Effects of Monitoring on Mortgage Delinquency: Evidence from a Randomized Field Study

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Abstract

The rapid rise of mortgage defaults in 2008 has led to a series of policy proposals to reduce mortgage default risk, including regulatory changes to underwriting that would eliminate certain riskier borrowers from the market. However, policy interventions can also be designed to offset default risk by improving the financial capability of individual borrowers. Through a randomized field experiment with first-time homebuyers, we test the impact of financial monitoring on mortgage payments. A financial monitoring treatment consisting of quarterly emails and telephone calls from a financial coach for up to one year after purchase significantly lowered mortgage delinquency rates among borrowers with a history of default on other types of loans. These results suggest that relatively low-cost procedures embedded into loan servicing may increase adherence to timely repayments, thereby reducing the probability of delinquency.

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1 Introduction

The rapid rise of mortgage defaults in 2008 calls into question the long-term sustainability of offering mortgages to riskier borrowers. Mistakes made are costly at the household and community level; missed mortgage payments can place the homeowner at risk of mortgage default, with profound negative impacts for the consumer, the housing market and the economy at large. Regulatory changes to mortgage underwriting, such as those included under the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 (Pub.L. 111203), specifically seek to limit risky mortgage characteristics that have been associated with higher rates of default. However, underwriting thresholds such as minimum credit scores and loan to value ratios are a blunt policy instrument to sort credit risk that may disproportionately disadvantage first-time homebuyers and low and moderate income (LMI) households (Quercia et al. 2012). To the extent that access to mortgage credit for first-time and LMI homebuyers remains a policy goal, identifying alternative strategies to offset the potentially higher default risk of such mortgages will become a critical, yet challenging, objective.

In contrast to policy interventions that target the structure of the market to reduce mortgage default risk, e.g., through underwriting criteria, policy interventions can also be designed to offset default risk by improving the financial capability of individual borrowers. Factors such as lack of experience, information, or self-control may contribute to mortgage default, and may be targeted through a variety of strategies ranging from education, to one-on-one counseling, to financial coaching. Indeed, this is an implicit assumption underlying the U.S. Department of Housing & Urban Development's (HUD) annual funding for housing counseling and education services. In 2013, $40 million was awarded to 334 housing counseling agencies nationwide, with a goal to assist more than 1.6 million households "to find housing, make more informed housing choices or keep their current homes" (HUD 2013). Despite the potential of housing counseling interventions to reduce mortgage delinquency, the interventions are costly and demonstrating effectiveness empirically proves difficult. Questions about the effectiveness of housing counseling and education contributed to a moratorium on HUD counseling funding

in FY2011, and have motivated a series of HUD sponsored studies (Herbert, Turnham and Rodger 2008; Turnham and Jefferson 2012; Jefferson et al. 2012). There is a need to develop and test replicable, cost-efficient interventions that reduce mortgage delinquency.

Through a randomized field experiment with 425 LMI first-time homebuyers, we develop and test a low-touch financial monitoring program ("MyMoneyPath") designed to increase attention to mortgage payments and reduce mortgage delinquency. We situate our analysis in a broader literature testing the effectiveness of housing education and counseling initiatives on borrower outcomes (Agarwal et al. 2009; 2010; Ding et al. 2008; Hartarska & Gonzalez-Vega 2006; Hirad and Zorn 2002; Mayer & Temkin 2013; Quercia and Spader 2008), drawing additional insights from behavioral economics and literature on consumer financial decision-making (e.g. Duflo and Saez 2003; Mills et al. 2008; Stango and Zinman 2011; Zwane et al. 2011). Previous research has found associations between education and counseling and reduced mortgage delinquency; however, issues with self-selection complicate the ability to test the causal impact of specific interventions (Meier and Sprenger 2010, 2012). Even with statistical corrections for self-selection, it is difficult to identify the precise mechanism(s) responsible for reduced default; such identification is imperative to efficient and effective policy design.

Our study contributes to this existing literature in two important ways. First, we are able to overcome concerns about self-selection through the use of random assignment, providing the first results of a randomized control-trial for counseling-related interventions for homebuyers. Second, rather than testing housing education and counseling services broadly, we design and randomly test a low-touch intervention -- external monitoring after purchase-- behaviorally aimed at increasing attention to mortgage payments among first time homebuyers. We estimate treatment effects in the order of a 10 percentage point reduction in cumulative ('ever') delinquent rates within the first year of owning a home among subprime borrowers, relative to an average delinquency rate of 15%. Effects are primarily for borrowers with a previous credit history of missed debt payments, who may benefit more from reminders for new mortgage

payments. Estimates hold up to a variety of identification tests. This effect seems to be related to the use of automated payments and a tendency toward more savings and less revolving (mainly credit card) debt.

This paper begins with a review of related research, including research on the default risk of new homeowners and studies of consumer financial decision-making. We then continue with a description of the specific field experiment tested here, followed by an overview of the methods of analysis, findings and related robustness checks. We conclude with a brief discussion of the policy and practice implications of this field experiment, limitations and suggestions for future research.

2 Previous Research & Theory

Several factors may increase the default risk of first-time, LMI homebuyers. Being younger and lower income, these households may have less experience managing their finances and lower levels of wealth to deal with unexpected expenses such as home repairs and property taxes, or financial shocks such as a loss of income or illness. In a study of affordable mortgage borrowers, Van Zandt and Rohe (2011) find that nearly half of new LMI homeowners experienced major unexpected home repairs, and more than one-third reported major unexpected increases in utility costs, property taxes, or homeowner's insurance within the first two years after purchase. Home equity is likely too illiquid for such shortfalls, especially within the first few years after the purchase of a home with a highly leveraged mortgage, increasing the risk of mortgage default. Anderson and Dokko (2010) exploit geographic variations in property tax payment due dates to analyze the impact of an exogenous liquidity constraint (property tax bill) on early payment default for new subprime homebuyers, who typically lack an escrow for taxes as part of their mortgage payment. They find that borrowers with early tax payment due dates are more likely to experience early payment delinquency than borrowers with later tax payment due dates and are less likely to cure from a spell of delinquency, indicative of liquidity constraints caused by the tax bill. New homebuyers also have strong demand for housing related

goods and services after moving in, and such spending might derail household budgets in the first year after buying a home. Consumer Expenditure Survey data show that the median household shifts 5 percent of annual income to household durable goods, home-related consumption and home maintenance/improvement services (Siniavskaia 2008).

