_i. One

possible instrument could be whether a household lives in a farm or a ranch. Such households are likely to face a larger distance than households not living in a farm or a ranch.

Finally, bank-specific omitted factors, like promotional and marketing activities, and quality of service, are likely to affect the price of branch visits. However, I am using a proxy for price, which is distance to the closest branch. The distance variable or the geographic distribution of customers, unlike the "true" price, is unlikely to be affected by bank-services like promotional activity and quality. As a result, these bank-specific unobservables are unlikely to contaminate the coefficient on distance.

5 Results

Table 1 presents some characteristics of the 1998 and 2001 samples. In the 1998 SCF, 5% of the respondents report using online banking as a channel for doing business with their main financial institution. By 2001, this share increased to 17%. This is not surprising given the rapid diffusion of the Internet in the late 1990s. The spread of the Internet is also evident from the share of respondents that report using the Internet for gathering financial information. In 1998, 13% of the respondents used the Internet for gathering information on credit and borrowing, whereas 10% used it for savings and investment. By 2001, these numbers rose to 23% and 17% respectively. Table 2 presents some characteristics of online banking users and non-users in 1998 and 2001. As found in the previous literature (Kennickel and Kwast, 1997), online banking users, on average, are younger, more educated, and earn more than their non-user counterparts. Table 2 also shows that online banking users, in general, are more technically and financially savvy. A

larger fraction of online banking users also uses the Internet for researching credit, borrowing, saving and investment options. In addition, a larger share of online banking users makes purchases with debit cards, and uses direct bill pay and direct deposit. They also shop around more for the best deal while taking investment and borrowing decisions, and live or work further away from their bank branch than their non-user counterparts.

Table 3 shows that there is significant regional variation among online banking users in the 1998 SCF. This could be due to network externality, that is, residents of a region may be more likely to use online banking if a larger portion of the total population uses online banking in that region (Stavins, 2001). This could also be due to the regional variation in the availability of online banking, and advertisement and marketing strategies of banks. Banks may promote a service channel like Internet banking more aggressively in regions where a larger portion of the population is likely to adopt.

Recall that the control function approach used in this paper requires a two-step estimation process. In the first step, distance (i.e. price) is regressed on the instrumental variables using ordinary least squares (OLS) estimation method. The exogenous variables are included as their own instruments in the OLS. The estimated residual from the first step is then directly incorporated as a regressor in the second step, in addition to the other regressors including distance. By doing this, we can directly control for the portion of the error term that is correlated with distance. As a result, the remaining part of the disturbance is mean-independent of distance.

Table 4 presents the coefficient estimates from the first step of the estimation. Tables 5 and 6 present the parameter estimates from the logit model from the 1998 SCF. Tables 7 and 8 present those from the 2001 SCF. The first columns in Tables 5 through 8

report the estimated coefficients from the logit model without the control function, whereas the second columns report those from the IV logit or control function model. The specification in Tables 6 and 8 include the interactions of the distance variable with the type of account dummy variables. By including the interaction terms I can control for the possibility that distance may have differential impacts on online banking use for different types of accounts.

According to Table 4, the instruments are jointly significant in predicting distance at any conventional level of significance. The 1998 sample shows that ownership of multiple cars is positively correlated with distance. This is intuitive, since owners of multiple cars are likely to live in relatively more suburban areas, and therefore face sparser distribution of branch networks than their urban counterparts. As expected, this effect varies by census division. Multiple car owners in the West Mountain division face lower distance than their counterparts in the Pacific West division (the excluded division), implying that multiple car owners in Mountain West are more likely to live in relatively urban areas than their counterparts in the Pacific West. The 2001 sample shows that households that live in multiple-unit housing structures face shorter distance to bank branches. This is again intuitive given that these households are more likely to live in urban areas. In both the 1998 and 2001 samples, the farm dummy positively affects distance, implying that households living in a farm or ranch face greater distance to banks than their non-farm counterparts.

Tables 5 through 8 report the estimated coefficients from the logit models with and without the control function. According to Table 5, a person is more likely to use online banking if she lives or works further away from her closest bank branch. As

expected, college graduates are more likely to use online banking than their non-graduate counterparts. Household income as well as proxies for technical competence and financial sophistication positively and significantly affect adoption. The proxies for learning effects give mixed results --- the first proxy is significant, whereas the second proxy is not significant.

