How Important is Household Heterogeneity for Monetary Policy? Evidence from Mortgage Refinancing*

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Abstract

This paper examines how heterogeneity among households influences the refinancing channel of monetary policy. We demonstrate that the correlation between two key factors—the probability of mortgage refinancing and the marginal propensity to consume—determines the strength of this transmission mechanism. Using novel survey data, we find a small but positive correlation, suggesting that the refinancing channel is more effective than previously recognized. However, this correlation conceals two opposing forces: financial sophistication, or the lack thereof, generates a negative relationship, while liquidity preferences drive a stronger, positive relationship. Furthermore, the aggregate correlation masks heterogeneity across the types of mortgage refinancing. Borrowers who take out cash-out refinances exhibit large immediate consumption responses, whereas those who refinance to take advantage of lower interest rates display more muted consumption responses. These mechanisms shape both time-dependent and state-dependent refinancing inaction, ultimately influencing the magnitude and speed of monetary policy pass-through.

Keywords: Monetary Policy Transmission, Mortgage Refinancing, Consumer Spending

JEL classifications: E21, E52, G51, G53

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1 Introduction

Mortgage rates are one of the main channels, if not the primary direct channel, through which monetary policy influences household consumption (Campbell, 2023). Central banks seeking to stimulate demand have employed both conventional and unconventional tools to lower mortgage rates, encouraging households to refinance, extract equity, and increase current consumption (Bhutta and Keys, 2016; Di Maggio et al., 2020). However, since households differ in their propensity to refinance and their marginal propensity to consume, the distribution of these characteristics is a key driver of the refinancing channel of monetary policy (Di Maggio et al., 2017; Beraja et al., 2019).

In this paper, we argue that the correlation between these two critical parameters—the Likelihood of Refinancing a Mortgage (LRM) and the Marginal Propensity to Consume (MPC)—plays a decisive role in determining both the strength and speed of monetary policy's impact on aggregate demand. If, on the one hand, the correlation is positive, lower policy will translate into lower mortgage rates for households with high MPCs, resulting in large and swift effects on aggregate demand. On the other hand, if the correlation is negative, the households who refinance would predominately be those with low MPCs, resulting in a slow and subdued effect. Theoretically, the correlation is ambiguous. On the one hand, impatient households with high marginal utility of liquidity could have both high refinancing rates and high MPCs, leading to a positive correlation. On the other hand, financially sophisticated households that refinance more might have low MPCs, resulting in a negative correlation. Consequently, it remains an empirical question.

We address this empirical question by surveying a representative sample of US homeowners and combining the survey evidence with estimates using microdata from the near universe of mortgage refinances. Our main result is a small but positive and significant correlation between refinancing rates and MPCs. We find evidence that the correlation is driven by two opposing economic mechanisms: financially sophisticated consumers have high refi likelihoods and low MPCs (generating a negative correlation), while impatient households with high marginal values of liquidity have high refi likelihoods and high MPCs (generating a positive correlation). The former results are consistent with the findings by Jørring (2024) on the relationship between financial sophistication and consumer spending, while the latter findings are consistent with the idea proposed in the theoretical work by Maxted et al. (2025) that present bias affects both mortgage refinancing and MPCs. Overall, our results offer a silver lining for the refinancing channel of monetary policy. Relative to models that impose no correlation, we find that lower policy rates (or quantitative easing targeted at bringing down mortgage rates) translate into larger and faster responses in aggregate demand.

