Does It Pay to Read Your Junk Mail? Evidence of the Effect of Advertising on Financial Decisions[*]

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ABSTRACT

We examine the effect of direct mail (commonly referred to as junk mail) advertising on individual financial decisions by studying consumer choice of debt contracts. Consistent with the theoretical predictions, we find that financial variables underlying the relative pricing of debt contracts are the leading factors explaining consumers debt choice. Furthermore, we also find that the intended use of debt proceeds significantly impacts consumer choice. However, when we study a subset of consumers who received a direct mail solicitation for a particular debt contract (fixed versus adjustable-rate), we find evidence that the relative pricing variables are less revelent in explaining consumer contract choice, even though they were presented with a full menu of debt contracts. Our results are consistent with the persuasive view of advertising and suggest that advertising and persuasion can lead to suboptimal financial choices.

Keywords: Persuasion, Advertising, Contract Choice, Home-equity Lending

1 Introduction

In 2005, the top 100 U.S. advertisers spent over $271 billion on marketing across all forms of media. Of this amount, over $55 billion was spent on direct mail advertisements, making 'junk mail' second only to television (at $68 billion) in dollars expended.[1] In terms of industries that report large expenditures on advertising, financial institutions spent over $8.4 billion marketing a wide variety of investment and credit products (e.g., mutual funds, insurance contracts, bank accounts, credit cards, and mortgage loans to name just a few of the major categories) making the financial services industry the fourth highest advertising category by dollar spent.[2]

Obviously, one of the roles of advertising is to persuade the consumer to purchase a good or service. Thus, a natural question arises: To what extent does advertising or persuasion impact consumer financial decisions? We answer this question by examining the effect of direct advertising (often referred to as 'junk' mail) on one of the most important financial decisions facing households – the choice of mortgage contract type.

Financial economists now recognize that marketing and persuasion can affect consumer investment decisions. For example, studies of consumer investments in mutual funds indicate that marketing plays an active role in determining the money flow into funds.[3] In addition to evidence from mutual fund trading, Grullon, Kanatas, and Weston (2004) find evidence linking firm product market advertising and investor interest. Furthermore, Barber and Odean (2005) document that exogenous factors calling attention to particular stocks can affect investor purchase decisions.[4] Thus, these studies reinforce the idea that marketing can and does impact financial decisions.

While previous research in economics and marketing indicates that advertising is effective, little is known about the impact that advertising has on altering consumer evaluation of financial decisions.[5] That is, can advertising lead consumers to ignore important financial factors when faced

[1] Source: *Advertising Age*, June 26, 2006. (http://adage.com/images/random/lna2006.pdf)

[2] To put this in perspective, automotive, retail and telecom were the top three industries in terms of advertising expenditures at $20.9 billion, $18.6 billion and $9.9 billion, respectively (Source: *Advertising Age*, June 26, 2006.)

[3] In one of the first studies to explicitly examine mutual fund marketing, Sirri and Tufano (1998) suggest that mutual fund advertising lowers consumer search costs and that this can explain the link between advertising and fund flow. Similarly, Jain and Wu (2000) and Barber, Odean, and Zheng (2003) show that mutual fund advertising is related to money flow (investment). More recently, Cronqvist (2006) shows that mutual fund advertising impacts investors' choices even though it provides little information. In addition, Reuter and Zitzewitz (2006) find that mutual fund flows are positively related to positive news articles in the financial press.

[4] Although Barber and Odean (2005) do not explicitly examine the role of advertising, they do note that news events, excessive trading volume, and extraordinary returns can affect investment decisions.

[5] The economics literature traditionally classifies advertising as being persuasive, informative, or complementary

with an economic decision? In one of the few studies to examine this question, Bertrand et al. (2006) conduct a field experiment in South Africa using personal loan contracts. Their experiment presents evidence showing that variations in the psychological features of the advertisement, as well as traditional economic variables, such as interest rates, impact consumer loan take-up rates. The results from this field experiment are consistent with the findings of Russo, Carlson and Meloy (2006) that persuasive information can lead decision makers to choose inferior alternatives.[6] At the theoretical level, Mullainathan, Schwartzstein and Shliefer (2006) build a simple model of persuasion that helps explain certain aspects of marketing - branding, advertisement, and product attributes (also see Mullainathan and Shliefer, 2005); while Shapiro (2006) theoretically demonstrates that advertisement can be persuasive rather than informative.

To the best of our knowledge, almost no research has examined the impact that advertising and persuasion can have on consumer choice in the mortgage market. Yet, for most households, their mortgage is their single largest financial liability and the choice between fixed (FRM) versus floating (ARM) mortgage interest rate contracts can have a substantial impact on the overall cost of home financing (Campbell, 2006). For example, the historic decline in interest rates between 2000 and 2003 resulted in a dramatic lowering of mortgage costs for ARM borrowers, which prompted the Chairman of the Federal Reserve Board to remark that homeowners may have incorrectly preferred fixed-rate mortgages over adjustable rate mortgages.[7,8]

We examine the consumer choice of fixed versus variable rate debt by focusing on the home equity lending market in order to determine whether consumers rationally price the interest-rate insurance feature of fixed-rate mortgages in the presence of direct mail advertising. Our data comes from a financial institution that accepted home equity credit applications from a large number of

(Bagwell, 2006). The informative view assumes that advertising simply conveys information, (e.g. Stigler, 1961, and Nelson, 1974 and 1975.), while the persuasive view assumes that advertising can alter consumer preferences.

[6] In a related area of the literature, numerous studies have focused on the role that information framing has on individual decision choices (see for example, Kahneman and Tversky, 1979, and Tversky and Kahneman, 1981 and 1986, among others.)

[7] See remarks by Chairman Alan Greenspan, *Understanding household debt obligations* at the Credit Union National Association 2004 Governmental Affairs Conference, Washington, D.C. (February 23, 2004) [http://www.federalreserve.gov/boardDocs/speeches/2004/20040223/default.htm].

[8] Previous research on mortgage choice indicates that borrowers rationally price the interest rate risk inherent in adjustable rate contracts. For example, Brueckner and Follain (1988) examined borrower choice for first mortgage contracts and found that the interest rate differential between fixed and adjustable rate mortgages and the interest rate level for fixed rate mortgages are the primary factors explaining why borrowers choose fixed versus adjustable contracts. Their result suggests that borrowers react rationally to changes in the relative pricing of ARM and FRM contracts when originating mortgage debt.

branch offices. Furthermore, we utilize a natural experiment arising from the bank's marketing campaign that allows us to determine whether an applicant was exposed to a direct mail solicitation prior to applying for a loan. During the marketing campaign, applicants arrived at the branch locations via one of two methods. First, applications were accepted at local branch locations from customers that were not targeted by the bank's marketing campaign. We refer to these applicants as 'walk-in' (WI) customers. Second, the lender received applications at the branch locations from customers who were targeted with a direct mail solicitation advertising a home equity product. We refer to these applicants as 'direct mail' (DM) customers. We are able to test the persuasive view versus the informative or complementary view of advertising by examining the choices of the DM customers relative to the choices made by the WI customers. If the lender's direct mail campaign is persuasive, then we should observe differences between the DM and WI customers' mortgage choices. However, if the the advertising is informative or complementary, then we should observe DM and WI customers responding similarly to changes in economic conditions.

Previewing our results, we find that the WI customers reacted as expected and chose fixed-rate or variable-rate home equity credit products based on the prevailing interest rate and economic environment at the time of application. That is, WI customers selected the variable-rate product during periods with higher interest rates. The results from the analysis of the WI customers are broadly consistent with previous empirical work. However, in comparing product choice across DM and WI customers, we find that DM customers do not react as expected to changes in the economic environment. For example, the simple correlation of the ARM share with the interest rate prevailing on the fixed-rate product is -0.144 for the DM customers and is 0.482 for the WI consumers indicating that DM customers are less likely to select the variable-rate product when interest rates are higher. We also find that the simple correlation between the fixed and variable interest rate differences and the ARM share for the DM customers is -0.084 and for the WI customers is 0.286. Again, the negative correlation observed for the DM customers is counter to theoretical expectations.

Using a variety of empirical methods, we control for possible differences between the WI and DM customers. As a result, we are able to isolate the effect of the direct mail solicitation on the customer's mortgage decision. In particular, we show that consumers who receive a direct mail solicitation are more likely to ignore the important economic and interest rate environment factors

that influenced the decisions of the WI customers. Examining the applicant choices reveals that 78 percent of the DM customers were influenced by the bank's solicitation while 22 percent responded to signals present in the economic environment. Further analysis of the subset of applicants that were clearly influenced by the bank's solicitation reveals that 74 percent were persuaded to originate a product that was opposite to the one selected by their counterparts that did not receive a direct mail solicitation. However, we also find that the direct mail solicitation could be classified as informative for 26 percent of the DM customers.

In support of our finding that some borrowers were persuaded to make an incorrect product choice, we find that the three-month prepayment rate for the persuaded borrowers is almost four times higher than the corresponding prepayment rates on borrowers that were informed by the bank's solicitation. Our results are consistent with evidence of consumer learning.[9] Thus, while our study reveals that bank advertising has a persuasive effect on consumer financial decisions for a majority of the applicants that received a solicitation, we also find evidence that is consistent with the informative role of advertising for a smaller subset of consumers.

Our paper proceeds as follows: In the next section, we outline the previous theoretical and empirical studies of borrower mortgage choice and the role of advertising. In Section 3, we discuss the differences between home equity lines-of-credit and home equity loans. We describe the data and empirical method in section 4. Section 5 present the results and section 6 compares the switchers and non-switchers. Section 7 provides robustness tests and section 8 concludes.

2 Mortgage Choice and the Role of Advertising

In this section we discuss the theoretical motivations for borrower mortgage choice and the role that lender advertising may play in influencing that choice. The theoretical literature on mortgage choice is well developed and offers a number of testable hypothesis. For example, Alm and Follain (1987) and Brueckner (1986) suggest that borrower risk aversion is a primary factor determining choice betweeen ARM and FRM. These models indicate that borrowers with low risk aversion and high discount rates should prefer the higher interest rate risk associated with adjustable contracts while borrowers with relatively high risk aversion and/or lower discount rates should prefer fixed-

[9] See Agarwal et al. (2005).

rate contracts. Thus, the trade-off between fixed-rate and adjustable-rate mortgages should depend upon the prevailing interest rate environment at the time of origination.[10]

Extending the earlier work on mortgage choice, Brueckner (1993) and Rosenthal and Zorn (1993) focus on the role that borrower expected mobility plays in determining the selection of adjustable versus fixed rate debt. The comparative statics derived from these models indicate that the borrower's propensity to choose an adjustable rate contract is inversely related to her expected tenure. Furthermore, the comparative statics in Brueckner (1993) also support earlier theoretical models by indicating that the level of interest rates are inversely related to the attractiveness of the adjustable rate debt.

More recently, a number of researchers have recognized the complexity and importance of the optimal mortgage choice problem within the context of household life-cycle consumption models. For example, Campbell and Cocco (2003) solve a dynamic model of mortgage choice and consumption assuming that borrower income is risky. Their analysis implies that borrowers with high risk aversion will prefer fixed-rate mortgages and that mortgage choice may reveal unobserved heterogeneity in borrower risk profiles.[11] In addition, Campbell and Cocco's (2003) analysis suggests that when the yield spread between fixed- and adjustable-rate mortgages is large (small), homeowners should prefer ARMs (FRMs). Empirically, Campbell (2006) confirms this result by finding that the share of ARMs to total mortgage origination is directly proportional to the both the FRM-ARM interest rate differential and the level of the FRM interest rate. In a novel empirical test taking advantage of the discontinuity in the U.S. mortgage market resulting from the distinction between 'conforming' and 'non-conforming' mortgages, Vickery (2006) finds that borrower mortgage choices are highly sensitive to changes in FRM interest rates.[12] For example, Vickery (2006) estimates that a 10 basis point increase in fixed-rate mortgage rates corresponds to a 10.4 percentage point decline in the FRM market share.[13]

[10]Empirically, Dhillion, Shilling, and Sirmans (1987) find that loan pricing factors are the primary determinants of borrowers choosing ARMs over FRMs in the first mortgage market.