The control function in the second column of Table 5 is not significantly different from zero. The effect of the distance variable consequently does not change after I include the control function in order to correct for the possible endogeneity of distance. Recall that the first stage regressions, reported in Table 4, show that the instruments are jointly highly significant in predicting distance. This implies that distance is unlikely to be endogenous, after controlling for demographics, technical and financial competence, and learning effects. As discussed earlier, the error term in the adoption equation likely includes omitted factors like a household's overall levels of trendiness, and security concerns – since adding the control function does not change the distance coefficients, we can conclude that these "omitted factors" are likely to be have been captured by the observable household characteristics. As a result, the distance variable is unlikely to be endogenous, conditional on the individual and bank-specific characteristics.

Table 6 presents the estimates from the specification that allows for the effect of distance to vary by the type of account. The parameter estimates imply that the positive and significant effect of distance, reported in Table 5, is not robust to this new specification. The interaction terms are also not significant. So distance to the closest branch does not impact the use of online banking. The rest of the results are quite similar to Table 5 --- most of the demographic variables are highly significant in explaining

online banking use, and the control function again is not significant.

Using the values of the log likelihood functions reported in Tables 5 and 6, we can test for the joint significance of the interaction terms between distance and type of accounts. A likelihood ratio can not reject the null hypothesis that the coefficients of the interaction terms are jointly zero.[5] Note that I use the logit model, without the control function, for the hypotheses tests in this section. This is because the model with the control function is not significantly different from the model without the control function.

Tables 7 and 8 present the parameter estimates from the 2001 SCF. Distance to the closest bank branch again does not affect online banking use whereas the demographic variables are still highly significant. A likelihood ratio again can not reject the null hypothesis that the coefficients of the interaction terms in Table 8 are jointly zero. Type of account, however, has considerably more impact on adoption than that in the 1998 SCF. Households are more likely to use online banking for saving, money market, brokerage and mutual fund accounts, and are less likely to use online banking for CD's.

Since the coefficients somewhat differ from 1998 to 2001, particularly those corresponding to the type of account variables, it is interesting to test whether there has been a structural change between 1998 and 2001. In order to test whether the logit coefficients are significantly different in 2001 from 1998, I re-estimate the logit model for 1998 after dropping the 9-level census division dummy variables. Recall that the 2001 sample does not contain the data for the 9-level census division. The results are presented

[5]The LR statistic = $2(L_1-L_0)$ is distributed chi-square with degrees of freedom = numbers of restrictions = 6. Here L_1 = value of log-likelihood from the unrestricted model where the interaction terms are included, and L_0 = value of log-likelihood from the restricted model where the interaction terms are dropped. From the first columns of Tables 5 and 6, LR = 3.6 < 12.53, where the 5 percent critical value is 12.53.

in Table 9. Column 1 of Table 9 presents the parameter estimates from the pooled sample where the 2001 and 1998 data are pooled. Columns 2 and 3 present the parameter estimates from the 1998 and 2001 samples separately. A likelihood ratio test rejects the null hypothesis that the coefficient vectors are identical for the two samples, implying that the parameters should be estimated separately for 1998 and 2001.[6]

Which variables explain the differences across the two periods? Is there a change in the relationship between the demographic variables and online banking use? That is, do the same changes in demographics lead to greater changes in online banking use in 2001 than 1998? Or is the difference being driven by a change in the correlation between the type of accounts and online banking use? In order to test these hypotheses, I re-estimate the logit model using the pooled data, and by imposing one restriction at a time. For example, to test if there was a shift in the effects of the demographic variables, I let the corresponding coefficients to vary across 1998 and 2001 while assuming that the other coefficients are identical across the two periods. I follow the same process for testing the coefficients on type of accounts.