We begin the paper by collecting novel survey data from a geographically representative sample of 1,027 U.S. homeowners via the Prolific platform. The survey elicits detailed information on financial behavior, mortgage history, and attitudes toward consumption. Following prior work, we measure MPCs using hypothetical windfall scenarios. Participants are asked how much they would adjust their spending, saving, and debt repayment in response to an unexpected one-time gain of $5,000 and a permanent decrease in mortgage payments of $250 per month. Their MPC is then defined as the fraction of additional income they report they would spend. To measure refinancing behavior, we ask homeowners whether they have refinanced their mortgage in the past 20 years, how frequently they have done so, and whether they engaged in cash-out refinancing. Additionally, we measure respondents' familiarity with refinancing and their financial literacy using the "Big Three" financial literacy questions from Lusardi and Mitchell (2023). We collect further financial and demographic characteristics, including credit scores, mortgage size, income, and a measure of present bias based on an impatience index from Aggarwal et al. (2022). To extend our analysis beyond the survey sample, we incorporate large-scale HMDA and GSE mortgage data, which allows us to observe actual refinancing behavior at a national level. By linking survey-based predictors to this dataset, we estimate homeowners' refinancing probabilities based on observable financial characteristics. Conversely, we use survey data to predict borrowers' MPCs based on the same financial characteristics observed in the GSE data. This bidirectional linking of datasets allows us to assess whether individuals with high MPCs are more or less likely to refinance in practice.

Our survey results reveal a small but positive unconditional correlation between MPCs and refinancing propensity. Homeowners who have refinanced in the past tend to have higher MPCs than those who have not. We find that the average MPC from a $250 decrease in mortgage payments is 0.101 for individuals who have never refinanced, compared to 0.139 for those who have refinanced at least once. This result suggests that the refinancing channel of monetary policy is more effective than it would be if the two variables were uncorrelated. However, we also find that this relationship is shaped by two opposing forces. First, among individuals familiar with refinancing, there is a strong positive relationship between MPCs and refinancing propensity, indicating that those who refinance frequently also have a higher marginal utility of liquidity. Second, there is a negative correlation between MPCs and refinancing awareness, implying that individuals with high MPCs are less likely to be aware of refinancing opportunities. These counteracting effects suggest that financial literacy and awareness play a central role in determining the strength of the refinancing channel.

To better understand these patterns, we analyze how financial and demographic characteristics shape the relationship between MPCs and refinancing. We find that financially

literate individuals are more likely to refinance but have lower MPCs, consistent with the hypothesis that sophisticated individuals optimize their mortgage decisions but are less liquidity constrained. Impatient individuals, in contrast, exhibit both higher MPCs and greater refinancing likelihood, indicating that impatience may drive both consumption responses and willingness to engage in mortgage transactions. Higher credit scores and income levels are associated with lower MPCs and higher refinancing rates, while homeowners with larger mortgages exhibit higher MPCs, even after controlling for income. These findings highlight the liquidity constraints imposed by debt burdens and suggest that mortgage relief policies may disproportionately impact higher-MPC households.

Moreover, the aggregate correlation between the likelihood of refinancing and the marginal propensity to consume masks significant heterogeneity across different types of refinancing. Borrowers who engage in cash-out refinancing exhibit large immediate consumption responses, as they directly convert home equity into liquid funds, often to finance durable goods or other major expenses. In contrast, those who refinance to take advantage of lower interest rates display a more muted immediate consumption response, both as a percentage change and in dollar terms, as the increase in disposable income is smaller on a per-period basis. However, this reduction in mortgage payments is more persistent, generating a longer-lasting boost to household cash flow that accumulates over time. This distinction is crucial for understanding both the speed and the strength of monetary policy pass-through. The speed of the transmission is amplified by the large and immediate impact of cash-out refinances on consumption, while the strength of transmission is shaped by the refinancing incentives of rate-driven borrowers, whose cumulative gains unfold gradually but persist for the duration of the loan. Recognizing these distinct channels of monetary policy transmission helps refine our understanding of how interest rate changes propagate through the household sector.

We extend our analysis by linking survey findings to GSE mortgage performance data. Using a predictive model trained on survey responses, we estimate MPCs for borrowers in the GSE dataset based on observable financial characteristics. This approach allows us to analyze real-world refinancing behavior for borrowers with high versus low predicted MPCs. We find that conditional on being aware of refinancing opportunities, high-MPC borrowers are more responsive to monetary incentives. However, high-MPC borrowers also exhibit greater inaction when refinancing would be optimal, suggesting that behavioral frictions or lack of awareness prevent them from taking advantage of lower rates. Refinancing probabilities are lower for high-MPC borrowers at small rate incentives but increase sharply when incentives become large. This pattern suggests that high-MPC borrowers require stronger financial incentives to overcome frictions, consistent with the idea that financial sophistication shapes

responsiveness to refinancing opportunities.