[11]See Sa-Aadu and Shilling (1995), Sa-Aadu and Sirmans (1995) and Chiang, Chow and Liu (2002). In addition, borrower mobility (see Chan, 1996; and Gabriel and Rosenthal, 1993) and borrower perceptions of default risk (see Posey and Yavas, 2001) may play a role in contract choice. Recent theoretical work by van Hemert, de Jong, and Driessen (2005) and van Hemert (2006) also reinforces the link between borrower risk aversion and ARM preference.

[12]'Conforming' mortgages are loans that are eligible for purchase by the housing government sponsored enterprises (GSEs), Fannie Mae and Freddie Mac. In contrast, 'non-conforming' mortgages are ineligible for purchase by the GSEs. In general, 'conforming' mortgages have loan balances below the conforming loan limit (updated annually) and meet other underwriting risk criteria set by the GSEs.

[13]Recent work by Koijen, van Hemert, and van Nieuwerburgh (2006) using aggregate ARM/FRM market shares

While the theoretical literature clearly shows that borrower choice of mortgage type should depend upon prevailing financial conditions at origination, the prior empirical research has relied on the use of originated loans, necessitating the use of econometric models to infer borrower sensitivity to the interest rate environment.[14] Yet, a recent analysis of the home equity lending market by Agarwal et. al. (2007a) reveals that lenders can and do alter loan contract terms during the underwriting process and thus effect the observed "choice" of fixed versus adjustable contracts. In this study, we focus on the borrower's initial choice as revealed on the credit application. Thus, we are able to isolate the factors impacting borrower choice free of any bias introduced through subsequent lender screening and underwriting.

While the brief review above demonstrates that borrower mortgage choice has received considerable attention, no study has examined the impact of lender advertising on this choice. Economists have long considered the effect of advertising on consumer behavior. In a recent survey of the previous century of economic research on advertising, Bagwell (2007) notes that economist generally view advertising as falling into one of three categories: persuasive, informative, or complementary. Under the persuasive view, economists assume that "advertising alters consumers' tastes."[15] According to the persuasive theory, firms advertise with the goal of altering consumers' preferences so that they purchase the good being advertised.[16] Thus, one outcome of persuasive advertising is that consumers purchase the 'wrong' or 'incorrect' amount or product. In the context of our mortgage choice problem, the persuasive view of advertising suggests that a lender's direct mail solicitation causes consumers to ignore their evaluation of the economic environment and thus select the advertised product.

In contrast, the informative view, based on the work of Ozga (1960) and Stigler (1961), concludes that advertising provides consumers with information and lowers consumer search costs. In the context of the mortgage choice problem, the informative view of advertising suggests that the lender's direct mail solicitation provided information to the consumers, for example reminding them that attractive interest rates existed on home equity products. As a result, direct mail solicitations

indicates that the inflation risk premium and prepayment option value are primary factors in determining ARM market shares.

[14]See Brueckner and Follain (1986) for example.

[15]Bagwell (2007), page 3.

[16]Bagwell (2007) documents that the persuasive view developed from early research by Robinson (1933) and Braithwaite (1928). Bagwell comments that Braithwaite suggested that "advertising's effect is to induce consumers to purchase the wrong quantities of goods that are not well adapted to their true needs..." (page 10.)

lower search costs, but do not alter preferences for a particular product based on the prevailing economic environment. Under this view, the consumer's choice should coincide with the type of product advertised on the solicitation.

Finally, the complementary view assumes that consumer taste preferences are stable and advertising complements these tastes to encourage consumption.[17] Under this view, the direct mail solicitation encourages prospective customers to want a home equity product from the lender, but the choice of product type still reflects their individual tastes and preferences.

To summarize, our study of home equity product choice has the potential to differentiate these competing economic views of advertising. First, if the persuasive view of advertising is correct, then we should observe the direct mail customers ignoring economic and interest rate environment factors and selecting the mortgage product suggested in the solicitation. However, if the informative view is correct, then we should observe the consumer's product choice coinciding with the product advertised in the solicitation and this choice should be consistent with our theoretical expectations regarding the economic and interest rate environment prevailing at the time of application. Finally, if the complementary view is correct, then we should observe the direct mail customers selecting products based on the theoretical predictions regarding the economic and interest rate environment, without regard to the type of product listed on the solicitation.

Empirically differentiating between the three competing views of advertising is difficult. Thus, we utilize several independent methods to isolate the effect. First, we estimate a direct probabilistic choice model. Second, we analyze the DM customer who selected products other than the one on the solicitation. Finally, we compare DM customers with a matched sample of WI customers in order to eliminate any spurious comparisons. Each method has advantages and disadvantages. However, by triangulating the results we can separate the persuasive effect of advertising from the informative effect.

3 Differences Between Home Equity Lines and Loans

Home equity credit falls into two categories: home equity loans (i.e. "spot" loans) and home equity lines (i.e., credit lines or lines-of-credit). Agarwal et al., (2006) note that "a spot loan is a closed-

[17] Bagwell (2007) traces the complementary view to the work of Telser (1964) and Stigler and Becker (1977).

end loan extended for a specified length of time requiring repayment of interest and principal in equal monthly installments." The interest rate on home equity loans is set at loan origination. In contrast, they define a credit line as "an open-ended, variable rate, revolving credit facility that permits the consumer to borrow up to a predetermined amount (the line amount)," and note that borrowers usually are required to pay interest only on the used portion of the line during the first five years, after which the line becomes a fully amortizing loan.

Significant differences exist between borrowers who choose lines versus loans, with line borrowers having greater wealth - as indicated by their having relatively more expensive homes, higher incomes, and greater home equity. For example, Canner et al. (1998) document that the median home equity for credit line borrowers is $41,000 greater than spot loan borrowers ($76,000 versus $35,000) and that the median household income for spot loan borrowers is $10,000 less than the median household income of credit line borrowers. Canner et al., (1998) also note a significant difference in the ages of line borrowers and loan borrowers; 23 percent of the loan borrowers versus 6 percent of line borrowers are below the age of 34. In addition, the 1997 Survey of Consumers shows that 49 percent of the households who prefer loans over lines are relatively more sensitive to interest rates and that "ease of use" is the primary motivation for credit line borrowers. Thus, it is imperative to control for borrower heterogeneity in analyzing contract choice.

4 Data

As discussed in Agarwal et al. (2007a), the data used in this study were provided by a large financial institution (proprietary in nature) and consists of variable-rate home-equity lines of credit (HELOCs) and fixed-rate home-equity loans (HELs) issued to owner-occupants from March 2002 to December 2002. The credit lines are open for the first five years and the borrower is only required to make interest payments on the utilized line balance during this period. After the fifth year, the line is closed and is converted to a fully amortizing, fixed-rate term loan with a remaining term of 5 to 15 years.

The lender received applications from customers via two channels. First, the majority of applications were from customers walking into their local branch and requesting a home equity credit. At this point, the local loan officer provided the customer with a menu of various home equity

products – with the primary choice being a variable rate (line-of-credit) or fixed rate (loan).[18] We refer to these customers as 'walk-in' (WI). Between March 2002 and December 2002, the lender received over 108,000 walk-in applications.

Second, the lender also received applications from customers who had received a direct mail solicitation advertising either a line-of-credit or home-equity loan. Between March 2002 and May 2002, the bank sent out over 3 million direct mail solicitations in 12 equally distributed waves (or campaigns) to potential customers (or households) with credit (FICO) scores above 640.[19] Across these 12 campaigns, approximately 2.1 million customers were targeted with a line of credit solicitation while 981 thousand received a home equity loan solicitation. Conditional on maintaining the approximately two to one ratio of line to loan mailings, the bank randomly selected customers to receive the line of credit or loan offer. That is, the bank did not specifically target individuals for a line or loan offer, rather the bank randomly sent the line and loan mailings to customers with FICO scores greater than 640. Table 1 shows the mean FICO scores and geographic distribution of the customers sent the direct mail solicitations. Consistent with the bank's practice of randomly selecting customers for the two product solicitations, we see that the average FICO scores of the line and loan groups do not differ economically.[20] Table 1 also shows the average credit scores and geographic distribution for the customers that responded to the bank's solicitation. As is typical in direct mail marketing campaigns, the response rate is low. For example, 20,500 customers responded to the bank's line of credit solicitation for a 0.99 percent response rate while 11,249 customers responded to the loan solicitation for a response rate of 1.15 percent. We also see that the credit scores for responding customers are lower than the credit quality of the population receiving the solicitation, which is consistent with the experience reported in other consumer loan research.[21] Although the customers received a solicitation for a specific product (either a line-of-credit or a loan), at the time of application the local loan officer showed them the same product menu as the

[18] Each product also contained a variety of pricing options based on the requested loan-to-value ratio.

[19] In designing the marketing program, the bank requested that the credit bureau provide a random sample of households in the target area that had credit scores above 640 for the purpose of conducting a direct mail campaign. By law, the bank cannot request information from the credit bureau and then screen the households again prior to mailing the solicitation. That is, once the bank pulls a credit score for a household, it is obligated to send that household a solicitation. The solicitation does not indicate that the households are "pre-approved" for credit. Since the solicitation is based only on credit score, some households that ultimately respond to the offer may be denied credit by the bank based on other factors inconsistent with the bank's underwriting standards.

[20] Although the mean FICO scores are statistically different across the two groups because of the large number of observations, economically, the bank would not distinguish between borrowers with FICO scores of 729 and 722.

[21] Ausubel (1999) reports a similar result for responses to direct mail credit card solicitations.

WI customers and they were free to choose either product. Additionally, the solicitation for a line offer provided the option for the customer to choose a loan offer (and vice versa). We refer to the customers who responded to this advertisement as 'direct mail' or DM customers.

Table 2 shows the descriptive statistics for the DM and WI customer groups. With the exception of borrower age, the t-tests for differences in sample means are statistically significant for all variables, which is not surprising given the large number of observations. Comparison of the sample means between the WI and DM customers clearly suggest that the population of the two groups is different. For example, on average the WI customers have higher home values, greater income, more job seniority, and longer tenure at present address. Furthermore, WI customers request greater loan amounts (consistent with having higher average house values) but lower loan-to-value ratios. Combining these risk factors suggests that WI loans are lower risk.

5 Empirical Methods and Results

Our empirical analysis focuses on identifying the effect that lender advertising has on financial decisions. As discussed above, identifying advertising's effect is challenging. In this section, we estimate a consumer choice model under the assumption that consumers choose the contract that maximizes their personal utility function and that this utility is maximized subject to a variety of economic and personal factors. Analogous to studies that examine the effect of various programs or treatments, we include shift variables that identify consumers who received direct mail solicitations.

5.1 A Model of Mortgage Choice

We begin by letting Y_i represent applicant i's choice of mortgage type, where $Y = 1$ denotes the variable rate line-of-credit and $Y = 0$ is the fixed-rate home equity loan. As noted above, we also observe that some applicants received a direct mail solicitation from the bank. Our goal is to determine whether this solicitation had an impact on the applicant's mortgage choice. The classical approach for this type of problem is to estimate the following probit model of borrower home-equity choice:

$$Pr(Y_i = 1) = \beta X_i + \alpha I_i + \varepsilon_i \tag{1}$$

where X_i is a matrix of explanatory variables, $I_i = [I_i^v, I_i^f]'$ with I_i^v equaling one if the applicant received a direct mail variable-rate line-of-credit solicitation and zero otherwise and I_i^f equaling one if the applicant received a direct mail fixed-rate home equity loan solicitation and zero otherwise, $\alpha = [\alpha_v, \alpha_f]$ and β are a set of coefficients to be estimated, and ε_i is a standard error term. In (1), I_i represents a demand shift that isolates the effect of the direct mail solicitation on the borrower's mortgage choice probability.