The values of the log likelihood functions are reported in Table 10. A likelihood ratio test strongly rejects the null hypothesis that the demographic coefficients are identical across the two periods. Similarly, a likelihood ratio test strongly rejects the null hypothesis that the coefficients on the type of account variables are identical across the two periods. I further test if the demographic change is originating from income, education and age as opposed to levels of technical and financial sophistication. I find

[6]The LR statistic = $2(L_1-L_0)$ is distributed chi-square with degrees of freedom = 23. Here L_1 = value of log-likelihood from the unrestricted models = value of log-likelihood from 1998 + value of log-likelihood from 2001 and L_0 = value of log-likelihood from the restricted model where the coefficient vectors are assumed to be identical. From Table 9, LR = 185.2 > 35.17, where the 5 percent critical value is 35.17.

that both sets of proxies for user characteristics, that is income, age, education as well as sophistication and learning effects, contribute to the differences across 1998 and 2001. Comparing the log likelihood functions along with their degrees of freedom, however, imply that the strongest change may have originated from income, education and age. There has been a rapid diffusion of Internet use between 1998 and 2001, which has increased both the availability of the Internet to U.S. households as well as the acceptance, familiarity and know-hows regarding the Internet. Consequently, online channels like online banking, electronic commerce, online greeting cards, email and the like have become more established and popular transaction channels over time. As a result, it is not surprising that the effects of various individual and bank specific characteristics on online banking use have changed between 1998 and 2001.

6 Conclusion and Future Work

In this paper, I estimated a model for online banking use with household level data from the U.S. for 1998 and 2001. My goal was to test whether online banking use is affected by the distance to the closest bank branch. I found that distance to the closest bank branch does not affect the likelihood of online banking use by a household. The type of financial account that a household has with its financial institution, however, is a significant predictor of online banking use, implying that households are likely to use the online provision more for some accounts than others. The results suggest that online channels may be perceived as a supplement to other more traditional channels.

In addition, I find that household income and education positively and significantly affect adoption. Also, people who use the Internet for gathering financial

information, and people who use debit cards for making purchases are more likely to use online banking, implying that technical competence and financial sophistication positively impact adoption.

I also find that the impacts of various individual and bank specific characteristics on online banking use have changed from 1998 to 2001. This is not surprising given the rapid diffusion of the Internet in the late 1990s, and the corresponding rise in the availability, acceptance and familiarity of the Internet as an additional business channel.

In future, I would like to extend the model by incorporating more than two channels for banking. One weakness of my data is that I do not observe the menu of service channels faced by each household. In other words, I do not have data on Internet banking availability for each household. As a result, I do not know whether some of the households would have used online banking if it were available to them. Another weakness of the data, as I mentioned previously, is the lack of geographic information. Availability of state-level or MSA-level geographic data would let us use region-specific instrumental variables.

Table 1: Characteristics of Survey Respondents, 1998 and 2001 SCF

	1998 SCF	2001 SCF
Number of Observations	3,718	3,888
Individual Characteristics		
Online banking user: main inst.	0.05 (0.22)	0.17 (0.38)
Online banking user: any inst.	0.09 (0.29)	0.25 (0.43)
Distance to the closest ATM/Bank Branch (miles)	5.6 (10.6)	5.7 (10.3)
Age – respondent	50.5 (16.3)	50.7 (16.0)
Highest grade completed – respondent	14.0 (2.7)	14.0 (2.8)
Highest grade completed – spouse	9.4 (6.9)	9.6 (6.9)
Household Income (annual)	56,246 (251,075)	71,164 (216,190)
Use internet to gather information on credit/borrowing	0.13 (0.33)	0.23 (0.42)
Use internet to gather information on saving/investment	0.10 (0.30)	0.17 (0.38)
Use direct bill pay	0.40 (0.49)	0.46 (0.50)
Use direct deposit	0.64 (0.48)	0.70 (0.46)
Used a debit card for purchase	0.34 (0.47)	0.46 (0.50)
Share that shop around for investment decisions	0.69 (0.46)	0.68 (0.47)
Share that shop around for loan decisions	0.72 (0.45)	0.72 (0.45)
Main Institution Characteristics		
Main institution: checking	0.91 (0.29)	0.91 (0.29)
Main institution: saving	0.42 (0.49)	0.43 (0.49)
Main institution: brokerage	0.07 (0.25)	0.07 (0.26)
Main institution: CD	0.11 (0.31)	0.10 (0.31)
Main institution: mutual fund	0.05 (0.22)	0.05 (0.21)
Main institution: money market account	0.06 (0.23)	0.07 (0.26)
Instruments		
Own multiple cars	0.58 (0.49)	0.61 (0.49)
Live in multiple unit housing structure	0.07 (0.26)	0.06 (0.24)
Live in farm or ranch	0.03 (0.16)	0.03 (0.16)

Note: Standard Deviation in parentheses.