New homeowners are also likely to suffer from common behavioral biases, including myopic decision frames, procrastination, and/or difficulties with self-regulation, often resulting in less than optimal money management behaviors. Attention is an increasing focus of behavior modification programs across a number of domains, from health to personal finance. Inattention has been shown to be related to a number of potential biases in markets where consumers are systematically not attentive to product attributes, including fundamental information such as prices (Gabaix and Laibson 2006; Reis 2006). Several studies suggest that even modest interventions can increase the salience of a behavior for consumer financial decisions (Stango and Zinman 2011; Zwane et al. 2011). In fact, while studies have found that financial incentives increase savings behavior (Duflo and Saez 2003; Mills et al. 2008), one of the underlying mechanisms may simply by the focusing effects of these programs, in addition to the direct pecuniary effects of an incentive. Interventions to boost attention have been evaluated in other settings, including health care. For example, patient adherence to prescribed protocols can be enhanced using text messaging reminders (Pop-Eleches et al. 2011; Miloh et al. 2009).

Several studies in household finance focus on how limited attention may create a present bias in intertemporal choices where people are inattentive to future consequences related to savings (Karlan et al. 2010; Karlan and Zinman 2012). Recently this framework has been applied to credit management and debt repayment (Gal and McShane 2012; Karlan and Zinman 2012). Paying a mortgage or spending on current consumption could be considered an example of such an intertemporal choice. The decision requires a consideration of the future consequences of current expenditures paired with the potential of triggering a payment delinquency, as opposed to forgoing current expenditure opportunities and paying down a mortgage in a timely way.

Along with reminders, people may also show improvements in behaviors when provided an external monitor, especially for tasks that require self-control. This is related to several constructs in behavioral decision making, including the planning fallacy (people systematically underestimate the time required for tasks) (Buehler et al. 2010) and self-control failures (Fudenberg et al. 2012; Gul and Pesendorfer 2004). Prior work predicts that more self-aware individuals (so called 'sophisticates') may recognize their own limited self-control and reveal demand for constraints or monitoring to enhance their capacity for self-regulation (Karlan et al. 2010). One way to encourage people to overcome self-control problems is to link people's long-term goals to shorter-run behavioral intentions. Establishing specific implementation intentions can improve the likelihood of goal attainment by establishing links between specific situations and the desired behavioral responses (Brandstatter et al. 2001; Gollwitzer 1999; Baumgartner and Pieters 2008). Goal directed reminders have been associated with increased savings (Karlan et al. 2010; Kast et al. 2012), perhaps due to increased attention or heightened salience effects that overcome procrastination (Loibl and Schraff 2010; Ariely and Wertenbroch 2002). External monitoring can prove more effective than self-monitoring in terms of adherence to goals, as it increases perceived accountability on four dimensions: (1) expectations of being observed; (2) identifiability; (3) expectations that performance will be assessed, and (4) expectations of the need to give reasons for actions or inactions (Lerner and Tetlock 1999).

The application of external monitoring to financial behaviors is relatively new, and no known studies have tested the effects of external monitoring for mortgage payment behaviors. Related research links variations in mortgage servicing to borrower delinquency and default. Stegman et al. (2007) find significant variations by mortgage servicer in the ability of a borrower to cure from a spell of delinquency, and Ding (2013) finds servicer variation to be associated with the probability of loan modification for borrowers in default. Securitization has also been associated with increased mortgage default in some studies (Piskorski, Seru & Vig 2010; Agarwal et al. 2011), suggesting differences in servicing practices for securitized loans

relative to those held on the lender's books.

A few studies have evaluated the effectiveness of counseling interventions to assist borrowers in default (Collins and Schmeiser 2013; Ding et al. 2008); however, such interventions are designed to guide borrowers through the loan modification or renegotiation process, rather than to prevent delinquencies through low-touch monitoring. Similarly, while pre-purchase housing counseling programs might also include post-purchase follow-up, existing studies of pre-purchase homebuyer education do not disaggregate the bundle of services provided (Agarwal et al. 2009; 2010; Ding et al. 2008; Hartarska & Gonzalez-Vega 2006; Hirad and Zorn 2002; Mayer & Temkin 2013; Quercia and Spader 2008). Agarwal et al. (2010) note that the improved loan performance observed among counseled borrowers could be due to types of mortgage contracts selected, learned budgeting and money management skills, or active post-purchase counseling that proactively prevents and cures delinquencies. One can envision different policy instruments related to each of the components, with varying associated structures and costs.

In this study, we design and test a post-purchase monitoring intervention that may increase borrower attention to mortgage payments and serve as an external reminder of financial goals, thereby reducing mortgage delinquency. We expect that external monitoring within the first year after purchase may reduce missed mortgage payments, by increasing attention to the new monthly obligation and potentially increasing adherence to financial goals. While monitoring may increase salience of the mortgage payment for all new homebuyers, we expect the effects on mortgage delinquency to be greatest for borrowers who demonstrate a previous history of missed payments on other non-mortgage debt obligations. These individuals may be more susceptible to inter-temporal biases, discounting future consequences in exchange for present consumption. Monitoring may help increase short-term attention to mortgage payments and costs associated with homeownership, thereby increasing timeliness of mortgage payments, decreasing other discretionary consumption, and increasing liquidity available to buffer future financial shocks. Aside from mortgage payments, we thus expect that monitoring may be

associated with other positive financial behaviors, such as higher residual savings and lower levels of revolving and installment debt within the first year after purchase.