Estimation of (1) provides an indication of whether receiving a direct mail solicitation impacts the mortgage choice decision. However, we are also interested in whether the bank's direct mail solicitation altered the borrower's sensitivity to financial environmental factors. For example, prior studies indicate that mortgage choice should depend upon relative borrower risk aversion and interest rates.[22] Thus, we segment X_i into variables representing borrower riskiness (X_i^R), interest rate environment (X_i^E), and other demographic and geographic factors (X_i^D). By interacting the direct mail solicitation variables with X_i^R and X_i^E, we are able to isolate whether the bank's marketing efforts altered the applicant's decision process. As a result, we estimate the following model

$$Pr(Y_i = 1) = \beta X_i + \alpha I_i + \pi_R X_i^R I_i + \pi_E X_i^E I_i + \varepsilon_i. \tag{2}$$

where $\pi_R = [\pi_R^v, \pi_R^f]'$ and $\pi_E = [\pi_E^v, \pi_E^f]'$. The estimated coefficients π_R and π_E provide an indication of the impact that the direct mail solicitation had on the applicants evaluation of the economic and risk factors.

As discussed above, the persuasive view implies that direct mail customers will ignore economic and interest rate factors. Thus, we should observe significant coefficients for the advertising shift parameters with $\alpha_v > 0$ and $\alpha_f < 0$ since the solicitation is supposed to alter consumer's taste preferences causing them to desire the product being advertised, while the interaction terms should not be significant ($\pi_E = \pi_R = 0$) since the advertising effect is assumed to cause consumers to ignore other factors. In contrast, the informative and complementary views imply that the interaction terms (π_E, π_R) should have the same sign as the base parameters (β) since informative advertising does not alter the consumer's underlying preferences.

[22] See Alm and Follain (1987) and Brueckner (1986).

5.2 Results

The estimated coefficients reported in Table 3 confirm prior research about the decision to choose between a variable and fixed rate contract. Given the large number of observations included in the analysis, it is not surprising that almost all of the variables are statistically significant (at the 5 percent level), with the exception being the interaction of the direct mail dummy variables with the income and interest rate variables. Thus, we focus on the variables' marginal impacts to provide guidance as to the relative importance of the factors in impacting the borrower's decision.[23] Interestingly, the variables related to interest rates (FRM/ARM rate differential and FRM rate level), the borrowers declared intended use of the funds (consumption or refinancing), and direct mail solicitation are the only variables that have marginal impacts greater than 10 percent.[24]

5.2.1 Impact of Borrower's Stated Use of Funds

The borrower's declared use of the debt proceeds clearly has a strong impact on choice of contract. The marginal impacts indicate that a borrower that intends to use the funds for consumption is 13.1 percent more likely to select the adjustable-rate line-of-credit than borrowers intending to use the funds for home improvements. However, borrowers intending to refinance existing debt are 16.7 percent less likely to select the adjustable-rate line-of-credit than borrowers seeking funds for home improvements. Clearly borrowers prefer the flexibility associated with the adjustable-rate line-of-credit when using home-equity to smooth consumption while preferring the certainty of fixed-rate contracts when refinancing (or consolidating) existing debt.

[23] Ai and Norton (2003) point out that the marginal effects typically supplied by conventional statistical software for interaction terms in non-linear models are incorrect. Thus, we follow Ai and Norton (2003) and calculate the marginal effects for the interaction variables as

$$\frac{\partial^2 \Phi(\cdot)}{\partial I_i \partial X_i^R} = \pi_R \Phi^{'}(\cdot) + (\beta + \pi_R I_i)(\alpha + \pi_R X_i^R)\Phi^{''}(\cdot) \tag{3}$$

$$\frac{\partial^2 \Phi(\cdot)}{\partial I_i \partial X_i^E} = \pi_E \Phi^{'}(\cdot) + (\beta + \pi_E I_i)(\alpha + \pi_E X_i^E)\Phi^{''}(\cdot) \tag{4}$$

where Φ represents the standard normal cumulative distribution.

[24] The 'home improvement' intended use is the reference category for the use of funds dummy variables.

5.2.2 Impact of Interest Rate Environment

We find that the impact of market interest rates in influencing the borrower choice of contract is consistent with the theoretical predictions of Alm and Follain (1987) and Brueckner (1986) as well as the previous empirical evidence presented in Brueckner and Follain (1988). For example, the theoretical literature indicates that borrowers with high relative risk aversion and low discount rates are more likely to prefer fixed-rate contracts. Consistent with this theory regarding borrower risk aversion, we find that every one percentage point increase in the difference between the fixed- and adjustable- interest rates results in a 12.4 percent increase in the probability that the borrower will select the adjustable rate contract. Furthermore, every one percentage point increase in the home equity loan interest rate (the fixed-rate product) raises the probability that the borrower will select the adjustable-rate line-of-credit by 13.3 percent.

To highlight the impact of interest rate movements on borrower contract choice, we estimate the probabilities of selecting a home equity line-of-credit for two sets of hypothetical borrowers based on the short term (three months) and long term (five years) daily Treasury rates observed between January 2003 and December 2004.[25] We construct our hypothetical borrowers by assuming that one set of borrowers are "walk-in" customers ($DM = 0$) and the other set received a direct mail solicitation ($DM = 1$). We further assume that each borrower has values for the other variables in X_i equal to the sample means. Finally, in each set we assume that one borrower indicated that she would use the debt proceeds for consumption while the other would use the debt proceeds to refinance. Based on these values and the estimated coefficients in Table 3, we calculate the time-varying probabilities that each borrower would select an adjustable-rate line-of-credit.[26]

To highlight the interest rates used in the simulation, Figure 2 shows the FRM interest rate and interest rate differential between January 2003 and December 2004. Over this period, the fixed-rate reference interest rate varied from 3.1 percent (in June 2003) to over 4.8 percent (in June 2004). Furthermore, this period saw a decline in the yield curve from 3.1 percent (in May 2004) to 1.3 percent (in December 2004) indicating a substantial drop in short-term interest rates.

Figures 3 and 4 show the probability of selecting an ARM for borrowers with consumption and

[25] See Brueckner and Follain (1988) for a similar simulation.

[26] Obviously, the probability of selecting the fixed-rate home equity loan is simply one minus the adjustable-rate probability.

refinancing motives, respectively. Looking first at the consumption borrowers, we see that the probability that the walk-in customer will select the adjustable-rate product ranges between 54 percent and 77 percent, and closely tracks the FRM interest rate. During periods when the FRM interest rate is relatively low, the probability of selecting the adjustable-rate product is correspondingly low – indicating that borrowers are correctly anticipating higher future rates and thus seek to lock-in the lower current rate. As interest rates increase, the probability of selecting an adjustable-rate product increases. Comparing the walk-in customers with the direct-mail customers, it is striking to observe the relative interest-rate insensitivity of the direct-mail customers. For example, the probability that a direct mail customer who received a line-of-credit offer only varies between 81 percent and 84 percent. Furthermore, for borrowers who received a solicitation suggesting a home equity loan, the probability of selecting the adjustable rate product only varies between 8 percent and 10 percent.

Figure 4 reveals a similar pattern for the borrowers indicating a refinancing motive. Again, we see that the walk-in customers are relatively sensitive to changes in the interest rate environment with the probability of selecting an adjustable rate product declining when interest rates are low and rising after interest rates have moved up. Furthermore, the direct mail customers who indicated a refinancing motive also show the similar pattern of being relatively insensitive to interest rate movements.

When we compare the changes in ARM selection probability between walk-in customers based on their indicated use, we find that borrowers with refinancing motives are more sensitive to changes in the underlying yield curve than borrowers with consumption motives. For example, between March 9, 2004, and May 13, 2004, the FRM benchmark increased from 3.73 percent to 4.85 percent and the yield curve (interest rate differential) increased from 1.72 to 3.01 percent. As a result of this dramatic increase in longer term interest rates, the probability that a walk-in refinancing borrower would select an adjustable-rate product almost doubled, from 16 percent to 29 percent. However, during the same period, the probability that a similar consumption motivated borrower would select an adjustable-rate product only increased from 62 percent to 77 percent.

5.2.3 Impact of Bank's Advertising Campaign

We now examine the effect of the bank's solicitation on the applicant's mortgage choice. The marginal effects reported in Table 3 clearly indicate that the bank's direct mail solicitations had a significant impact on borrower product choice. After controlling for all other factors, a borrower receiving a line-of-credit solicitation was 17.7 percent more likely to select a variable rate line-of-credit than the fixed-rate product. Similarly, borrowers who received a direct mail loan offer were 14.8 percent less likely to select the variable rate product than the fixed-rate product. In other words, the results indicate that $\alpha_v > 0$ and $\alpha_f < 0$.

Consistent with the persuasive view, Figures 3 and 4 highlight the impact of the bank's direct mail solicitations and provide evidence that the interaction terms are not significant. Both figures indicate that WI customers are relatively sensitive to changes in the market interest rate environment. In comparison, the estimated probabilities for the customers that responded to the direct mail solicitation are virtually constant over the entire period. As a result, it does not appear that the customers who received a direct mail solicitation are responding to changes in the economic environment (as reflected in movements in interest rates) in a manner that is consistent with the WI customers. The lack of response for the DM customers to changes in the interest rate environment is consistent with persuasive view that the advertising caused the customers to ignore other factors. That is, $\pi_E = 0$ and $\pi_R = 0$.

The results presented here make a compelling case against the informative view of advertising. Under the informative view, we should observe similar sensitivities to changes in the interest rate environment for the WI and DM customers. Thus, the relatively constant probabilities of ARM choice for the DM customers is inconsistent with the informative view and suggests that the lender's solicitation was persuasive.

The results are less clear for differentiating the persuasive effect from the complementary effect. The complementary view suggests that we should observe similar probabilities of ARM selection for the DM customers regardless of the type of solicitation received since the solicitation is supposed to remind the customers of the availability of credit but not alter their taste preferences for a particular type of credit. The results for the consumption motivated borrowers support the complementary view. For example, Figure 3 shows that the probability of selecting an ARM for the consumption

motivated customers that received a loan offer is significantly lower than the corresponding probability for the borrowers who received a line offer. For the complementary view to hold, we expect a relatively high probability of selecting an adjustable rate line of credit for borrowers who intend to use the funds for consumption since interest is only charged on the amount of credit utilized. Thus, Figure 3 reveals that borrowers who received a home equity loan solicitation are not only insensitive to interest rate movements, but they are also have a low probability of selecting the adjustable-rate line-of-credit. This is inconsistent with the complementary view of advertising.

However, in order to refrain from 'overselling' our results, we note that the results for the refinancing motivated borrowers may be consistent with the complementary view. We expect that refinancing motivated borrowers should prefer the stability of the fixed-rate product when consolidating their debts.[27] Consistent with this expectation, we see that the probability of selecting an ARM is almost zero for the refinancing customers that received a loan solicitation. We also see that the probability of selecting an ARM is approximately 30 percent for customers receiving the line solicitation. However, we note that the WI customers also have an ARM probability averaging approximately 20 percent. Thus, we can not state that the solicitation altered the line versus loan preferences for the refinancing customers since the estimated probability of selecting a ARM is consistent with the estimated probability of selecting an ARM for the customer that did not receive a solicitation. As a result, one could view the results presented in Figure 4 as also being consistent with the complementary view. However, again we observe that the lack of sensitivity to changes in market interest rates for the DM customers is inconsistent with the informative view. We explore the issue of informative versus persuasive advertising in Section 7, below.

5.3 Summary

To summarize, our analysis reveals that borrower mortgage choice is sensitive to the economic environment. Yet, we also observe that a subset of borrowers who received solicitations or 'cues' from the bank did not select a mortgage product in a manner consistent with theoretical expectations. Overall, the results suggest that the lender's advertising campaign had a persuasive effect. In the next section, we explore the impact of the direct mail solicitation in greater detail by highlighting the differences between borrowers who ignored the lender's direct mail cue and switched to the

[27] See Canner et al. (1998).

alternative product and those that selected the product advertised in the mailing.