Our findings have important implications for monetary policy. Since high-MPC borrowers are more responsive to mortgage rate reductions when they do refinance, policies aimed at increasing awareness and financial literacy could significantly amplify the effectiveness of the refinancing channel. Targeted outreach programs that help high-MPC households understand the benefits of refinancing could accelerate monetary policy transmission and enhance aggregate demand responses. Additionally, our results highlight the need for structural models of mortgage refinancing that incorporate behavioral heterogeneity. The dual effects of financial sophistication and liquidity constraints suggest that standard macroeconomic models may underestimate the role of frictions in the mortgage market. In future work, we will explore structural modeling of refinancing behavior, allowing us to simulate counterfactual policy scenarios and quantify the aggregate impact of different monetary policy paths.

Related literature

Our paper's main contribution is to study how heterogeneity across households impacts the refinancing channel of monetary policy. We build on the growing empirical literature studying mortgage refinancing and how it relates to the transmission of monetary policy. This literature has documented how the Fed can influence mortgage rates either conventionally by lowering its target rate, which lowers rates on 10-year Treasury rates (Nakamura and Steinsson, 2018) and in turn lowers 30-year fixed-rate mortgage rates (Gertler and Karadi, 2015; Gilchrist et al., 2015), or unconventionally through quantitative easing by buying mortgage-backed securities (MBS) (Gagnon et al., 2011; Krishnamurthy and Vissing-Jorgensen, 2011). Lower mortgage rates, in turn, encourage households to refinance to extract equity (Bhutta and Keys, 2016) and increase car purchases (Di Maggio et al., 2017, 2020). Critically, several papers find significant variation in the pass-through depending on both cross-sectional variation in home equity (Beraja et al., 2019) and the time-series path of interest rates (Berger et al., 2021; Eichenbaum et al., 2022). We contribute to this literature by providing empirical evidence on the correlation between two key determinants of the refinancing channel: mortgage refinancing and consumer spending.[1]

The literature on mortgage refinancing has documented significant variations across borrowers, emphasizing how many are often unsophisticated. Specifically, several studies have shown that borrowers fail to refinance optimally (Agarwal et al., 2016; Keys et al., 2016; Andersen et al., 2020). This lack of sophistication among mortgage borrowers extends to broker commissions (Woodward and Hall, 2012), mortgage points (Agarwal et al., 2017),

[1]See Amromin et al. (2020) for a recent review of the research on the effects of the refinancing channel of monetary policy.

non-salient fees (Liu, 2019), and interest-rate resets (Jørring, 2024).[2] Similarly to the literature on mortgage refinancing, the literature on consumer spending—going back to Friedman (1957) and Hall (1978)—documents vast differences in MPCs across households. A key result in the literature is that households with low levels of liquid savings (or equivalently, with high marginal utility of liquid wealth) have high MPCs, and this finding has been instrumental in the influential work analyzing how heterogeneity in MPCs affects monetary policy (Kaplan et al., 2018; Auclert, 2019).[3] We contribute jointly to the two literatures on the determinants of mortgage refinancing and MPCs, respectively, by providing empirical evidence on the joint distribution of mortgage refinancing and MPCs.

Our paper is most closely related to the empirical work on the relationship between financial sophistication, MPCs, and mortgage refinancing by Jørring (2024), and the theoretical work on the effect of present bias on mortgage refinancing and MPCs by Maxted et al. (2025). Jørring (2024) studies a sample of HELOC borrowers and finds that unsophisticated consumers have higher MPCs out of anticipated changes in mortgage payments and also show a failure to refinance their mortgage optimally, while Maxted et al. (2025) calibrate a theoretical model where present bias increases individuals MPCs leading them to cash-out refinance (although this present bias can also induce procrastination in refinancing). Our main innovation relative to these studies is to document empirically how the two proposed mechanisms—financial sophistication and present bias—lead to opposing effects on the correlation between mortgage refinancing and MPCs. Consistent with Jørring (2024), we find that when sorting on financial sophistication (e.g., when sorting on credit score or financial literacy), we find a negative correlation, and consistent with Maxted et al. (2025), we find that when sorting on measures of present bias (e.g., using the impatience index from Aggarwal et al. 2022), we find a positive correlation. While the two previous studies have posited a single economic mechanism generating either a strong negative or positive correlation, respectively, in our paper, we show that both effects are present in the data.