3 Study Design

'MyMoneyPath' is a program developed in partnership with the Ohio Housing Finance Agency (OHFA), a state agency that issues tax-favored bonds to fund mortgages for qualified borrowers. From June through December of 2011, *all* first time homebuyers purchasing homes through OHFA's First Time Homebuyer Program were required to complete an online financial assessment prior to home purchase. A subset of 425 consenting participants who subsequently closed on their mortgages were randomly assigned (using a random number generator) to a treatment group (N=295), and were incentivized to complete an online goal setting module and assigned to receive no-cost telephone calls from a financial coach at quarterly intervals after purchase. The telephone monitoring sessions were provided by a select group of counselors employed with a nonprofit financial counseling organization, trained by the study team. Data were collected through the online system, a follow-up survey and from OHFA administrative records.

3.1 Randomized Intervention: 'MyMoneyPath'

MyMoneyPath consists of three parts: (1) an online financial assessment completed immediately prior to home closing; (2) an online financial planning module that allows participants to set self-identified financial goals and implementation intentions; and (3) monitoring at quarterly intervals for the first year after home purchase, including scheduled e-mails and phone calls from an assigned "financial coach". While all study participants received the online financial assessment, two-thirds of the participants were also assigned to receive the online financial planning module and telephone based monitoring after purchase.

The online financial assessment collected self-report information from participants about their financial behaviors in five areas (budgeting, borrowing, savings, home and

retirement), as well as basic demographic and socio-economic information. Questions targeted behaviors, such as having adequate emergency savings, managing personal debt, and investing in longer term financial goals, thought to be associated with the long term well-being of the new homeowner. After completion of the assessment, participants viewed a concise results sheet reporting the status of their financial health in each of the five areas, coded "red" if the area was in need of immediate attention, "yellow" if the area needed some attention, and "green" if the area was not in need of attention. The content of the financial health assessment and coding for the indicators was developed through interviews with industry experts in conjunction with the National Foundation for Credit Counseling (NFCC). Study participants received a $25 gift card incentive at the completion of the online assessment.

After completing the financial assessment, two-thirds of borrowers were assigned to the treatment group. Treatment group participants were incentivized to complete an online, interactive financial goals module (treatment group participants received an addition $25 gift card upon completion of the online module). For each of the five areas above, the online module guided participants through a review of their financial assessment, allowing them to visualize how changes in certain financial variables (e.g., amount saved each month) would affect future time periods, and then were guided to identify specific goals and set implementation intentions for the next year. Finally, all treated borrowers received a letter followed by quarterly emails and telephone calls from an assigned "financial coach" to track progress towards their financial goals. The follow-up phone calls were designed to: (1) focus on financial goals the borrower entered into the online assessment; (2) systematically work with borrowers to refine these goals into actionable steps; and (3) call back to monitor progress towards goals. Treated borrowers completing at least one telephone session were rewarded with a $25 gift card. Treatment in this study is therefore the combination of the offer of the online goals module, combined with the initial letter and quarterly emails and telephone calls from the assigned coach. Emails and telephone calls were made to all treated borrowers at quarterly intervals, although only a subset responded to the calls. Regardless, the scheduled calls and emails at least served as reminders--

even if the calls were unanswered-- and perhaps also enhanced the borrower's perception of being subject to external monitoring. The assessment module was required as part of the mortgage application process and all borrowers took part. All estimated treatment effects are therefore relative to this baseline of borrowers to complete an online assessment only.

3.2 Field Setting and Sample

This program was designed in conjunction with the Ohio Housing Finance Agency, a state housing finance agency. These quasi-public agencies exist in most states and play a significant role in promoting mortgages for lower-income first-time homebuyers (Moulton 2012; Moulton and Quercia 2013). On average, 100,000 homebuyers purchase homes using state mortgage programs annually, providing a potentially scalable opportunity for replication (National Council of State Housing Agencies 2011).

This is an ideal setting for a field study in many ways. Because of the subsidized mortgage loan involved, interest rates and loan terms are held constant across homebuyers at any given point in time. Further, while there are multiple lenders originating loans, all loans are sold to the same loan servicing firm within 60 days of closing, holding constant variation in servicing practices. Importantly, data on borrower loan repayment, credit histories and other information is administratively available. All borrowers are required to take part in activities prior to loan closing, allowing for the implementation of the program evaluated in this study.

3.3 Recruitment, Assignment, and Data Collection

Study enrollment occurred during the seven month period between June 1 and December 31, 2011. During the study period, all prospective homebuyers seeking mortgages through the Ohio Housing Finance Agency's homebuyer program completed the online financial assessment prior to home purchase. Upon completion of the assessment, prospective homebuyers were invited to participate in a study following an IRB approved protocol. Homebuyers who consented to participate received a $25 gift card via e-mail. Figure 1 provides

a flow-diagram of the enrollment process. Of the 932 home- buyers completing the assessment, approximately two-thirds (574, or 62%) consented to participate in the study, about two-thirds of whom were randomly assigned to the treatment group. At the conclusion of the initial data collection period (June 30, 2012), 488 (85%) of the consenting participants purchased a home, for whom 425 had complete credit-report and mortgage-origination data. Of the 425 participating homebuyers, 295 had been randomly assigned to the treatment group, were offered the online goals module and were assigned to receive monitoring from a financial coach at quarterly intervals after home purchase, commencing within two months of their purchase date and culminating in the anniversary month of their purchase. Of the 295 assigned to the treatment group, 107 (36%) completed at least one telephone session. All treatment group participants continued to receive offers to talk with their assigned financial coach by phone, email and letter throughout the study period, potentially serving as an external reminder, regardless of take-up. Over the 12 month program, borrowers received between 9 and 20 contacts through the various modes.