6 Switchers versus Non-switchers

As discussed above, during the application process, all customers are presented with the full loan contract menu. Thus, even though the DM customer may have received a solicitation advertising a line-of-credit, the customer also had the option of applying for a home equity loan. By matching the database that tracked the customers who received a direct mail solicitation (for either a loan or line-of-credit) with the database of applications, we can identify instances when the borrower switched products. For example, if the borrower received a line-of-credit (or loan) solicitation, but applied for a home equity loan (or line-of-credit), then we classify that borrower as a 'switcher.' However, if the borrower received a line-of-credit (loan) solicitation and also applied for a line-of-credit (loan), then we classify that borrower as a 'non-switcher.' The presence of switchers raises an interesting question: Do observable differences exist between the switchers and non-switchers? In other words, can we identify the customers that are more likely to be persuaded by the bank's solicitation?

Table 4 shows the descriptive statistics for the DM customers based on whether the borrower switched products. We note that out of the 31,749 customers that received a direct mail solicitation, 22 percent selected a product that was different from the one in the solicitation. Furthermore, we see that 2,375 (21 percent) of the applicants who selected the fixed-rate product received a direct mail offer for a variable-rate product, while 4,623 (23 percent) of the applicants who selected the variable-rate product received the fixed-rate solicitation.

In order to focus on the explicit differences between customers who switched from the solicited product and those who did not, we estimate a simple logit model for switch versus no switch. We are not attempting to determine whether the customers made the "correct" choice since such a model is beyond the limits of the data available. Table 5 reports the estimated coefficients. The results indicate the customers having the characteristics of being more financially sophisticated (higher incomes and higher credit scores) are more likely to switch away from the advertised product. For example, the marginal effects imply that a customer with a FICO score of 824 is 48 percent

more likely to switch than a customer with a FICO score of 724.[28] Interestingly, we also see that older customers are less likely to switch than younger customers. For example, the marginal effects indicate that a 56-year old customer is 33 percent less likely to switch than a 46-year old customer.[29] This result is consistent with the findings of Agarwal et al. (2007b) that financial sophistication declines with age.

We also see that the customer's indicated intended use of the funds has a direct effect on the probability of switching. For example, borrowers using the loan proceeds for refinancing are 2.7 percent more likely to switch, while borrowers using the funds for consumption are 5.6 percent less likely to switch than borrowers using the funds for home improvements. These results are consistent with the idea that customers seeking to rate refinance are sufficiently sophisticated that they respond to incentives present in the economic environment and are not persuaded to accept the offer presented in the solicitation.

7 Robustness Tests

As a robustness check on the evidence presented above, we analyze the impact of the direct mail solicitation using a matched sample method. This method requires that we create a matched sample of WI customers that is statistically similar to the DM customer sample. Since the bank targets a sub-sample of the WI population to receive a direct mail solicitation (those with credit scores greater than 640), our analysis concentrates on the sub-set of WI customers that are identical to the DM customers with the exception that they did not receive a solicitation. In this context, the direct mail solicitation is the experimental "treatment" and our goal is to assess whether it has any impact on mortgage choice. Under the null hypothesis that consumers are financially rational and choose debt contracts based on the prevailing economic environment, we should not observe a difference in the factors affecting the mortgage choice between the two groups.

We begin by matching the 108,117 walk-in consumers to the 31,749 direct mail consumers using the nearest centroid sorting algorithm (see, Anderberg, 1973 and Hartigan, 1985) based on the Euclidean distances computed over all demographic and financial variables within a zip code.[30]

[28] The mean FICO score for the DM customers is 724.

[29] The mean customer age at date of application if 46.5 years.

[30] As a robustness check, we also computed the Euclidean distances over a set of five pre-determined 'key' variables. The sorting algorithm produced an approximately 99 percent overlap between the respective WI subsamples. As a

Once we obtain the probability of the distance to the centroid, we rank order the 108,117 WI observations and choose the closest 31,749 accounts. Thus, the clustering procedure produces a sample of WI consumers that matches the DM consumers along these financial, demographic, and geographical variables.

Table 6 reports the descriptive statistics for the DM customers and the matched WI sample. It is clear from examining the mean values in Table 6 that the matching algorithm produces a WI sample that closely resembles the DM customers in terms of credit quality, loan amount, house value, income, and borrower age. For example, the average FICO scores and loan-to-value ratios of the two groups are within approximately 1 point of each other, and the difference in the average borrower incomes is about 2 percent ($2,462).

7.1 Evaluation of Customer Choice

We estimate separate logit models of borrower choice for the matched walk-in and direct mail samples. We then compare the marginal effects to determine the sensitivity of borrowers to the independent variables based on whether or not they received a solicitation. Effectively, this method is equivalent to estimating a single model over both samples and interacting a dummy variable for direct mail with each variable.

Table 7 reports the consumer choice logit model for the walk-in matched sample. Not surprisingly, the results are consistent with the results reported in table 3. The marginal effects indicate that WI borrowers are sensitive to changes in the interest rate environment. For example, a one point increase in the fixed-rate reference interest rate results in a 14.3 percent jump in the probability that the borrower will select the adjustable rate line-of-credit. Furthermore, we also see that the borrower's intended use of funds significantly impacts their product choice. Borrowers intending to use the home equity funds for consumption are 12.8 percent more likely to choose the variable rate line-of-credit while borrowers indicating that they are refinancing existing debt are 20.3 percent more likely to select the fixed-rate loan.

Table 8 shows the estimated coefficients and marginal effects for the borrower choice model estimated on the direct mail sample. In contrast to the WI borrowers, we first notice that none of the independent financial and demographic variables have marginal effects above 10 percent.

result, the results reported below are not qualitatively different.

Furthermore, many of the key variables identified in the WI sample are no longer statistically significant. For example, neither the term structure variable (rate difference) or the FRM reference interest rate are statistically significant. This result suggests that, in direct contrast to the WI borrowers, the direct mail customers are not basing their mortgage choice decision on the key factors identified by theory.

Comparing the marginal effects in Tables 7 and 8 indicates that the intended use of the loan funds affects both the WI and DM customer choice. However, we see that DM customer choice is less sensitive to their stated use of funds. For example, DM borrowers indicating that they are refinancing are 8.3 percent more likely to select the fixed rate product while the refinancing WI customers are 20.3 percent more likely to select the fixed rate product. Consumption borrowers also display a similar, but less dramatic, difference.

We included the dummy variable *Line Solicitation* in this model to isolate the impact of the type of direct mail offer sent to the customer.[31] The marginal effect clearly indicates that this variable has the largest impact on the customer's choice. Customers who receive a line of credit direct mail solicitation are 44.7 percent more likely to select the variable rate line of credit than the fixed rate loan product. The impact of this variable far exceeds the effect of any of the other variables. Thus, it appears that the bank's solicitation even significantly dampens the effect of the customer's intended use of the funds.

Finally, we examine the choice of borrowers who received a direct mail solicitation, but chose the product not advertised. Did these customers ignore the bank's direct marketing cue and select the product consistent with prior theoretical predictions? Table 9 reports the results from this model. Again, we compare the marginal effects to the baseline WI customers to identify any differences in sensitivity. The results in table 9 clearly indicate that the DM customers who switched are similar to the WI customers in that they are sensitive to the interest rate environment. The marginal impact of a one point increase in the yield curve results in a 11.1 percent increase in the probability that they will select the variable rate product. This result compares favorably with the 10.3 percent effect observed for the WI customers. Similarly, we see that a one point increase in the reference fixed-rate mortgage rate increases the probability of selecting the variable rate product by 8.2 percent (compared with 14.3 percent for the WI customers.) Finally, we also

[31] *Line Solicitation* equals one if the borrower received a variable rate line of credit offer and zero otherwise.

note that consumption and refinancing has the same effect on the DM switching customers as the WI customers. Thus, the results from Table 9 are consistent with the complementary view of advertising. These customers responded to the bank's offer letter, but still reacted to the economic environment in selecting the product.

7.2 Persuasive versus Informative Advertising

As noted in Section 5.2, our analysis makes a compelling case that the bank's direct mail solicitation was largely persuasive and not informative. In this section we explore this distinction in greater detail. Our objective is to identify the applicants that were persuaded or informed by the bank's solicitation.

We focus our analysis on the 24,751 customers (78 percent of the direct mail customers) who selected the product that was advertised (i.e. did not switch products) as these were the individuals most likely to be persuaded or informed by the bank's advertising campaign.[32] In order to determine the product that 'should' have been selected, we use the estimated coefficients from the walk-in matched sample model (Table 7) to generate a prediction of whether the customer should select the adjustable or fixed-rate product.[33] We then compare the customer's model prediction to their actual selection. Table (10) reports the frequency of persuaded versus informed consumers. Based on our classification scheme, we see that 74 percent of the borrowers were effectively "persuaded" by the bank's direct mail solicitation. That is, these borrowers selected the product that was featured on the solicitation but was opposite the one predicted by the model. However, we also note that 26 percent of the customers were "informed" by the bank's solicitation since they selected the product predicted by the model and it was also featured on the solicitation.

Although the analysis above suggests that 74 percent of the DM customers were persuaded to select a product that was counter to the one predicted by our model, it is possible that our model has a high predictive error rate resulting in a large Type II error. Thus, to gain a greater appreciation for the whether model predictive error can explain these results, we examine the model predictive accuracy using a hold-out sample of customers that were not exposed to the bank's direct mail

[32] By definition, the 6,998 customers who selected the product opposite to the one that was advertised in their solicitation letter could not have been persuaded. For the advertisement to be persuasive, the customer would have to select the product that was featured on the solicitation.

[33] We use a 50 percent cutoff criteria to determine whether the customer should select the adjustable rate product.

solicitation. Recall that the above analysis is based on the borrower choice model for the matched-sample of 31,749 walk-in customers, leaving 76,386 walk-in customers as a defacto hold-out sample. Thus, by estimating the predicted product choice for the hold-out walk-in customers, we are able to observe an unbiased estimate of the model's predictive accuracy. Table (11) reports the results of this test. The results clearly indicate that the model's predictive accuracy (using the 50 percent cutoff criteria) is very high. Table (11) shows that the model is able to predict the actual product choice for 85 percent of the customers implying a Type II error rate of 15 percent. In contrast, the predictive error rate for the direct mail customers is 74 percent. Since the only observable difference between the two groups is the receipt of the bank's direct mail solicitation, we feel that this is compelling evidence that the bank's marketing campaign did have a persuasive effect.[34]

As a final test of whether the advertising was persuasive or informative, we examine the *ex post* origination performance of the applications that were actually booked. If the advertising was persuasive such that it caused borrowers to select the wrong product, then we would expect to observe these customers learning about their mistake and making adjustments accordingly. To test for this effect, we examine the loan prepayment rates over the three months after origination. The three month window is a sufficiently short period that exogenous factors (such as changes in interest rates or household mobility) should have a minimal impact on borrower prepayment decisions. If the persuaded borrowers learn that they selected the incorrect product, then we should observe a higher prepayment rate for these borrowers than for borrowers that we identified as being informed or complimented.[35]

[34]One concern with our conclusion is that we may be attributing a persuasive effect to the bank's marketing campaign for borrowers who may not care that they selected the 'wrong' product simply because the costs associated with making an 'incorrect' decision are trivial. For example, our analysis could classify borrowers as being 'persuaded' even if they originated a line of credit in order to have ready access to funds in the future. These borrowers would clearly not select a fixed-rate product, even if the economic environment pointed to it as the optimal choice, since they will not be utilizing the funds immediately. In order to test whether this effect could be driving our results, the following table shows the average takedown (or utilization) rates for the matched WI and DM borrowers who selected the line of credit at origination, month 12, and month 24.

Average Line of Credit Takedown Rate

	Month 0	Month 12	Month 24
Walk-in	58.9%	63.2%	67.1%
Direct Mail	60.3%	63.7%	66.0%

The results reported above clearly reveal that the average utilization rates for WI and DM customers are comparable. Thus, the results do not support the hypothesis that the costs associated with selecting the line of credit are trivial.

[35]We note again that the home equity loans and lines were "no fee" products. Thus, the borrowers were able to repay their loans and lines without penalty.

To examine the differences in prepayment, we identified all applications that ultimately resulted in loan or lines being booked. We note that approximately 89 percent of the DM and WI matched sample applications resulted in booked loans or lines (28,099 DM customers and 28,256 WI customers, respectively.) For the customers identified by our model as being persuaded by the bank's solicitation, we note that approximately 90 percent of the applications resulted in booked loans or lines. Similarly, approximately 86 percent and 87 percent of the complemented and informed customer applications resulted in booked loans or lines, respectively.