Table 2: Characteristics of Survey Respondents by Online Banking Use, 1998 and 2001 SCF

	1998 SCF		2001 SCF	
	Non-user	**User**	**Non-user**	**User**
Number of Observations	3,522	196	3,235	653
Individual Characteristics				
Distance to the closest ATM/Bank Branch (miles)	5.5 (10.3)	7.4 (14.7)	5.5 (9.8)	6.9 (12.6)
Age – respondent	50.7 (16.5)	47.0 (13.3)	51.6 (16.4)	46.1 (13.0)
Highest grade completed – respondent	13.9 (2.7)	15.5 (1.9)	13.8 (2.8)	15.3 (2.0)
Highest grade completed – spouse	9.2 (6.9)	12.2 (6.2)	9.2 (6.9)	11.8 (6.4)
Household Income (annual)	56,246 (251,075)	71,614 (217,996)	62,350 (169,281)	127,159 (397,721)
Use internet to gather information on credit/borrowing	0.11 (0.31)	0.39 (0.49)	0.18 (0.39)	0.48 (0.50)
Use internet to gather information on saving/investment	0.09 (0.29)	0.34 (0.47)	0.13 (0.34)	0.37 (0.48)
Use direct bill pay	0.39 (0.49)	0.61 (0.49)	041 (0.49)	0.66 (0.47)
Use direct deposit	0.63 (0.48)	0.76 (0.43)	0.69 (0.46)	0.79 (0.41)
Used a debit card for purchase	0.33 (0.47)	0.51 (0.50)	0.43 (0.49)	0.62 (0.49)
Share that shop around for investment decisions	0.68 (0.46)	0.83 (0.38)	0.66 (0.48)	0.78 (0.42)
Share that shop around for loan decisions	0.72 (0.45)	0.83 (0.38)	0.71 (0.46)	0.79 (0.41)
Main Institution Characteristics				
Main institution: checking	0.90 (0.29)	0.92 (0.27)	0.91 (0.29)	0.92 (0.27)
Main institution: saving	0.42 (0.49)	0.39 (0.49)	0.43 (0.49)	0.44 (0.50)
Main institution: brokerage	0.06 (0.24)	0.18 (0.38)	0.06 (0.23)	0.15 (0.36)
Main institution: CD	0.11 (0.31)	0.08 (0.27)	0.11 (0.32)	0.07 (0.25)
Main institution: mutual fund	0.05 (0.22)	0.08 (0.27)	0.04 (0.19)	0.10 (0.31)
Main institution: money market account	0.05 (0.22)	0.11 (0.31)	0.06 (0.24)	0.12 (0.33)
Instruments				
Own multiple cars	0.58 (0.49)	0.69 (0.46)	0.59 (0.49)	0.73 (0.45)
Live in multiple unit housing structure	0.07 (0.26)	0.09 (0.28)	0.06 (0.24)	0.07 (0.26)
Live in farm or ranch	0.03 (0.17)	0.02 (0.12)	0.03 (0.17)	0.01 (0.10)

Note: Standard Deviation in parentheses.

Table 3: Geographic Distribution of Online Banking Users, 1998 SCF

	All Respondents[1] (# of Obs: 3,718)	Online-Banking User[2] (# of Obs: 196)
9-level Census Division	%	%
Northeast: New England Division (CT, ME, MA, NH, RI, VT)	5.3	5.5
Northeast: Middle Atlantic Division (NY, NJ, PA)	16.1	7.7
South: South Atlantic Division (DE, DC, FL, GA, MD, NC, SC, VA, WV)	17.3	5.3
South: East South Central Division (AL, KY, MS, TN)	7.4	3.7
South: West South Central Division (AR, LA, OK TX)	10.4	5.4
Midwest: East North Central Division (IL, IN, MI OH WI)	16.3	2.6
Midwest: West North Central Division (IA, KS, MN, MO, NE, ND, SD)	7.1	3.0
West: Mountain Division (AZ, CO, ID, MT, NV, UT, WY, NM)	6.2	7.8
West: Pacific Division (AK, CA, HI, OR, WA)	13.9	6.2

[1]Column 1 reports the share of respondents in each division.
[2]Column 2 reports the share of respondents in each division that use online banking in 1998 SCF.