[2]More broadly, our paper connects to a larger literature on financial literacy and the effect on financial decisions in general (Bernheim, 1995, 1998; Agarwal et al., 2009; Lusardi and Mitchell, 2011; Gathergood, 2012; Lusardi and Mitchell, 2014; Campbell, 2016).

[3]The empirical literature estimating heterogeneity in MPCs includes studies of Social Security tax withholdings (Parker, 1999), income taxes (Souleles, 1999; Johnson et al., 2006; Agarwal et al., 2007; Parker et al., 2013; Parker, 2017; Baugh et al., 2021), paycheck receipts (Stephens, 2006; Olafsson and Pagel, 2018), minimum wage increases (Aaronson et al., 2012), changes in income or unemployment benefits (Agarwal and Qian, 2014; Gelman et al., 2018; Baker and Yannelis, 2017; Baker, 2018), and decreases in loan payments (Stephens, 2008). See Jappelli and Pistaferri (2010) for a recent review.

2 Conceptual Framework

In this Section, we show that the correlation between MPCs and LRMs is a critical value in assessing the effectiveness of the mortgage refinancing channel of monetary policy. The sign of this correlation is theoretically ambiguous. We suggest two competing hypotheses that could lead to a positive or a negative relationship between MPCs and LRMs.

2.1 Decomposition of the effectiveness of the refinancing channel

We are ultimately interested in the effect of a cut in interest rates r, on aggregate consumption C. We can denote this effect as $\frac{dC}{dr}$. This effect is the sum of the effect of the interest rate on consumption for all of the individuals in the economy; so if we index individuals by i, $\frac{dC}{dr} = \int \frac{dC_i}{dr} di$.

For each of these individuals, we can break this derivative into two components. First, we need to know how much the change in rates changes the liquid wealth of the individual, $\frac{dm_i}{dr}$. Next, we need to know how much the individual increases their consumption in response to changes in liquid wealth. This is the consumer's marginal propensity to consume, MPC_i. Therefore, the total effect can be rewritten as $\frac{dC}{dr} = \int MPC_i \times \frac{dm_i}{dr} di$.

Finally, we can break the change in liquid wealth resulting from a change in rates into two components. First, we have how much liquid wealth changes conditional on an individual refinancing. We denote this $\frac{dm_i}{\text{drefi}_i}$. This is then multiplied by the probability of refinancing conditional on the rate cut. This is the consumers likelihood of refinancing a mortgage LRM_i. We can therefore write the total effect in Equation 1.

$$\frac{dC}{dr} = \int MPC_i \times LRM_i \times \frac{dm_i}{\text{drefi}_i} di \neq \int MPC_i di \times \int LRM_i di \times \int \frac{dm_i}{\text{drefi}_i} di \qquad (1)$$

The total effectiveness of the mortgage refinancing channel of monetary policy therefore depends on the *joint* distribution of MPC_i and LRM_i. As noted in Equation 1, simply multiplying the average MPC_i by the average LRM_i will lead to a biased estimate of effectiveness, unless the two variables are uncorrelated.

2.2 Competing hypotheses relating MPCS and LRMs

Given the importance of the correlation between MPCs and LRMs, what should we expect their joint distribution to look like? We suggest two plausible but opposing hypotheses.

2.2.1 Positive correlation: heterogeneous marginal utility from a liquid dollar

If individuals value additional liquid wealth differently, this could induce a positive correlation between MPCs and LRMs. Some individuals could have a high marginal utility from an additional liquid dollar, MULD. These individuals want additional liquidity to fuel high marginal utility consumption. These individuals could have limited ability to adjust the intensive margin of labor and limited access to credit. They are therefore in need of a channel through which they can increase their liquidity and consumption. Mortgage refinancing, especially cash-out refinancing, could be one such channel. These individuals would be more likely to pay the non-monetary effort costs involved in refinancing a mortgage. Therefore, these individuals could have a high LRM. This connection between the strong desire to increase present consumption and the ability to increase present wealth by refinancing would induce a positive correlation between MPCs and LRMs.