[Insert Figure 1 Here]

4 Data

4.1 Baseline Characteristics

The data for this study was collected from several different sources. Data on participant demographics was provided by the Ohio Housing Finance Agency at the time of home closing. Credit report data was provided for closed loans within 60-90 days after home closing, and on the one year anniversary of the initial credit report date. Data on mortgage loan attributes and performance was provided at the time of closing and monthly thereafter by the Agency (through the servicer). Finally, online financial health assessment data was completed prior to home closing, and again on the one year anniversary of completion (on or before December 31, 2012). Participants were contacted by email and telephone to complete the one-year follow-up financial

health assessment; of the 488 contacted, 225 completed the follow-up assessment, for a response rate of 46 percent. Another incentive of a $25 gift card was provided to all participants completing the follow-up assessment.

Table 1 presents summary statistics of borrower characteristics at the time of loan origination (baseline), comparing treatment and control group participants. Included are those characteristics that have been previously employed in models of mortgage delinquency and default, such as demographic, income, debt and credit report indicators. We report summary statistics for all study borrowers, by treatment and control group, and then for those study participants that have prior defaults, as we expect borrowers with prior defaults to respond more strongly to the treatment intervention. We define borrowers with prior defaults as those who have ever been 60 or more days late on any debt payment on their credit report history at baseline. In the study sample, 43.76% (186) have ever been 60 days late on a debt payment.

[Insert Table 1 Here]

The average age of the primary borrower was 33 years, with a gross monthly household income of $3,770, or about $45,000 per year. About half (46.4%) of primary borrowers were female, with an average household size of 2.4. About one third (35.5%) had completed a college degree, and 14 percent of primary borrowers were either African-American or Hispanic. Most borrowers were highly leveraged, with an average loan to value (LTV) ratio of 98.4 percent. From the credit report data, the median credit score at the time of application for all borrowers was 668. Because credit score is often non-linear, we also break credit score into 5 categorical variables. The average borrower had a non-housing debt to income ratio of about 14% (minimum monthly revolving and installment debt payments as a percent of monthly income, excluding the mortgage payment).[5] From the self-reported financial assessment data, the total amount of money in savings and checking accounts at the time of purchase is about $3,162.

[5] The follow-up credit report data was collected 12 months after the initial credit report date for 96.5 percent of participants; however, because of constraints from the funder, data on the remaining 3.5 percent was collected 10 to 11 months after the initial report date, on March 15, 2013.

Further, 8.5% of respondents reported that they would rather get $40 now than $60 in a month, an indicator of a present-biased discount rate.

To check the effectiveness of random assignment, we test for statistical differences on baseline characteristics for treatment and control group borrowers (using t-tests). For the most part, random assignment worked as intended, with few statistically significant differences. While the average credit score is not statistically different for treatment and control group borrowers, the distribution across the credit score categories is not always equal. Specifically, a statistically higher proportion of borrowers from the treatment group have marginal credit scores of 650-680 ($p<.05$). Among prior defaulters, a statistically higher proportion of control group borrowers have higher credit scores in the 680-720 range ($p<.05$). Among prior defaulters, those assigned to the treatment group are also more likely to have a college degree ($p<.05$). Other differences are not statistically significant. Controls for baseline characteristics are included in the treatment effects models to account for any measureable differences that might affect the outcome.

4.2 Estimating Impacts

The primary outcome of interest in this analysis is mortgage delinquency, coded 1 if the borrower was ever 60 or more days late on their mortgage payment within the first 15 months after home purchase and 0 otherwise. Because of the rolling pre-purchase enrollment of participants into the study (June-December, 2011), and the delay between the study enrollment and home closing (typically, 30 days after enrollment), the 15 month anniversary for study participants occurred between September, 2012 and June, 2013. While we observe loan performance through May 30, 2013, for the binary indicator of mortgage delinquency we limit the observation period for loan performance to 15 months for all borrowers. We also estimate a hazard model of loan performance and include observations through May 31, 2013 for all borrowers (with duration ranging from 15 to 25 months).

While the primary outcome of interest is mortgage delinquency, a few other measures of financial health are explored. These indicators may help explain the mechanisms by which financial monitoring reduces default risk. From the credit report data at follow-up, we measure changes in installment and revolving debt in two ways: (1) continuously, as the change in the outstanding balance from baseline on the post assessment; and (2) discretely, with an indicator coded "1" if the revolving or installment balance increased by $2,000 or more. From the follow-up financial assessment, we measure changes in self-reported savings as well as a discrete indicator of whether or not they report saving any money. We also include an indicator of whether or not they have automated their mortgage payment (e.g., automatically deducted from their checking or savings account each month). Automation of payments is a behavioral strategy to overcome inattention. Monitoring may increase the likelihood that inattentive borrowers automate their payments to overcome their tendencies towards procrastination. Finally, we include an indicator for whether or not the borrowers self-report having a written household budget. By increasing attention to finances, monitoring may increase general financial planning behaviors, such as the use of a household budget.

Because of the randomized study design, comparisons of distributions (and means) on the primary outcomes between treatment and control group participants is the primary specification. However, additional covariates commonly associated with the outcomes (described above) are also included to ensure consistency in our results. The reduced form model produces average treatment effects, conditional on measured baseline characteristics as shown in the following:

$$Y_i = \alpha 0_i + \beta 1 Treatment_i + \boldsymbol{\lambda X_i} + \varepsilon_i$$

where $\beta 1$ is the average effect of being assigned to the treatment group for borrower i, α is the constant coefficient for borrower i, and λ is a vector of coefficients for borrower level controls. ε_i is a Huber–White corrected standard error. Dichotomous outcomes, such as loan delinquency, are estimated using a probit model with marginal effects coefficients presented. Continuous outcomes are estimated using an OLS model including a control for baseline levels, in effect

providing an average change in the outcome associated with treatment assignment. Because we expect the effects of treatment to be stronger for borrowers with a history of missed non-mortgage debt payments, we also restrict the sample to borrowers with prior non-mortgage defaults.