Turning first to the persuaded customers, we observed that 707 prepaid during the three months after origination, implying an unconditional prepayment rate of 4.3 percent. In contrast, we observed an unconditional three-month prepayment rate of 2.9 percent for the complimented (switchers) and informed customers.[36] In contrast, the unconditional three-month prepayment rate for the walk-in customers is 1.7 percent.[37]

Table (12) reports the estimated coefficients for a simple logistic prepayment model.[38] Using the empirical mortgage performance literature to provide guidance in specifying the independent variables in the prepayment model, we estimated the following model:

$$Pr(h_i = 1) = \beta X_i + \alpha A_i + \varepsilon \tag{5}$$

where h_i equals one if the mortgage prepays during the three-month period following origination, and zero otherwise; X_i is a matrix of explanatory variables, $A_i = [A_i^P, A_i^I, A_i^C]'$ with $A_i^k (k = P, I, C)$ equaling one if borrower i was identified as being persuaded (P), informed (I), or complimented (C).[39] Following Agarwal et al. (2006), we include in the set of explanatory variables (X) a series of variables designed to capture the financial incentives to repay the loan. The variables include the value of the borrower's prepayment option ($OPTION$), an indicator of whether the prepayment option is "in-the-money" ($InMoney$), and a variable ($DSpread$) that captures the interaction of

[36] We observed 172 prepayments out of 6,018 complimented borrowers (or switchers) and 163 prepayments out of 5,619 informed borrowers.

[37] 491 out of the 28,256 walk-in loans booked prepaid within the first three months after origination.

[38] Given the short time horizon of our prepayment model, we estimated the prepayment model using a logistic framework rather than with a hazard rate model.

[39] The walk-in customers are the reference category.

between *InMoney* and *OPTION*.[40] Not surprising, given that we examine only the three-month period after origination, none of the financial variables are significant indicating that changes in the economic environment over the three months after origination did not impact borrower prepayment behavior. However, consistent with the theory that persuaded borrowers may have recognized that they selected the 'wrong' product, we see that the coefficient on the variable indicating that the borrower was persuaded is positive and significant. The marginal effects suggest that the prepayment rate for persuaded borrowers is almost four times as high as the prepayment rate experienced by the walk-in customers. Furthermore, the coefficients indicating whether the borrower was informed or complimented are insignificant suggesting that the three-month prepayment rate for these borrowers is not statistically different from the prepayment rate for the walk-in customers. Thus, our analysis shows that the borrowers most likely to have made a mistake by following the bank's advertising cue (the borrowers identified as being persuaded) are significantly more likely to quickly prepay out of this product than the typical walk-in customer not exposed to the bank's solicitation.

7.3 Sample Selection

One potential problem associated with our estimation of (2) is that the consumer's response to the bank's marketing effort may not be exogenous. That is, the household's decision to respond to the offer may be correlated with the variables in X that impact the mortgage choice decision. The nature of the correlation arises from the fact that the choice of fixed versus adjustable rate loans is a function of expected borrower tenure. For example, analysis by Rosenthal and Zorn (1993) suggests that borrowers with relatively higher expected mobility should prefer adjustable rate loans over fixed rate loans. Since our study involves home equity credit (not first mortgages), it is reasonable to assume that applicants seeking home equity credit have low expected mobility – leading to a high tenure expectation. As a result, home equity credit applicants should have an unbiased preference for a fixed-rate loan, all else being equal. Thus, any bias introduced as a

[40]The *OPTION* variable follows Deng et al. (2000) and is calculated as

$$OPTION_i = \frac{V_i - V_i^*}{V_i} \tag{6}$$

where V_i is the present value of the remaining mortgage payments at the current market interest rate and V_i^* is the present value of the remaining mortgage payments at the contract interest rate.

result of applicant self selection should be skewed toward observing a higher probability of selecting the fixed-rate product, weakening the effect of a line solicitation and biasing our estimate of α_v downward. As a result, any presence of applicant self selection should bias the estimated coefficients away from our hypothesis, suggesting that the findings reported in Section 5 of a persuasive effect from advertising are actually stronger than indicated.

However, in order to confirm that our assertion that sample selection is not influencing our results, we also estimate the following bivariate probit model:

$$\Delta_i = \gamma Z_i + \nu_i; \tag{7}$$

$$Pr(Y_i = 1) = \beta X_i + \alpha I_i + \pi_R X_i^R I_i + \pi_E X_i^E I_i + \varepsilon_i. \tag{8}$$

where (7) reflects the customer's decision to respond to the bank's direct mail solicitation with Δ_i equal to one if the customer responded to the direct mail solicitation and zero otherwise, Z_i is the household's credit (FICO) score at the time the bank began the marketing campaign, and ν_i is a standard error term.[41] Equations (7) and (8) are estimated via full information maximum likelihood where $\rho = Cov[\nu_i, \varepsilon_i]$.

Tables (13) and (14) report the estimated coefficients for the bivariate probit model. First, we note that the estimated coefficient for the sample selection correction parameter (ρ) is statistically insignificant. Second, the estimated coefficients and marginal effects reported in Table (14) are not qualitatively different from those reported in Table (3). As a result, the findings from the bivariate probit model confirm our prior expectation that the results reported in Section 5 do not suffer from sample selection bias.

8 Conclusions

Financial economists now recognize that marketing and persuasion can have important effects on consumer decisions. In this paper, we examine the effect of direct mail (or junk mail) advertising

[41] Due to the time lag between the start of the marketing campaign and the customer's decision to apply for a home equity product, the customer's credit score may change. We refer to the former as the "Solicitation FICO Score" and the later as the "Application FICO Score".

on individual financial decisions by studying consumer choice of debt contracts.

The results from our analysis suggest that financial variables underlying the relative pricing of debt contracts are the leading factors explaining consumer debt choice. Furthermore, we also find that the intended use of debt proceeds significantly affects consumer choice.

With respect to the impact of advertising on borrower choice, we find evidence that the relative pricing variables no longer explain consumer contract choice for a subset of consumers who received a solicitation for a particular debt contract (fixed versus adjustable-rate). Thus, the results suggest that advertising can lead to suboptimal financial choices for some consumers. Specifically, our analysis reveals that a majority of the consumers who received a solicitation were persuaded to choose suboptimal financial contracts. However, we also note that a substantial (one third) portion of the consumers who received a direct mail solicitation did not view the offer as persuasive since they remained sensitive to the economic environment as theory predicts. The evidence indicates that these consumers used the direct mail advertisement as complement in their decision making process.

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Table 1: **Summary Statistics for Direct Mail Customers**

	Bank Solicitations				Consumer Response			
	Loans		Lines		Loans		Lines	
Variables	Mean	Std	Mean	Std	Mean	Std	Mean	Std
FICO Score	722.6	42.8	729.7	48.6	714.8	37.0	726.8	44.8
State MA	22.7%	30.2%	20.8%	28.6%	24.7%	28.6%	21.0%	27.2%
State CT	10.8%	37.3%	13.0%	33.6%	10.8%	15.7%	14.9%	13.7%
State ME	5.7%	8.7%	6.7%	9.7%	6.1%	6.2%	6.1%	4.9%
State NH	4.4%	20.4%	4.7%	21.2%	5.0%	14.7%	4.4%	14.7%
State NJ	8.4%	27.7%	10.3%	11.2%	7.1%	14.8%	10.7%	7.7%
State NY	35.5%	47.6%	33.0%	37.5%	33.7%	38.5%	30.7%	35.5%
State PA	4.9%	9.6%	4.2%	5.2%	4.5%	4.7%	4.5%	7.5%
State RI	7.2%	25.7%	6.8%	25.0%	6.8%	24.7%	6.9%	17.6%
Frequency	.981 Million		2.072 Million		11,249		20,500	

Table 2: **Summary Statistics for Walk-In and Direct Mail Customers**

	Walk-In		Direct Mail		
Variables	Mean	Std	Mean	Std	T-test for the means
Customer LTV	61.88	25.49	70.31	19.98	-54.25
Appraised LTV	64.68	28.21	71.40	19.08	-39.84
Borrower Estimated Home Value	$329,521	$236,802	$299,334	$221,874	20.25
Appraised Home Value	$318,491	$202,334	$286,330	$189,785	25.25
Requested Loan Amount	$66,664	$50,431	$60,291	$40,428	20.65
Loan Amount Approved	$67,279	$51,631	$61,123	$40,592	19.55
APR	5.46	1.06	5.45	1.06	1.92
FICO Score	728.02	50.50	724.40	41.03	11.68
Debt to Income	38.17	18.99	27.89	14.49	89.19
Consumption	30%	42%	28%	42%	6.97
Refinancing	46%	48%	48%	48%	-6.86
Years on the Job	7.85	9.01	4.57	2.81	63.87
Income	$122,241	$160,425	$110,694	$71,919	12.46
Borrower Age	46.51	12.57	46.52	11.25	-0.16
First Mortgage Balance	$143,361	$110,230	$132,991	$108,955	14.78
Months at Address	99.20	129.26	86.14	26.62	17.89
Self Employed	7%	26%	6%	23%	9.40
Retired	8%	27%	2%	13%	41.69
Home Maker	1%	11%	1%	10%	3.35
Married	53%	50%	48%	50%	14.53
Frequency	108,117		31,749		

Table 3: **Analysis of borrower home-equity choice**

	Coeff. Value	Standard Error	P-value	Marginal Impact
Intercept	-8.2566	0.2567	<.0001	
Economic Environment Variables:				
Rate Difference (FRM% - ARM%)	0.3543	0.0179	<.0001	12.35%
FRM APR%	0.2244	0.0192	<.0001	13.26%
Loan-to-Value Variables:				
Ln(Borrower Estimate of the House Value)	0.0053	0.0018	<.0001	1.42%
Ln(Loan Amount Requested)	0.0046	0.0007	<.0001	1.57%
Borrower Stated Use of Funds:				
Consumption	1.1083	0.0240	<.0001	13.09%
Refinancing	-0.9922	0.0206	<.0001	-16.73%
Borrower Characteristics:				
FICO	0.0063	0.0002	<.0001	0.04%
Debt to Income	-0.0147	0.0005	<.0001	-0.03%
Ln(Income)	0.0660	0.0187	0.0003	6.10%
Borrower Age	0.0010	0.0008	<.0001	0.18%
Years on the Job	0.0539	0.0009	<.0001	0.31%
Ln(First Mortgage Balance)	0.0653	0.0110	<.0001	4.84%
Ln(Months at Address)	0.0271	0.0081	0.0005	4.86%
Self Employed	0.4010	0.0334	<.0001	2.26%
Retired	-0.4188	0.0430	<.0001	-0.98%
Home Maker	-0.3381	0.0684	<.0001	-0.32%
Married	-0.1685	0.0162	<.0001	-1.97%
Direct Mail Solicitation Effects:				
DM Line Offer Dummy	0.2261	0.0560	<.0001	17.68%
DM Loan Offer Dummy	-0.2131	0.0360	<.0001	-14.78%
DM Line * FICO Score	0.0026	0.0005	<.0001	0.03%
DM Loan * FICO Score	-0.0035	0.0004	<.0001	-0.03%
DM Lines * Log(Income)	0.0049	0.0436	0.9400	0.03%
DM Loans * Log(Income)	-0.0058	0.0731	0.9940	-0.01%
DM Line * Rate Difference	-0.2106	0.1968	0.5832	0.00%
DM Loan * Rate Difference	-0.1940	0.5199	0.8926	-0.02%
DM Line * FRM APR %	-0.2634	0.5350	0.9340	-0.03%
DM Loan * FRM APR%	-0.2087	0.2725	0.4775	-0.02%
DM Line * Consumption	0.1997	0.0677	<.0001	5.24%
DM Loan * Consumption	0.4706	0.1943	0.0058	1.99%
DM Line * Refinancing	-0.1082	0.0440	0.0291	-1.19%
DM Loan * Refinancing	-0.3337	0.0872	<.0001	-6.18%
Month Loan Origination Dummies	Yes			
State Location Control Dummies	Yes			
Number of Observations	139,866			
Pseudo R-sq	26.32%			

Notes: This table reports the maximum-likelihood parameter estimates for the logit model of borrower home-equity choice. The dependent variable equals one if the borrower selected a variable rate line-of-credit and zero otherwise. FICO is the borrower's credit quality score at application; Rate Difference is the difference between the home-equity loan interest rate and the home-equity line-of-credit interest rate prevailing at the time of application; FRM APR is the fixed-rate home equity loan interest rate; Debt-to-income is the ratio of the borrower's debt to total income; Income is the borrower's income at date of application; Consumption is a dummy variable indicating that the borrower intends to use the loan/line proceeds for consumption purposes; Refinancing is a dummy variable indicating that the borrower is using the loan/line proceeds to refinance existing debt; Self Employed, Retired, Home Maker, and Married are dummy variables indicating the borrower's respective employment and marriage status. Following Ai and Norton (2003), the marginal effects for the interaction variables as are calculated as: $\frac{\partial^2 \Phi(\cdot)}{\partial I_i \partial X_i^R} = \pi_R \Phi^{'}(\cdot) + (\beta + \pi_R I_i)(\alpha + \pi_R X_i^R)\Phi^{''}(\cdot)$ and $\frac{\partial^2 \Phi(\cdot)}{\partial I_i \partial X_i^E} = \pi_E \Phi^{'}(\cdot) + (\beta + \pi_E I_i)(\alpha + \pi_E X_i^E)\Phi^{''}(\cdot)$. The Standard Errors are corrected for Heteroskadisticity.