Table 4: First Stage from the IV Regression, OLS

	1998 SCF	2001 SCF
Dependent Variable: Distance, d_i	OLS Coefficients of Instruments	OLS Coefficients of Instruments
Own Multiple Car ?	1.48* (0.89)	0.37 (0.35)
Multiple Unit Housing Structure?	0.59 (2.19)	-1.25* (0.66)
Live in Farm/Ranch?	4.0** (1.02)	4.06** (0.98)
Mult Car* Northeast: New England Division (NE: CT, ME, MA, NH, RI, VT)	-1.81 (1.69)	
Mult Car* Northeast: Middle Atlantic Division (NE: NY, NJ, PA)	-0.41 (1.22)	
Mult Car* South Atlantic Division (South: DE, DC, FL, GA, MD, NC, SC, VA, WV)	-1.14 (1.22)	
Mult Car* East South Central Division (South: AL, KY, MS, TN)	-0.39 (1.54)	
Mult Car* South: West South Central Division (South: AR, LA, OK TX)	-2.58 (1.40)	
Mult Car* Midwest: East North Central Division (Mid-West: IL, IN, MI OH WI)	1.01 (1.22)	
Mult Car* Midwest: West North Central Division (Mid-West: IA, KS, MN, MO, NE, ND, SD)	0.52 (1.56)	
Mult Car* West: Mountain Division (West: AZ, CO, ID, MT, NV, UT, WY, NM)	-5.52** (1.60)	
Mult House* Northeast: New England Division	-2.95 (3.28)	
Mult House * Northeast: Middle Atlantic Division	-0.19 (2.60)	
Mult House * South Atlantic Division	-2.19 (2.60)	
Mult House * East South Central Division	-4.60 (3.93)	
Mult House * South: West South Central Division	-2.34 (3.52)	
Mult House * Midwest: East North Central Division	-2.02 (2.62)	
Mult House * Midwest: West North Central Division	-1.16 (3.08)	
Mult House * West: Mountain Division	-3.99 (3.41)	
Adj. R^2	0.10	0.11
F-stat	2.67	7.98
Significance level of the F-stat	0.0001	0.0000

Note: Also included are exogenous variables as their own instruments.
Note: Excluded division in 1998 is West Pacific Division (AK, CA, HI, OR, WA). Data on census division are not available for the 2001 SCF, and therefore are not included in the empirical analysis.

Table 5: Adoption Model for the Main Institution, 1998 SCF

Dependent Variable: use online banking or not	**Logit**	**Logit[1] (IV)**
Distance, d_i (miles)	0.01* (0.006)	0.01* (0.006)
Main Institution Characteristics		
Main institution: checking	1.00** (0.35)	1.02** (0.47)
Main institution: saving	0.10 (0.17)	0.10 (0.17)
Main institution: brokerage	0.99** (0.29)	0.96 (0.61)
Main institution: CD	-0.15 (0.28)	-0.14 (0.29)
Main institution: mutual fund	-0.33 (0.33)	-0.34 (0.49)
Main institution: money market account	0.41 (0.27)	0.41 (0.28)
Individual Characteristics		
Age – respondent	0.19 (0.19)	0.19 (0.19)
Education – college grad	0.49** (0.24)	0.49** (0.24)
Education – post-graduate education	0.32 (0.27)	0.33 (0.28)
LOG (Annual Household Income)	0.41** (0.06)	0.41** (0.06)
Use internet to gather information on credit/borrowing	0.93** (0.20)	0.93** (0.20)
Use internet to gather information on saving/investment	0.68** (0.21)	0.69** (0.21)
Used a debit card for purchase	0.59** (0.17)	0.59** (0.17)
Shop around for investment decisions	0.42** (0.21)	0.42** (0.21)
Shop around for loan decisions	0.20 (0.22)	0.20 (0.22)
Control Function (residual)[1]		0.003 (0.07)
Log Likelihood Function	-636.6	-636.6

Note: Also included are dummy variables for all (but one) census division.
Note: Standard Error in parentheses. Number of Observations: 3,718.
** 5% significance level *10% significance level
[1]The standard error has not yet been corrected for the two-step estimation.