Controls include credit score at loan application (the median score of up to 3 collected) which is presented by 5 categorical variables to deal with the non-linear form of credit score measures. The borrower's income (measured at loan application) debt-to-income ratio, reported savings and number of days since the borrower took out the mortgage (a crude measure of relative exposure to delinquency risk). Other characteristics include gender, age, college education, minority race and household size. Also included is a measure of time preferences commonly used in surveys, which asks for a choice between $40 today versus $60 in one month.

Average treatment effects for all borrowers assigned to treatment, regardless of whether the study participant cooperated with the treatment, is useful as an estimate of overall effects for a pool of loans without the bias introduced from borrowers self-selecting into a program.

6 Results

We first explore outcomes using simple comparison of means and chi-2 tests, without controlling for other model covariates. Table 2 shows key dependent variables for all borrowers by treatment and control group, and then for those with prior defaults on non-mortgage debt, by treatment and control group. Our primary dependent variable is an indicator of mortgage delinquency, coded "1" if the borrower was ever 60 days late on a mortgage payment within the first 15 months after home purchase (as of May 30, 2013). For the total sample, 12 percent of borrowers had ever experienced delinquency, with slightly lower rates for treatment group participants (11.2%) than for control group borrowers (13.8%). However, when the sample is limited to borrowers with a history of defaults, the differences between treatment and control group participants are much larger, with 12.9 percent of treatment group participants experiencing mortgage delinquency, compared with 24.1 percent of control group participants.

[Insert Table 2 Here]

Figure 2 shows this same pattern using a survivor estimate from a Kaplan-Meier failure model. Here the differences for treatment and controls are not noticeable for the borrower with no past history of default, but starkly different among prior non-mortgage debt defaulters. The effects of the financial monitoring seem to be concentrated among the borrowers who have a history of payment problems, consistent with an attention and implementations mechanism.

[Insert Figure 2 Here]

In addition to mortgage delinquency, we explore other financial outcomes that may be affected by monitoring and/or serve as mechanisms by which monitoring reduces delinquency. Table 2 includes changes in revolving and installment debt balances from the follow-up credit report data. Overall, treatment group participants have slightly lower installment debt balances and significantly lower revolving (credit card) debt balances post-purchase. More than one-third (36.2%) of treatment group participants increased their credit card debt by $2,000 or more post-purchase compared with only one fourth of treatment group participants. This suggests that monitoring may reduce discretionary (credit card) spending after purchase. Treatment group borrowers are also significantly more likely to self-report saving money post purchase (70.8%) compared to control group borrowers (53.6%), with slightly higher savings balances (although all borrowers self-report lower savings amounts, on average, one year post-purchase relative the amount in savings prior to purchase). Perhaps most interestingly, treatment group borrowers are more than twice as likely to report automating their mortgage payments- nearly 30 percent, compared with only 13 percent of control group borrowers. For prior defaulters, treatment group participants are nearly four times as likely to have automated their mortgage payments.

Next, we estimate a probit model to predict mortgage delinquency. Table 3 includes the average treatment effect estimates for delinquency using the regression model described above, displaying marginal effects from the mean. Column 1 shows overall estimates of lower

delinquencies among those borrowers assigned to treatment, although not at standard levels of statistical significance. Restricting the sample to borrowers with prior defaults shows an estimated 48.3% reduction in delinquency for the treatment group in Column 2, at the 5% statistical significance level. Adding controls in Columns 3 and 4 provides larger estimates. The main overall effect is negative and larger than without controls, but still not significant. Overall delinquency among treated borrowers with past default histories continues to show a very large reduction (48.39%). Credit score and household size are also significantly associated with delinquency, where borrowers with lower credit scores and larger household sizes are more likely to be ever delinquent. For the model including all borrowers (Column 3), an increase in income and an increase in savings is also associated with reduced probability of delinquency, as would be expected.

[Insert Table 3 Here]

In addition to mortgage delinquency, we model changes in other indicators of financial health that may be influenced by financial monitoring. Table 4 provides OLS estimates of changes installment debt, and revolving debt, and savings account balances for all borrowers (Panel 1) and only prior default borrowers (Panel 2), following a log-log specification. In addition to the dependent variable (logged) at baseline, each model also includes model covariates from the delinquency model specification (coefficients not shown). Installment and revolving debt balances are taken from credit report data at origination and 12 months after origination (data available for most all borrowers, N=424), whereas savings amounts are taken from the self-reported financial assessment before e and 12 months after origination (data available only for those responding to the follow-up survey, N=225). Financial monitoring is associated with a significant increase in self-reported savings accounts balances ($p<10$); however, changes in installment and revolving debt balances due not reach statistical significance. This may be due to the noisy measurement of account balances as a continuous variable, particularly for revolving accounts as measured at specific moment in time.

[Insert Table 4 Here]

Table 5 shows marginal effects of probit regressions results for binary indicators. First are measures for revolving (column 1) and installment (column 2) account balances that have increased by $2,000 or more. For all borrowers, those in the treatment group are about 29% less likely to have an increase in revolving debt of $2,000 or more, and those in the treatment group who have previously defaulted on other debt are 42% less likely to have increased their revolving debt by $2,000 or more. Self-reported measures are also shown in Table 5 in columns 3, 4 and 5. For all borrowers, those in the treatment group are 43% more likely to report saving money at follow-up, and are 76% more likely to report automating their mortgage payments. For previous defaulters, there is no self-reported difference in saving money among treatment group participants; however, treatment group participants are 130% more likely to report automating their mortgage payments. There are no significant differences between treatment and control group participants on reported use of a household budget, suggesting that this type of financial planning is not driving the relationship between financial monitoring and reduced mortgage delinquency.