Table 4: **Summary Statistics for the Direct Mail Customers Who Did and Did Not Switch Products at Origination**

	Direct Mail - Switch				Direct Mail - No Switch			
	Fixed Rate Home Equity Loans		Variable Rate Home Equity Lines		Fixed Rate Home Equity Loans		Variable Rate Home Equity Lines	
Variables	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Customer LTV	76.59	20.75	82.48	12.78	74.89	20.78	65.52	21.66
Appraised LTV	77.51	19.57	83.95	11.92	75.84	19.99	66.55	20.75
Borrower Estimated Home Value	$191,562	$144,906	$253,901	$179,175	$219,525	$159,651	$338,120	$253,598
Appraised Home Value	$184,142	$112,317	$243,508	$153,031	$210,580	$134,598	$323,056	$218,227
Requested Loan Amount	$51,853	$35,112	$52,603	$38,481	$46,862	$29,024	$66,193	$44,093
Loan Amount Approved	$48,610	$29,132	$50,510	$34,981	$44,563	$26,247	$68,842	$46,361
APR	8.24	1.13	5.61	1.06	8.13	1.18	4.57	1.03
FICO Score	705.72	38.71	719.24	44.72	716.14	34.42	730.38	46.25
Debt to Income	30.25	11.68	23.34	13.06	31.88	11.93	27.97	15.69
Consumption	15%	36%	53%	43%	18%	39%	24%	43%
Refinancing	81%	39%	24%	50%	77%	42%	46%	50%
Years on the Job	3.16	2.33	4.48	4.67	3.25	2.53	5.02	2.41
Income	$102,969	$53,361	$125,409	$65,256	$90,085	$66,596	$112,312	$76,223
Borrower Age	46.60	12.12	45.69	11.02	46.18	12.10	46.82	11.04
First Mortgage Balance	$92,004	$81,711	$151,488	$111,018	$108,787	$83,558	$136,660	$116,414
Months at Address	83.16	74.71	94.87	101.67	78.89	86.16	86.46	90.65
Self Employed	4%	19%	5%	22%	6%	23%	6%	24%
Retired	5%	21%	1%	11%	2%	15%	2%	13%
Home Maker	1%	8%	1%	10%	1%	10%	1%	10%
Married	45%	50%	45%	50%	48%	50%	50%	50%
Frequency	2,375		4,623		8,874		15,877	

Table 5: **Analysis of Decision to Switch Away from Product Offered in Direct Mail Solicitation**

	Coeff. Val.	Std. Err.	P-value	Marg Impact
Intercept	8.2849	0.0701	<.0001	
Loan-to-Value Variables:				
Ln(Borrower Estimate of the House Value)	-0.0040	0.0006	<.0001	1.45%
Ln(Loan Amount Requested)	0.0020	0.0004	<.0001	0.10%
Borrower Stated Use of Funds:				
Consumption	-0.2410	0.0450	<.0001	-5.64%
Refinancing	0.0042	0.0141	0.7722	2.71%
Borrower Characteristics:				
FICO	0.0209	0.0014	<.0001	0.48%
Debt to Income	-0.0238	0.0026	<.0001	0.00%
Ln(Income)	0.0220	0.0098	0.0258	2.07%
Borrower Age	-0.1259	0.0123	<.0001	-3.29%
Years on the Job	0.3505	0.0109	<.0001	0.10%
Ln(First Mortgage Balance)	-0.0132	0.0095	0.1694	-1.97%
Ln(Months at Address)	-0.1035	0.0080	<.0001	-0.63%
Self Employed	-0.0744	0.0024	<.0001	-0.04%
Retired	-0.0382	0.0050	<.0001	-0.17%
Home Maker	-0.0006	0.0002	0.0002	-0.06%
Married	1.4110	0.0076	<.0001	0.00%
Month Loan Origination Dummies	Yes			
State Location Control Dummies	Yes			
Number of Observations	31,749			
Pseudo R-sq	7.93%			

Notes: This table reports the maximum-likelihood parameter estimates for the logit model of whether the customer selected the alternative product from the one contained in the direct mail solicitation. The dependent variable is a dummy variable equal to 1 if the customer switched and 0 otherwise. FICO is the borrower's credit quality score at application; Debt-to-income is the ratio of the borrower's debt to total income; Income is the borrower's income at date of application; Consumption is a dummy variable indicating that the borrower intends to use the loan/line proceeds for consumption purposes; Refinancing is a dummy variable indicating that the borrower is using the loan/line proceeds to refinance existing debt; Self Employed, Retired, Home Maker, and Married are dummy variables indicating the borrower's respective employment and marriage status.

Table 6: **Summary Statistics for the Matched Sample Walk-In (WI) and Direct Mail (DM) Customers**

	Walk-In		Direct Mail	
Variables	Mean	Std	Mean	Std
Customer LTV	71.36	24.16	70.31	19.98
Appraised LTV	72.37	26.45	71.40	19.08
Borrower Estimated Home Value	$293,693	$137,769	$299,334	$221,874
Appraised Home Value	$282,975	$155,315	$286,330	$189,785
Requested Loan Amount	$57,038	$19,188	$60,291	$40,428
Loan Amount Approved	$57,927	$17,540	$61,123	$40,592
APR	5.87	1.16	5.45	1.06
FICO Score	722.80	39.35	724.40	41.03
Debt to Income	31.34	20.27	27.89	14.49
Consumption	26%	40%	28%	42%
Refinancing	50%	47%	48%	48%
Years on the Job	4.41	7.77	4.57	2.81
Income	$112,335	$70,896	$110,694	$71,919
Borrower Age	47.24	11.40	46.52	11.25
First Mortgage Balance	$127,492	$68,007	$132,991	$108,955
Months at Address	87.59	110.17	86.14	26.62
Self Employed	7%	25%	6%	23%
Retired	5%	21%	2%	13%
Home Maker	1%	9%	1%	10%
Married	50%	50%	48%	50%
Frequency	31749		31749	

Note: The walk-in sample was created using the nearest centroid sorting algorithm based on the Euclidean distances computed over all demographic and financial variables within a zip code. Customer LTV is the loan-to-value ratio based on the requested loan amount and the borrower's self-reported house value. Appraised LTV is the bank's loan-to-value ratio based on the approved loan amount and independent property appraisal. APR is the effective contract interest rate on the loan product selected.FICO is the borrower's credit quality score at application; Debt-to-income is the ratio of the borrower's debt to total income; Income is the borrower's income at date of application; Consumption is a dummy variable indicating that the borrower intends to use the loan/line proceeds for consumption purposes; Refinancing is a dummy variable indicating that the borrower is using the loan/line proceeds to refinance existing debt; Self Employed, Retired, Home Maker, and Married are dummy variables indicating the borrower's respective employment and marriage status.

Table 7: **Consumer Choice Between Fixed- and Adjustable Rate Home Equity**

Walk-In Consumers				
	Coeff. Val.	Std. Err.	P-value	Marg Impact
Intercept	-9.6807	1.4173	<.0001	
Economic Environment Variables:				
Rate Difference (FRM% - ARM%)	0.3060	0.0472	<.0001	10.34%
FRM APR%	0.1365	0.0246	<.0001	14.29%
Loan-to-Value Variables:				
Ln(Borrower Estimate of the House Value)	0.0024	0.0002	<.0001	1.92%
Ln(Loan Amount Requested)	0.0014	0.0002	<.0001	1.79%
Borrower Stated Use of Funds:				
Consumption	0.8121	0.0896	<.0001	12.80%
Refinancing	-1.2050	0.0630	<.0001	-20.26%
Borrower Characteristics:				
FICO	0.0062	0.0007	<.0001	0.06%
Debt to Income	-0.0167	0.0020	<.0001	-0.04%
Ln(Income)	0.0748	0.0184	<.0001	8.73%
Borrower Age	0.0036	0.0012	<.0001	0.28%
Years on the Job	0.0205	0.0032	<.0001	0.26%
Ln(First Mortgage Balance)	0.1943	0.0415	<.0001	6.87%
Ln(Months at Address)	0.2090	0.0293	<.0001	4.99%
Self Employed	0.0468	0.0879	0.8905	3.90%
Retired	-0.3269	0.1487	0.0173	-1.44%
Home Maker	-0.1392	0.0326	<.0001	-0.43%
Married	-0.2489	0.0554	<.0001	-1.69%
Month Loan Origination Dummies	Yes			
State Location Control Dummies	Yes			
Number of Observations	31,749			
Pseudo R-sq	12.39%			

Notes: This table reports the maximum-likelihood parameter estimates for the logit model of whether the customer selected the adjustable rate product. The model is estimated using the matched sample walk-in customers. The dependent variable is a dummy variable equal to 1 if the WI customer selected the ARM and 0 otherwise. FICO is the borrower's credit quality score at application; Debt-to-income is the ratio of the borrower's debt to total income; Income is the borrower's income at date of application; Consumption is a dummy variable indicating that the borrower intends to use the loan/line proceeds for consumption purposes; Refinancing is a dummy variable indicating that the borrower is using the loan/line proceeds to refinance existing debt; Self Employed, Retired, Home Maker, and Married are dummy variables indicating the borrower's respective employment and marriage status.

Table 8: **Consumer Choice Between Fixed- and Adjustable Rate Home Equity**

Direct Mail Consumers				
	Coeff. Val.	Std. Err.	P-value	Marg Impact
Intercept	-4.0226	0.5145	<.0001	
Economic Environment Variables:				
Rate Difference (FRM% - ARM%)	-0.0784	0.3229	0.8684	-1.65%
FRM APR%	-0.1026	0.1480	0.5548	-0.92%
Loan-to-Value Variables:				
Ln(Borrower Estimate of the House Value)	0.0022	0.0008	<.0001	1.68%
Ln(Loan Amount Requested)	0.0024	0.0003	<.0001	1.24%
Borrower Stated Use of Funds:				
Consumption	1.0304	0.0889	<.0001	8.78%
Refinancing	-0.7038	0.0429	<.0001	-8.25%
Borrower Characteristics:				
FICO	0.0013	0.0005	<.0001	0.04%
Debt to Income	-0.0262	0.0022	<.0001	-0.04%
Ln(Income)	0.3434	0.0870	0.0001	3.87%
Borrower Age	0.0048	0.0020	0.0119	0.27%
Years on the Job	0.0092	0.0060	0.1879	0.38%
Ln(First Mortgage Balance)	0.0719	0.0335	0.0277	5.68%
Ln(Months at Address)	0.0338	0.0028	<.0001	3.94%
Self Employed	0.2672	0.0713	<.0001	1.27%
Retired	-0.6141	0.1268	<.0001	-1.25%
Home Maker	-0.0615	0.0320	0.0399	-0.22%
Married	-0.1176	0.0705	0.0843	-0.85%
Direct Mail Solicitation Effects:				
Line Solicitation	2.1426	0.5740	<.0001	44.71%
Month Loan Origination Dummies	Yes			
State Location Control Dummies	Yes			
Number of Observations	31,749			
Pseudo R-sq	10.37%			

Notes: This table reports the maximum-likelihood parameter estimates for the logit model of whether the Direct Mail customer selected the adjustable rate product. The dependent variable is a dummy variable equal to 1 if the DM customer selected the ARM and 0 otherwise. FICO is the borrower's credit quality score at application; Debt-to-income is the ratio of the borrower's debt to total income; Income is the borrower's income at date of application; Consumption is a dummy variable indicating that the borrower intends to use the loan/line proceeds for consumption purposes; Refinancing is a dummy variable indicating that the borrower is using the loan/line proceeds to refinance existing debt; Self Employed, Retired, Home Maker, and Married are dummy variables indicating the borrower's respective employment and marriage status. Line Solicitation is a dummy variable equal to 1 if the customer received a line of credit offer and 0 otherwise.