Table 6: Adoption Model for the Main Institution, 1998 SCF

Dependent Variable: use online banking or not	**Logit**	**Logit (IV)**
Distance, d_i (miles)	0.02 (0.02)	0.02 (0.02)
Distance, d_i*dummy for checking account	-0.02 (0.02)	-0.02 (0.02)
Distance, d_i*dummy for saving account	0.01 (0.01)	0.01 (0.01)
Distance, d_i*dummy for brokerage account	-0.01 (0.02)	-0.01 (0.02)
Distance, d_i*dummy for CD account	-0.01 (0.03)	-0.01 (0.03)
Distance, d_i*dummy for mutual fund account	0.02 (0.02)	0.02 (0.02)
Distance, d_i*dummy for money mkt account	0.004 (0.02)	0.004 (0.02)
Main Institution Characteristics		
Main institution: checking	1.36** (0.50)	1.38** (0.59)
Main institution: saving	0.05 (0.19)	0.05 (0.19)
Main institution: brokerage	1.20** (0.34)	1.16 (0.65)
Main institution: CD	-0.07 (0.32)	-0.07 (0.32)
Main institution: mutual fund	-0.67 (0.44)	-0.70 (0.58)
Main institution: money market account	0.40 (0.31)	0.40 (0.32)
Individual Characteristics		
Age – respondent	0.20 (0.19)	0.20 (0.19)
Education – college grad	0.49** (0.24)	0.49** (0.24)
Education – post-graduate education	0.32 (0.27)	0.32 (0.28)
LOG (Annual Household Income)	0.41** (0.06)	0.41** (0.06)
Use internet to gather information on credit/borrowing	0.93** (0.21)	0.93** (0.21)
Use internet to gather information on saving/investment	0.68** (0.21)	0.68** (0.21)
Used a debit card for purchase	0.59** (0.17)	0.59** (0.17)
Shop around for investment decisions	0.40** (0.21)	0.40** (0.21)
Shop around for loan decisions	0.20 (0.22)	0.19 (0.22)
Control Function (residual)[1]		0.005 (0.07)
Log Likelihood Function	-634.8	-634.8

Note: Also included are dummy variables for all (but one) census division.
Note: Standard Error in parentheses. Number of Observations: 3,718. **5% sign. level *10% sign. level
[1]The standard error has not yet been corrected for the two-step estimation.

Table 7: Adoption Model for the Main Institution, 2001 SCF

Dependent Variable: use online banking or not	**Logit**	**Logit[1] (IV)**
Distance, d_i (miles)	0.005 (0.004)	0.005 (0.004)
Main Institution Characteristics		
Main institution: checking	0.72** (0.21)	0.30 (0.50)
Main institution: saving	0.33** (0.10)	0.26** (0.12)
Main institution: brokerage	0.73** (0.19)	1.27** (0.61)
Main institution: CD	-0.34* (0.18)	-0.33* (0.18)
Main institution: mutual fund	0.64** (0.20)	0.75** (0.23)
Main institution: money market account	0.51** (0.16)	0.46** (0.17)
Individual Characteristics		
Age – respondent	0.41** (0.11)	0.43** (0.11)
Education – college grad	0.60** (0.14)	0.58** (0.14)
Education – post-graduate education	0.80** (0.15)	0.76** (0.16)
LOG (Annual Household Income)	0.30** (0.03)	0.31** (0.04)
Use internet to gather information on credit/borrowing	0.93** (0.12)	0.97** (0.12)
Use internet to gather information on saving/investment	0.61** (0.12)	0.66** (0.13)
Used a debit card for purchase	0.71** (0.10)	0.70** (0.10)
Shop around for investment decisions	0.25** (0.12)	0.25** (0.12)
Shop around for loan decisions	-0.03 (0.13)	-0.01 (0.13)
Control Function (residual)[1]		-0.07 (0.07)
Log Likelihood Function	-1448.3	-1447.8

Note: Standard Error in parentheses. Number of Observations: 3,888.
** 5% significance level *10% significance level
[1]The standard error has not yet been corrected for the two-step estimation.