7 Discussion & Limitations

These results provide promising evidence that simple attention-focusing interventions can have significant impact on borrower repayment patterns. This intervention, targeted to first-time home buyers, is associated with reduced mortgage delinquency for borrowers with a history of missed payments. To the extent that low-cost interventions can be integrated into credit markets, default risks may be reduced to levels comparable to higher credit quality borrowers. It appears the act of self-assessing finances, with the expectation of external monitoring, influences repayment behaviors significantly during the first year of ownership for lower-income first-time buyers. Average treatment effects for borrowers with a history of missing non-mortgage payments show delinquency rates in in the first year cut in half due to this relatively modest intervention. It is not surprising that the impact of monitoring is limited to those with prior histories of defaults on non-mortgage defaults; we would not expect borrowers who have already established a habit of attention to non-mortgage debt payments to be

significantly affected by interventions designed to increase attention to payments.

Identifying the mechanisms by which financial assessment and monitoring leads to reduced mortgage delinquency is important for policy replication. While we cannot isolate specific components of the intervention that might help unpack the mechanisms (all borrowers assigned to treatment receive the same bundle of interventions), exploring how other financial behaviors were affected by the treatment provides insights. We find some evidence that treated borrowers have lower reported revolving debt; they are less likely to incur a significant amount ($2,000 or more) of additional credit card debt within the first year after purchase. This is potentially important, as rising credit card balances could crowd out mortgage payments after home purchase. Previous research has found that revolving debt balances generally increase after home purchase, due to desire for consumption related to a new home and new offers of credit extended because of the transition into homeownership. To the extent that financial assessment and monitoring might help restrain this increase, borrowers may be less constrained by non-mortgage debt have more liquidity to make their mortgage payments.

Further, we find some evidence that treated borrowers report larger savings amounts one year after purchase than control group borrowers. Overall, the amount of self-reported savings declines within the first year after purchase, in line with predicted spending pressures. However, treated borrowers are more likely to report saving money. By preserving a savings buffer, these individuals may be more able to weather financial shocks in the future and reduce their risk of mortgage default. Interestingly, those assigned to the treatment group do not report increased use of budgeting. This suggests that the reduction in mortgage delinquency resulting from the treatment may be less about financial planning (e.g., the use of a monthly budget), and more about reducing the inattention through reminders and perceived external accountability. Along these lines, one of the strongest findings is that those assigned to the treatment group significantly more likely to automate their mortgage payments- particularly among those who had a history of missed debt payments in the past. This suggests that by increasing attention, borrowers assigned to the treatment group were more likely to engage in behavioral strategies

(e.g. automation) to overcome their potential inter-temporal bias to procrastinate.

While the results of this study are promising, there are limitations. First, the study sample employed here is drawn from a select group of income qualified homebuyers participating in a publicly subsidized homeownership program. It is difficult to predict whether or not the results would hold up in a less structured program. Nonetheless, this program relies on private lenders to originate mortgages that conform with federal guidelines (all are federally guaranteed), privately serviced and sold to private investors in the secondary market. Thus, many of the characteristics of private market originations are still in place, increasing the potential for replication.

Second, the treatment tested here is really a bundle of interventions designed to increase attention to finances. Recall that all borrowers completed an online assessment; treated borrowers were randomly assigned to receive an online financial planning module and were assigned to a financial coach. An initial letter was sent to treatment group borrowers introducing their financial coach, and the coach made reminder emails and phone-calls to the borrower at quarterly intervals after purchase, regardless of whether or not the borrower responded to the initial letter and took up the offer for financial coaching. Because being assigned to a financial coach and receiving quarterly contact is in and of itself an intervention (increasing the sense of being monitored externally, and regular reminders), it is not possible to isolate the additional impact of the "take-up" of financial coaching in this study. Borrowers who self-select to take-up coaching are different than those who do not, and we do not have an exogenous variable by which to identify this selection process. Treatment on treated (TOT) models assume that those who do not take up the treatment receive no intervention, which is not true in this case. Future research can test the impact of regular reminders, with and without an offer of coaching, to try to disaggregate these effects. In addition, other mechanisms such as text messages or automated phone calls could potentially be equally effective as reminders. However, if it is the sense of being monitored, contact from a 'real' person may be necessary to influence behavior (even if calls are not answered).

8 Policy Implications & Conclusions

This analysis suggests that increasing attention to mortgage payments, including the potential for (or threat of) external monitoring appears to have economically significant effects on borrower behavior. The lack of use of such interventions in credit markets suggests a potential arbitrage opportunity. Mortgage servicers or investors could implement a payment monitoring program "en masse" among their riskier borrower segments, and potentially realize significant gains in reduced rates of delinquency, as well as reduced servicing and legal costs. In fact, the higher cost associated with servicing riskier borrower segments has been one of the arguments by industry in favor of strict QRM guidelines. To the extent that monitoring- perhaps even automated monitoring- is associated with financial gain (rather than cost), the private sector may find a cost-effective strategy to lend (sustainably) to otherwise riskier borrowers. On the other hand, incentives to capture such gains are so diffused in the lender market that it is not clear which institutions could capitalize on this potential innovation. Mortgage markets price and sell loans based on observable characteristics standardized in automated data systems. Lenders tend to sell loans rapidly to investors. A program like MyMoneyPath may ultimately require a role for the public sector to pilot or mandate interventions. Perhaps, taxpayers at the least could benefit from lowered default risks on federally-guaranteed mortgages.

Further, the federal government currently invests about $40 million per year in housing counseling services designed to improve the decision-making of consumers, most of whom are homebuyers purchasing homes or homeowners in default on their mortgages. Quantifying the effectiveness of this investment is difficult, as borrowers seeking counseling are fundamentally different than those not seeking counseling. Further, pricing the cost-effectiveness of the bundle of services included in housing counseling is even more difficult; pre-purchase counseling and education can be very costly, both to providers and consumers. In partnership with industry (mortgage servicers) and government funders/regulators (HUD), housing counseling organizations could adopt cost-effective interventions based on the financial assessment and

monitoring strategies tested here. Over time, these interventions could be fine-tuned based on the combination of automated reminders, personal phone calls, and/or financial coaching that is found to be most effective.