Table 9: **Consumer Choice Between Fixed- and Adjustable Rate Home Equity**

Direct Mail Switchers				
	Coeff. Val.	Std. Err.	P-value	Marg Impact
Intercept	-5.0475	1.5669	<.0001	
Economic Environment Variables:				
Rate Difference (FRM% - ARM%)	0.2707	0.0476	<.0001	11.10%
FRM APR%	0.1385	0.0131	<.0001	8.15%
Loan-to-Value Variables:				
Ln(Borrower Estimate of the House Value)	0.0062	0.0002	<.0001	2.01%
Ln(Loan Amount Requested)	0.0039	0.0001	0.0203	1.09%
Borrower Stated Use of Funds:				
Consumption	1.1114	0.1131	<.0001	10.49%
Refinancing	-0.7210	0.0553	<.0001	-12.20%
Borrower Characteristics:				
FICO	0.0015	0.0006	<.0001	0.02%
Debt to Income	-0.0288	0.0027	<.0001	-0.03%
Ln(Income)	0.1969	0.0525	<.0001	4.05%
Borrower Age	0.0041	0.0025	0.0972	0.11%
Years on the Job	0.0164	0.0077	0.0192	0.13%
Ln(First Mortgage Balance)	0.0866	0.0373	0.0243	2.06%
Ln(Months at Address)	0.0028	0.0008	<.0001	0.94%
Self Employed	0.0093	0.0849	0.9333	0.29%
Retired	-0.4596	0.1854	0.0147	-1.31%
Home Maker	-0.1987	0.1987	0.4028	-0.24%
Married	-0.0636	0.0859	0.5821	-0.24%
Month Loan Origination Dummies	Yes			
State Location Control Dummies	Yes			
Number of Observations	6,998			
Pseudo R-sq	18.92%			

Notes: This table reports the maximum-likelihood parameter estimates for the logit model of whether the Direct Mail customers who switched products selected the adjustable rate product. The dependent variable is a dummy variable equal to 1 if the DM 'switch' customer selected the ARM and 0 otherwise. FICO is the borrower's credit quality score at application; Debt-to-income is the ratio of the borrower's debt to total income; Income is the borrower's income at date of application; Consumption is a dummy variable indicating that the borrower intends to use the loan/line proceeds for consumption purposes; Refinancing is a dummy variable indicating that the borrower is using the loan/line proceeds to refinance existing debt; Self Employed, Retired, Home Maker, and Married are dummy variables indicating the borrower's respective employment and marriage status.

Table 10: **Analysis of Persuaded versus Informed Consumers**

	Number Mailed	Predicted FRM		Predicted ARM	
		Selected FRM	Selected ARM	Selected FRM	Selected ARM
Mailed ARM	15,877	$\cdots$	**12,336**	$\cdots$	*3,541*
			50%		*14%*
Mailed FRM	8,874	*2,918*	$\cdots$	**5,956**	$\cdots$
		12%		**24%**	

Notes: This table reports the frequency of customers identified as either persuaded or informed. For all direct mail borrowers who did not switch products, we estimated the predicted product that they should select based on the coefficients from the walk-in mortgage choice model (Table 7). We then compare the predicted choice to the actual choice based on whether the borrower received an adjustable-rate (ARM) or fixed-rate (FRM) solicitation. The persuaded borrowers selected the product opposite to the one predicted and are noted in bold. Informed borrowers selected the product that is consistent with the one predicted and are noted in italics. Borrowers following into the $(\cdots)$ cells selected the predicted product and thus ignored the bank's advertising.

Table 11: **Walk-in Customer Prediction Error Rate**

	Predicted Selection		
Actual Selection	ARM	FRM	Total
ARM	48,345	8,167	56,512
	85.5%	14.5%	
FRM	3,056	16,800	19,856
	15.4%	84.6%	
Total	51,401	24,967	76,386

Notes: This table reports the predicted walk-in customer selection error rate. For all walk-in customers who were not included in the matched-sample analysis, we estimated the predicted product that they should select based on the coefficients from the matched sample walk-in mortgage choice model (Table 7). We then compare the predicted choice to the actual choice. Effectively, this test provides an indication of the predictive accuracy of the estimated mortgage choice model using a hold-out sample.

Table 12: **Prepayment Behavior of Home Equity Loans and Lines**

	Coeff. Value	Standard Error	t-stat	Marginal Effects
Intercept	-3.1833	0.3723	-8.55	
Log(FICO)	0.1844	0.1373	1.34	1.828
LTV	0.0318	0.0388	0.82	0.187
OPTION	0.0184	0.0178	1.03	0.384
InMoney	-0.0311	0.1346	-0.23	-0.157
DSpread	0.0188	0.0691	0.27	0.066
Persuaded	0.4831	0.1839	2.63	3.992
Informed	0.1758	0.1592	1.10	0.950
Complimented	0.1472	0.1958	0.75	0.738
Other Controls	Yes			
State Dummies	Yes			
Time Dummies	Yes			
Number Prepayed	1,533			
Number of Observations	56,355			
Pseudo R-sq	0.0173			

Note: This table reports the maximum-likelihood parameter estimates for the logistic three-month prepayment model. The dependent variable equals one if the borrower prepaid the mortgage during the three month period following origination and zero otherwise. FICO is hte borrower's credit quality score at application; LTV is the loan-to-value ratio at application; OPTION is the value of the borrower's prepayment option reflecting the difference between the market rate of interest and the contract interest rate; InMoney indicates whether the prepayment option is 'in-the-money'; DSpread is the interaction of InMoney and Option; Persuaded, Informed, and Complimented are indicator variables denoting whether the borrower was persuaded, informed or complimented by the bank's direct mail solicitation (walk-in customers are the reference category.) Standard Errors are corrected for Heteroskadisticity.

Table 13: **Sample Selection Model**

	Coefficient Value	Standard Error	P-value	Marginal Impact
Intercept	-0.2374	0.0407	<.0001	
Solicitation FICO Score	-0.0013	0.0000	<.0001	-0.01%
State Fixed Effects	Yes			
Campaign Fixed Effects	Yes			
Number of Observations	3.01 Million			
Pseudo-Rsq	2.7%			

Notes: This table reports the maximum-likelihood parameter estimates for the first-stage bivariate probit model of whether the household responded to the direct mail solicitation. The dependent variable in is a dummy variable equal to 1 if the household responded to the solicitation and 0 otherwise. The independent variable, FICO, is the borrower's credit quality score at the time of the bank's solicitation. The Standard Errors are corrected for Heteroskadisticity.

Table 14: **Bivariate Probit Model of Borrower Home-Equity Choice**

	Coeff. Value	Standard Error	P-value	Marginal Impact
Intercept	-8.2318	0.2565	<.0001	
Economic Environment Variables:				
Rate Difference (FRM% - ARM%)	0.3542	0.0179	<.0001	12.37%
FRM APR%	0.2245	0.0193	<.0001	13.25%
Loan-to-Value Variables:				
Ln(Borrower Estimate of the House Value)	0.0053	0.0017	<.0001	1.43%
Ln(Loan Amount Requested)	0.0046	0.0007	<.0001	1.56%
Borrower State Use of Funds:				
Consumption	1.1023	0.0239	<.0001	13.17%
Refinancing	-0.9851	0.0206	<.0001	-16.76%
Borrower Characteristics:				
Application FICO	0.0063	0.0002	<.0001	0.04%
Debt to Income	-0.0147	0.0005	<.0001	-0.03%
Ln(Income)	0.0659	0.0187	0.0005	6.12%
Borrower Age	0.0010	0.0008	<.0001	0.18%
Years on the Job	0.0539	0.0009	<.0001	0.31%
Ln(First Mortgage Balance)	0.0657	0.0110	<.0001	4.84%
Ln(Months at Address)	0.0272	0.0081	0.0006	4.85%
Self Employed	0.4025	0.0333	<.0001	2.27%
Retired	-0.4191	0.0429	<.0001	-0.97%
Home Maker	-0.3379	0.0685	<.0001	-0.32%
Married	-0.1686	0.0163	<.0001	-1.96%
Direct Mail Solicitation Effects:				
DM Line Offer Dummy	0.2264	0.0556	<.0001	17.74%
DM Loan Offer Dummy	-0.2122	0.0359	<.0001	-14.67%
DM Line * FICO Score	0.0026	0.0005	<.0001	0.03%
DM Loan * FICO Score	-0.0036	0.0005	<.0001	-0.05%
DM Lines * Log(Income)	0.0049	0.0437	0.9418	0.02%
DM Loans * Log(Income)	-0.0058	0.0730	0.9940	-0.01%
DM Line * Rate Difference	-0.2102	0.1969	0.5830	-0.01%
DM Loan * Rate Difference	-0.1934	0.5202	0.8971	-0.02%
DM Line * FRM APR %	-0.2633	0.5337	0.9360	-0.01%
DM Loan * FRM APR%	-0.2097	0.2722	0.4780	-0.02%
DM Line * Consumption	0.1993	0.0678	<.0001	6.83%
DM Loan * Consumption	0.4709	0.1942	0.0058	1.10%
DM Line * Refinancing	-0.1085	0.0441	0.0291	-1.90%
DM Loan * Refinancing	-0.3333	0.0878	<.0001	-6.92%
ρ	-0.4251	0.2926	0.2714	
Month Loan Origination Dummies	Yes			
State Location Control Dummies	Yes			
Number of Observations	139,866			
Pseudo R-sq	24.82%			

Notes: This table reports the maximum-likelihood parameter estimates for the bivariate probit model of borrower home-equity choice. The dependent variable equals one if the borrower selected a variable rate line-of-credit and zero otherwise. Application FICO is the borrower's credit quality score at application; Rate Difference is the difference between the home-equity loan interest rate and the home-equity line-of-credit interest rate prevailing at the time of application; FRM APR is the fixed-rate home equity loan interest rate; Debt-to-income is the ratio of the borrower's debt to total income; Income is the borrower's income at date of application; Consumption is a dummy variable indicating that the borrower intends to use the loan/line proceeds for consumption purposes; Refinancing is a dummy variable indicating that the borrower is using the loan/line proceeds to refinance existing debt; Self Employed, Retired, Home Maker, and Married are dummy variables indicating the borrower's respective employment and marriage status. Following Ai and Norton (2003), the marginal effects for the interaction variables as are calculated as: $\frac{\partial^2\Phi(\cdot)}{\partial I_i \partial X_i^R} = \pi_R \Phi^{'}(\cdot) + (\beta + \pi_R I_i)(\alpha + \pi_R X_i^R)\Phi^{''}(\cdot)$ and $\frac{\partial^2\Phi(\cdot)}{\partial I_i \partial X_i^E} = \pi_E \Phi^{'}(\cdot) + (\beta + \pi_E I_i)(\alpha + \pi_E X_i^E)\Phi^{''}(\cdot)$. The Standard Errors are corrected for Heteroskadisticity.