Table 8: Adoption Model for the Main Institution, 2001 SCF

Dependent Variable: use online banking or not	**Logit**	**Logit (IV)**
Distance, d_i (miles)	0.001 (0.01)	0.001 (0.01)
Distance, d_i*dummy for checking account	0.01 (0.01)	0.01 (0.01)
Distance, d_i*dummy for saving account	-0.002 (0.01)	-0.002 (0.01)
Distance, d_i*dummy for brokerage account	-0.004 (0.01)	-0.004 (0.01)
Distance, d_i*dummy for CD account	-0.0003 (0.02)	-0.0003 (0.02)
Distance, d_i*dummy for mutual fund account	0.01 (0.01)	0.006 (0.01)
Distance, d_i*dummy for money mkt account	-0.001 (0.01)	-0.001 (0.01)
Main Institution Characteristics		
Main institution: checking	0.62** (0.26)	0.19 (0.52)
Main institution: saving	0.33** (0.11)	0.27** (0.13)
Main institution: brokerage	0.78** (0.23)	1.34** (0.63)
Main institution: CD	-0.33* (0.20)	-0.33* (0.20)
Main institution: mutual fund	0.57** (0.24)	0.67** (0.27)
Main institution: money market account	0.52** (0.18)	0.47** (0.19)
Individual Characteristics		
Age – respondent	0.41** (0.11)	0.44** (0.11)
Education – college grad	0.60** (0.14)	0.58** (0.14)
Education – post-graduate education	0.80 (0.15)	0.76** (0.16)
LOG (Annual Household Income)	0.30** (0.03)	0.30** (0.04)
Use internet to gather information on credit/borrowing	0.94** (0.12)	0.97** (0.12)
Use internet to gather information on saving/investment	0.61** (0.12)	0.67** (0.13)
Used a debit card for purchase	0.71** (0.10)	0.69** (0.10)
Shop around for investment decisions	0.25** (0.12)	0.25** (0.12)
Shop around for loan decisions	-0.03 (0.13)	-0.01 (0.13)
Control Function (residual)[1]		-0.07 (0.07)
Log Likelihood Function	-1447.9	-1447.4

Note: Standard Error in parentheses. Number of observations: 3,888.
**5% significance level *10% significance level
[1]The standard error has not yet been corrected for the two-step estimation.

Table 9: Adoption Model for the Main Institution, Pooled vs. 1998 & 2001 Samples

Dependent Variable: use online banking or not	**Logit 1998 & 2001**	**Logit 1998**	**Logit 2001**
Distance, d_i (miles)	0.01 (0.01)	0.02 (0.02)	0.001 (0.01)
Distance, d_i*dummy for checking account	-0.003 (0.01)	-0.02 (0.02)	0.01 (0.01)
Distance, d_i*dummy for saving account	0.002 (0.008)	0.01 (0.01)	-0.002 (0.01)
Distance, d_i*dummy for brokerage account	-0.006 (0.009)	-0.01 (0.02)	-0.004 (0.01)
Distance, d_i*dummy for CD account	-0.005 (0.01)	-0.02 (0.03)	-0.0003 (0.02)
Distance, d_i*dummy for mutual fund account	0.006 (0.009)	0.02 (0.02)	0.01 (0.01)
Distance, d_i*dummy for money mkt account	0.004 (0.011)	0.01 (0.02)	-0.001 (0.01)
Main Institution Characteristics			
Main institution: checking	0.82** (0.23)	1.40** (0.50)	0.62** (0.26)
Main institution: saving	0.25** (0.10)	0.03 (0.19)	0.33** (0.11)
Main institution: brokerage	0.86** (0.19)	1.19** (0.34)	0.78** (0.23)
Main institution: CD	-0.27 (0.17)	-0.08 (0.31)	-0.33* (0.20)
Main institution: mutual fund	0.25 (0.20)	-0.57 (0.44)	0.57** (0.24)
Main institution: money market account	0.49** (0.15)	0.33 (0.31)	0.52** (0.18)
Individual Characteristics			
Age – respondent	0.28** (0.09)	0.15 (0.19)	0.41** (0.11)
Education – college grad	0.50** (0.12)	0.51** (0.24)	0.60** (0.14)
Education – post-graduate education	0.57** (0.13)	0.38 (0.27)	0.80 (0.15)
LOG (Annual Household Income)	0.34** (0.03)	0.37** (0.05)	0.30** (0.03)
Use internet to gather information on credit/borrowing	1.07** (0.09)	0.98** (0.20)	0.94** (0.12)
Use internet to gather information on saving/investment	0.64** (0.10)	0.71** (0.20)	0.61** (0.12)
Used a debit card for purchase	0.78** (0.08)	0.63** (0.16)	0.71** (0.10)
Shop around for investment decisions	0.25** (0.10)	0.38* (0.21)	0.25** (0.12)
Shop around for loan decisions	0.0001 (0.11)	0.19 (0.21)	-0.03 (0.13)
Number of Observations	7606	3718	3888
Log Likelihood Function	-2185.7	-645.2	-1447.9