Finally, these results also suggest that rigid credit underwriting regulations, as have been introduced since the start of the 2008 housing crisis, may undervalue alternative avenues for expanding credit access paired with well-designed behavioral mechanisms. Attention-focusing mechanisms appear to have the potential to enhance credit markets through the use of technology and the application of recent insights from the behavioral economics and consumer decision making literature. Further studies might narrow this analysis to simpler assessment and goals modules, combined with automated email, text message or voice mail reminders customized to individual borrower goals.

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8 Tables and Figures

Table 1: Descriptive Statistics, Baseline Characteristics

	(1) All Borrowers			(2) Prior Defaulters	
	Control mean/sd	Treatment mean/sd	Total mean/sd	Control mean/sd	Treatment mean/sd
Credit Score	674.13	665.95	668.44	639.43	640.35
	(53.67)	(48.16)	(50.65)	(36.52)	(35.41)
CR < 620	0.162	0.132	0.141	0.278	0.197
	(0.369)	(0.339)	(0.349)	(0.452)	(0.399)
CR 620-650	0.215	0.275	0.256	0.389	0.409
	(0.413)	(0.447)	(0.437)	(0.492)	(0.494)
CR 650-680	0.185	0.275**	0.247	0.204	0.333*
	(0.389)	(0.447)	(0.432)	(0.407)	(0.473)
CR 680-720	0.223	0.159	0.179	0.130	0.0379**
	(0.418)	(0.367)	(0.384)	(0.339)	(0.192)
CR >720	.215	.159	.176	0	.023
	(.036)	(.021)	(.019)	0	(.013)
Monthly income(000)	38.56	37.32	37.70	37.09	37.89
	(12.08)	(12.31)	(12.24)	(11.85)	(12.20)
Debt To Income	0.145	0.144	0.144	0.133	0.155
	(0.142)	(0.245)	(0.219)	(0.0927)	(0.351)
LTV	0.979	0.986^	0.984	0.983	0.988
	(0.0297)	(0.0446)	(0.0407)	(0.0438)	(0.0441)
Female	0.446	0.471	0.464	0.481	0.515
	(0.499)	(0.500)	(0.499)	(0.504)	(0.502)
Age	33.31	32.25	32.58	36.65	34.64
	(10.64)	(10.06)	(10.24)	(10.56)	(9.465)
College Degree	0.362	0.353	0.355	0.111	0.280**
	(0.482)	(0.479)	(0.479)	(0.317)	(0.451)
Minority	0.115	0.153	0.141	0.185	0.212
	(0.321)	(0.360)	(0.349)	(0.392)	(0.410)
HH Size	2.400	2.431	2.421	2.778	2.629
	(1.309)	(1.286)	(1.292)	(1.396)	(1.350)
Days Since Purchase	597.68	606.43	603.75	600.48	606.20
	(65.49)	(62.15)	(63.24)	(74.65)	(59.16)
Total Savings	2987.1	3239.1	3162.0	2786	2745.3
	(3295.3)	(3340.0)	(3324.5)	(2922.0)	(2696.5)
Future Discounting	0.0615	0.0949	0.0847	0.0185	0.0530
	(0.241)	(0.294)	(0.279)	(0.136)	(0.225)
Observations	425			186	

T-tests for differences between treatment and control group participants
* p < .1, ** p < .05, *** p < .01

Table 2: Dependent Variables, by Treatment & Control Groups

	(1) All Borrowers N=425			(2) Prior Defaulters N=186	
	Control mean/sd	Treatment mean/sd	Total mean/sd	Control mean/sd	Treatment mean/sd
Loan & Credit Outcomes					
Delinquent, May 2013	0.138	0.112	0.120	0.241	0.129*
	(0.347)	(0.316)	(0.325)	(0.432)	(0.336)
Installment Debt-post	29779.7	28000.8	28545.0	23963.8	31113.4
	(30542.6)	(26426.3)	(27725.9)	(28630.4)	(29050.8)
Δ Installment Debt	4849.9	3612.3	3988.9	5049.0	6299.9
	(12238.6)	(14819.7)	(14081.8)	(14452.1)	(12628.2)
Installment Debt up 2k+	0.403	0.414	0.410	0.370	0.515*
	(0.492)	(0.493)	(0.492)	(0.487)	(0.502)
Revolving Debt-post	5711.7	4238.9***	4689.4	4534.2	3604.2
	(5914.2)	(4660.9)	(5115.3)	(4557.4)	(3655.5)
Δ Revolving Debt	1264.3	811.8	949.5	1503.3	934.3
	(3986.7)	(3173.3)	(3442.7)	(3454.5)	(2724.9)
Revolving Debt up 2k+	0.362	0.251**	0.285	0.370	0.258
	(0.482)	(0.434)	(0.452)	(0.487)	(0.439)
Observations	130	295	425	54	132
Self-Reported Outcomes		*N=223*		*N=88*	
Total Savings-post	1175	1625.8	1487.9	1171.4	1079.3
	(2615.8)	(3902.1)	(3561.3)	(3501.5)	(2438.6)
Δ Total Savings	-1080.8	-429.3	-632.0	-651.9	-677.6
	(3861.9)	(3773.1)	(3804.3)	(4268.2)	(3452.8)
Saving Money-post	0.536	0.708**	0.655	0.552	0.593
	(0.502)	(0.456)	(0.477)	(0.506)	(0.495)
Auto Mortgage Payment	0.130	0.279**	0.233	0.0690	0.254**
	(0.339)	(0.450)	(0.424)	(0.258)	(0.439)
Use Budget-post	0.700	0.723	0.716	0.759	0.712
	(0.462)	(0.449)	(0.452)	(0.435)	(0.457)
Observations	69	154	223	29	59

T-tests for differences between treatment and control group participants
* p < .1, ** p < .05, *** p < .01

Table 3: Probit Regression Model, Ever 60 Days Delinquent (first 15 months)