Figure 1: FRM APR, APR Difference, and ARM Share as a function of the Week Loans Originated

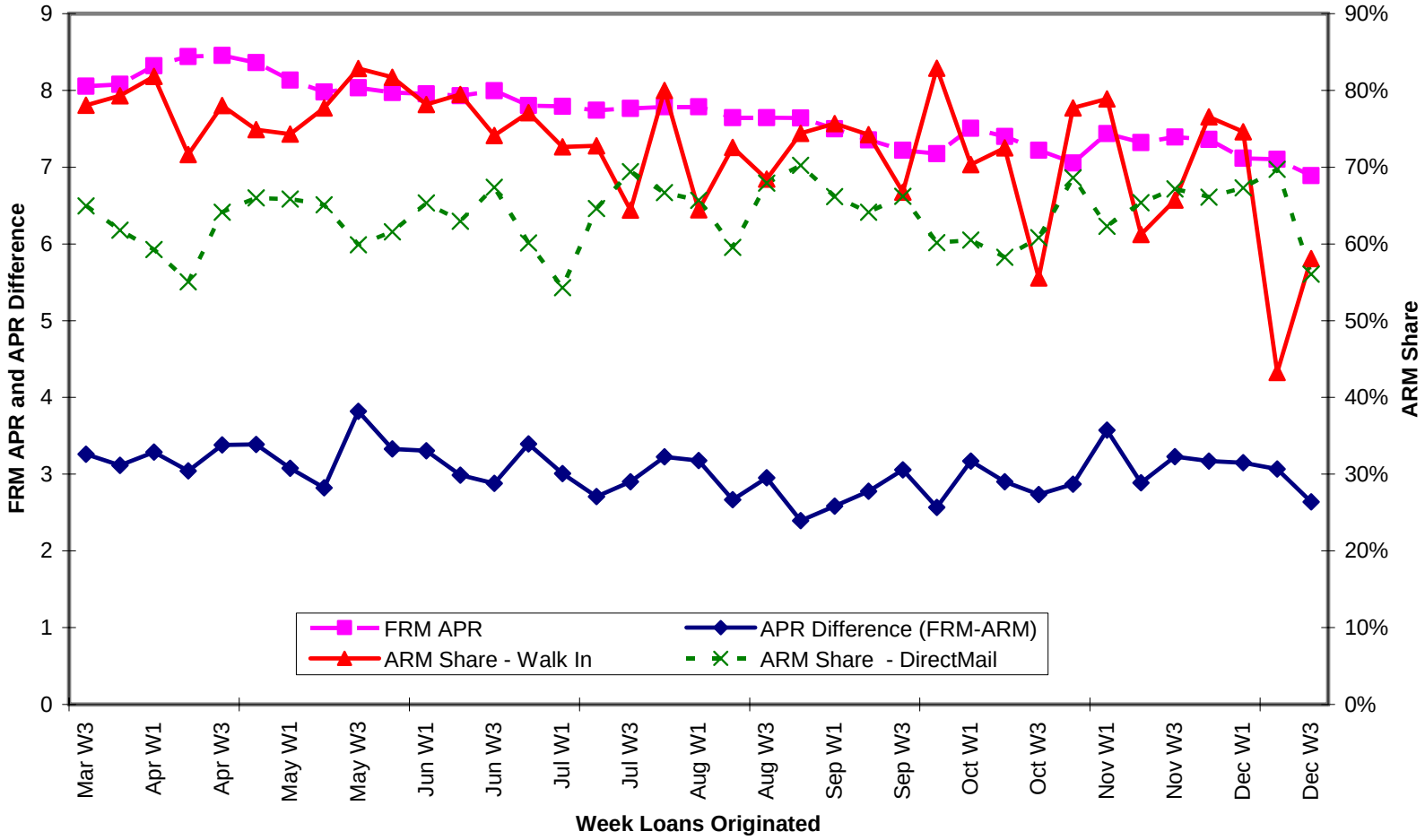

Figure 2: FRM ARP and FRM-ARM Differential Rates over the Loan Origination Period

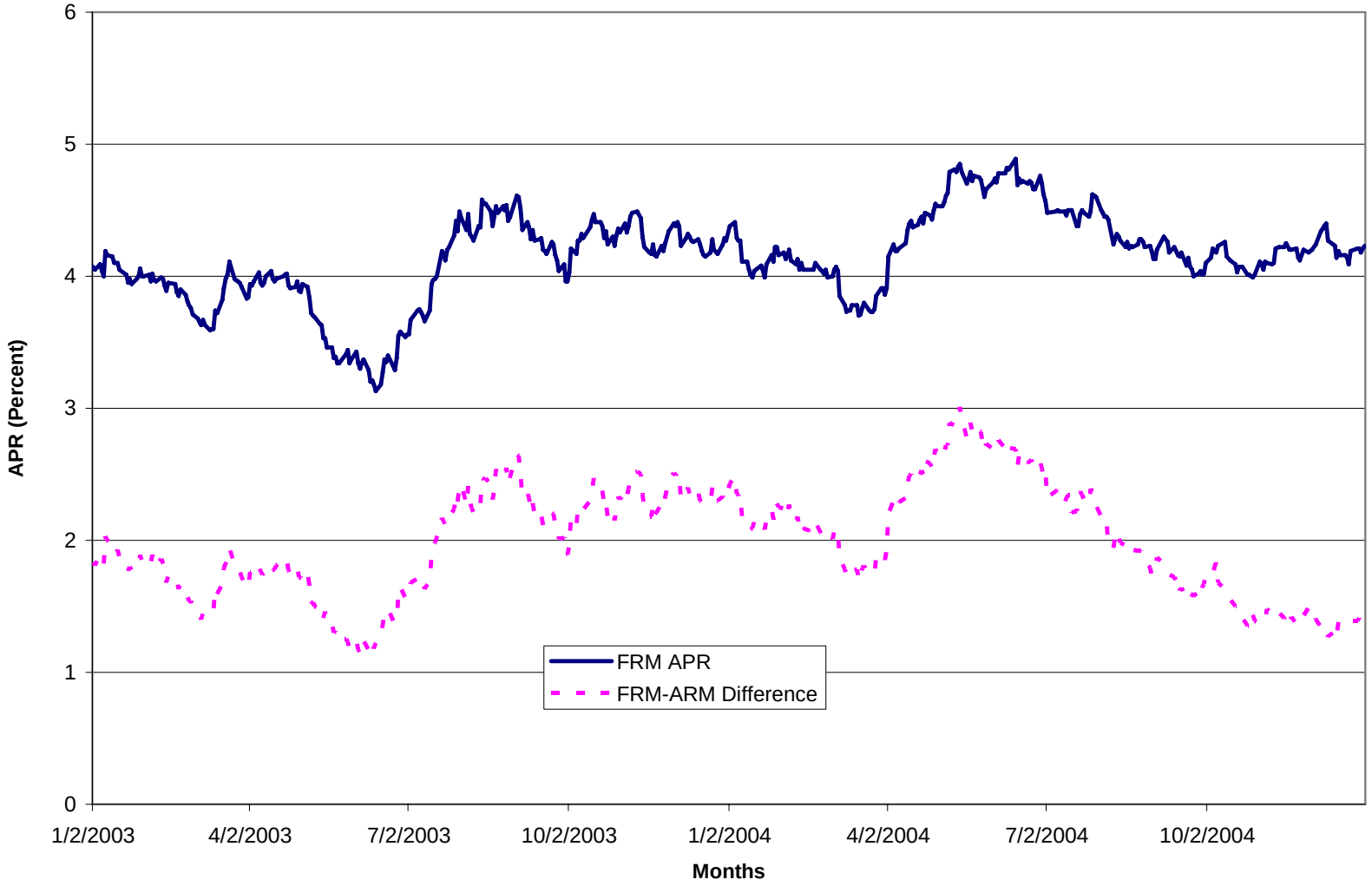

Figure 3: Probability of Choosing an ARM for Borrowers with Consumption Motives with varying FRM APR and Rate Differencials: Differences Between Business-as-Usual and Direct Marketing Consumers

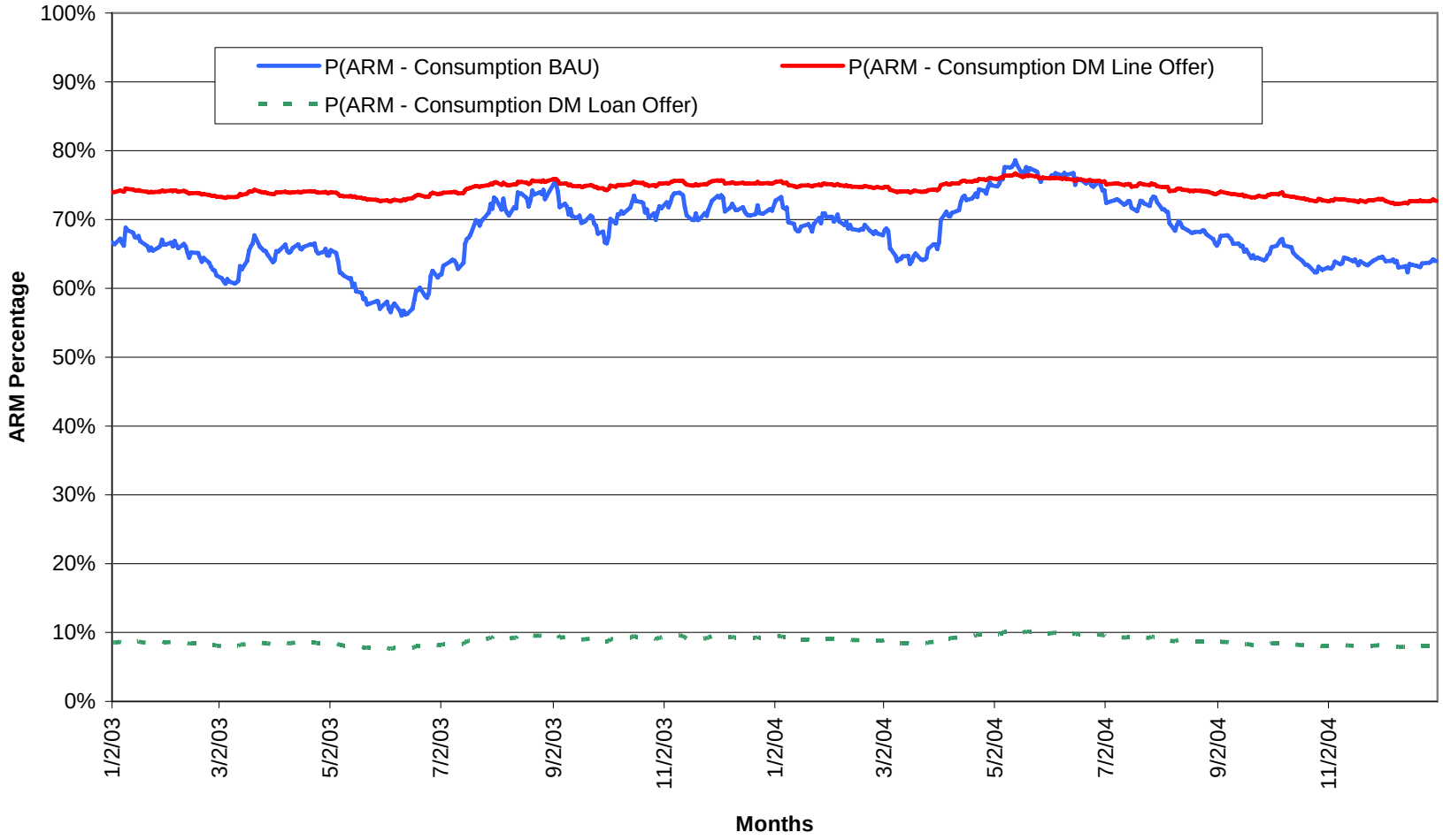

Figure 4: Probability of Choosing an ARM for Borrowers with Refinancing Motives with varying FRM APR and Rate Differencials: Differences Between Business-as-Usual and Direct Marketing Consumers