Note: Standard Errors in parentheses. **5% significance level *10% significance level

Table 10: Source of Difference between 1998 and 2001 Samples

Dependent Variable: use online banking or not	**Logit 1998 & 2001**	**Logit 1998 & 2001**	**Logit 1998 & 2001**	**Logit 1998 & 2001**	**Logit 1998 & 2001**
Distance, d_i (miles)	Same	Same	Same	Same	Same
Distance, d_i*dummy for checking account	Same	Same	Same	Same	Same
Distance, d_i*dummy for saving account	Same	Same	Same	Same	Same
Distance, d_i*dummy for brokerage account	Same	Same	Same	Same	Same
Distance, d_i*dummy for CD account	Same	Same	Same	Same	Same
Distance, d_i*dummy for mutual fund account	Same	Same	Same	Same	Same
Distance, d_i*dummy for money mkt account	Same	Same	Same	Same	Same
Main Institution Characteristics					
Main institution: checking	Same	Vary	Same	Same	Same
Main institution: saving	Same	Vary	Same	Same	Same
Main institution: brokerage	Same	Vary	Same	Same	Same
Main institution: CD	Same	Vary	Same	Same	Same
Main institution: mutual fund	Same	Vary	Same	Same	Same
Main institution: money market account	Same	Vary	Same	Same	Same
Individual Characteristics					
Age – respondent	Same	Same	Vary	Vary	Same
Education – college grad	Same	Same	Vary	Vary	Same
Education – post-graduate education	Same	Same	Vary	Vary	Same
LOG (Annual Household Income)	Same	Same	Vary	Vary	Same
Use internet to gather information on credit/borrowing	Same	Same	Vary	Same	Vary
Use internet to gather information on saving/investment	Same	Same	Vary	Same	Vary
Used a debit card for purchase	Same	Same	Vary	Same	Vary
Shop around for investment decisions	Same	Same	Vary	Same	Vary
Shop around for loan decisions	Same	Same	Vary	Same	Vary
Number of Observations	7606	7606	7606	7606	7606
Log Likelihood Function	-2185.7	-2102.7	-2102.0	-2102.9	-2116.0
LR test statistic		166.0	167.4	165.6	139.4
Distribution (dof)		$\chi^2(6)$	$\chi^2(9)$	$\chi^2(4)$	$\chi^2(5)$

Note: "Same" means that the coefficient of the corresponding variable is assumed to be identical for the 1998 and 2001 samples.
Note: "Vary" means that the coefficient of the corresponding variable is assumed to be different for the 1998 and 2001 samples.

Appendix 1: Online Banking Fee for Some Commercial Banks

Institution	Online Banking Fee
American Bank	Free Access and Free Bill Pay
Bank of America	Free Access and $5.95 for Bill Pay
Bank One	Free Access and $4.95 for Bill Pay
Chase Manhattan Bank	Free Access and Free Bill Pay
Citibank	Free Access and Free Bill Pay
Fleet National Bank	For Fleet One Gold and Premier accounts, Free Access and Free Bill Pay. All other customers, Free Access and $4.50 for Bill Pay
Net Bank	Free Access and Free Bill Pay
Pennsylvania State ECU	Free Access and Free Bill Pay
Washington Mutual Bank	Free Access and $5.00 for Bill Pay
Wells Fargo Bank	Free Access and $6.95 for Bill Pay
Woodforest National Bank	Free Access and Free Bill Pay

Source: http://www.bankrate.com/brm/publ/onlinefees.asp

The data was collected by a survey conducted on March 8, 2002.

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