	(1) All Borrowers b/se	(2) Prior Defaulters b/se	(3) All Borrowers b/se	(4) Prior Defaulters b/se
Treatment	-0.2087	-0.4830**	-0.2596	-0.4839*
	(0.173)	(0.240)	(0.198)	(0.260)
CR lt 620			4.8163***	4.1487***
			(0.278)	(0.427)
CR 620-650			4.4776***	3.8583***
			(0.240)	(0.385)
CR 650-680			4.1582***	3.6195***
			(0.256)	(0.417)
CR 680-720			3.7832***	3.3901***
			(0.295)	(0.515)
Monthly income(000)			-0.0194**	-0.0249**
			(0.008)	(0.012)
Debt To Income			-0.0861	-0.0014
			(0.229)	(0.250)
LTV			-1.8353	-0.1954
			(2.028)	(2.277)
Female			0.1231	0.1061
			(0.193)	(0.257)
Age			-0.0030	0.0019
			(0.008)	(0.011)
College Degree			-0.1690	0.2760
			(0.247)	(0.336)
Minority			0.1933	0.2916
			(0.251)	(0.306)
HH Size			0.1203*	0.1349
			(0.065)	(0.086)
Days Since Purchase			0.0006	0.0019
			(0.001)	(0.002)
Total Savings			-0.0001*	-0.0000
			(0.000)	(0.000)
Future Discounting			0.5025	
			(0.322)	
Constant	-1.1228***	-0.7647***	-3.2663	-5.0071*
	(0.139)	(0.190)	(2.218)	(2.589)
N	425	186	425	186
Psuedo R2	0.005	0.027	0.192	0.125

Marginal effects Probit
* $p < .1$, ** $p < .05$, *** $p < .01$

Table 4: OLS, Treatment on Account Balances at One Year Follow-Up

	(1) Installment Debt (Ln) b/se	(2) Revolving Debt (Ln) b/se	(3) Savings (Ln) b/se
Panel 1: All Borrowers			
Treatment	0.1871	-0.1574	0.5383*
	(0.245)	(0.177)	(0.296)
N	424	424	225
r2	0.331	0.467	0.248
Panel 2: Prior Defaulters			
Treatment	0.2871	-0.0912	0.9137*
	(0.379)	(0.192)	(0.541)
N	186	186	88
r2	0.341	0.539	0.309

OLS Log-Log model for account balance at baseline, predicting account balance at follow-up. Controls (not shown) include baseline credit score categories, income, gender, debt to income, LTV, age, education, race, time in home, savings, time preferences.
* $p < .1$, ** $p < .05$, *** $p < .01$

Table 5: Probit, Treatment on Financial Behaviors at One Year Follow-Up

	(1) Revolving Debt up 2k+ b/se	(2) Installment Debt up 2k+ b/se	(3) Saving Money-post b/se	(4) Automatic Mortgage Payment b/se	(5) Use Budget-post b/se
Panel 1: All Borrowers					
Treatment	-0.2876**	0.0221	0.4336**	0.7639***	0.0830
	(0.143)	(0.139)	(0.201)	(0.234)	(0.207)
N	425	424	223	223	225
Psuedo R2	0.042	0.053	0.068	0.132	0.103
Panel 2: Prior Defaulters					
Treatment	-0.4226*	0.2711	0.0368	1.3003**	0.2301
	(0.238)	(0.218)	(0.338)	(0.510)	(0.393)
N	186	186	85	81	88
Psuedo R2	0.113	0.077	0.059	0.235	0.297

Marginal effects Probit. Controls (not shown) include baseline credit score categories, income, gender, debt to income, LTV, age, education, race, time in home, savings, time preferences.
* $p < .1$, ** $p < .05$, *** $p < .01$

Figure 1: Study Design

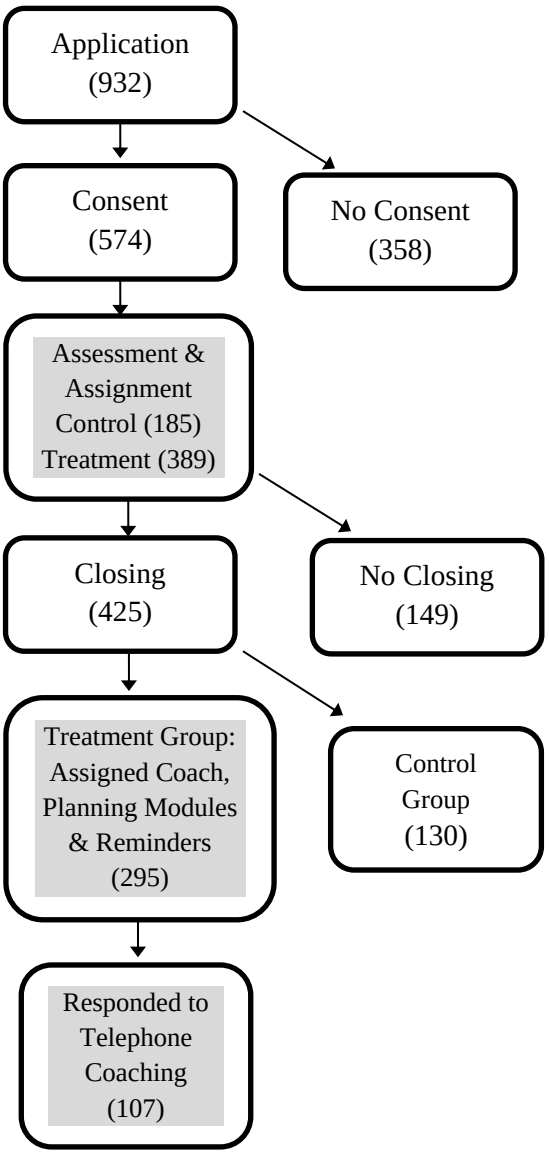

Figure 2: Mortgage Delinquency Rates by Treatment & Prior Default History