Maxted et al. (2025), model potentially present biased individuals who use cash-out refinances as an injection of liquidity in order to increase their current consumption. This suggests that some measure of present bias or impatience could mediate this sort of positive relationship between MPCs and LRMs driven by heterogeneous MULDs.

2.2.2 Negative correlation: heterogeneous financial sophistication

An alternative hypothesis is that differences in the financial sophistication of homeowners could generate a negative correlation between MPCs and LRMs. Jørring (2024) shows that financially unsophisticated individuals have larger spending responses to changes in income. These individuals are also less likely to follow financial markets and know about the opportunity to refinance. They could therefore have high MPCs and low LRMs, relative to financially sophisticated homeowners. This would suggest a negative relationship between the variables.

Such a model would suggest that direct measures of financial sophistication such as the "Big Three" questions from Lusardi and Mitchell (2023) or questions about familiarity with the concept of mortgage refinancing could be related to both MPCs and LRMs. Furthermore, certain financial characteristics such as income and credit scores that are known to correlate with financial literacy, could mediate such a negative correlation.

Given these competing hypotheses, the overall, unconditional correlation between MPCs and LRMs is ambiguous. We therefore seek to measure it empirically.

3 Methods and Data

In this paper we seek to estimate the relationship between two latent characteristics of homeowners: their marginal propensities to consume (MPCs) and their likelihood of mortgage refinancing (LRM). In addition we seek to measure a wide array of demographic covariates, their relationship with these two concepts of interest, and their role in intermediating the relationship between LRMs and MPCs. As the primary intent of this study is the novel estimation of the *relationship* between these variables, we attempted to measure these constructs using well established methods. Where possible, we closely replicate the existing literature, which has the added bonus of providing additional data in each of these domains.

The goal of our empirical work is not generally to establish causal relationships between MPCs and LRMs (or the other covariates). Instead, we hope to shed a light on the conditional and unconditional distributions of these variables which play an important role in intermediating the causal relationship between monetary policy and aggregate demand.

3.1 Primary Survey

To collect our primary data, we designed and ran a survey of over 1,000 US homeowners, who are geographically representative of the US population, via the online platform Prolific. Participants took the survey on January 16, 2025. All study materials were administered via Qualtrics.[4]

To measure MPCs, we closely follow the hypothetical scenario method utilized in Fuster et al. (2020). As in their paper, we ask each participant how they would adjust their spending, saving, and debt payment following a wealth increase. Fuster et al. (2020) find that a hypothetical gain of $5,000 induced the most participants to state that they would increase spending (and thus have a positive MPC), thus inducing meaningful variation between subjects. We therefore present our homeowner subjects with the following.

> Now consider a hypothetical situation where you unexpectedly receive a one-time payment of $5,000 today. We would like to know whether this extra income would cause you to change your spending behavior in any way over the next 3 months.

Subjects are then asked to select one of the following

- Over the next 3 months, I would **spend/donate** more than if I hadn't received the $5,000

[4]Relevant study materials can be found in Appendix B.

- Over the next 3 months, I would **spend/donate** the same as if I hadn't received the $5,000
- Over the next 3 months, I would **spend/donate** less than if I hadn't received the $5,000

They are then asked similar questions about **paying off debt** and **saving**. As in Fuster et al. (2020), subjects who respond that they would spend more than if they hadn't received the payment are asked, "How much more would you spend/donate than if you hadn't received the $5,000?" We then define their MPC in response to this scenario as their response to this question divided by 5,000 or 0 if they had answered that they would spend the same or less. For all measures of MPC, we censor at an MPC of 1, to reduce the potential for misunderstanding or mis-entry.

In order to capture MPCs relevant to the setting of refinancing one's mortgage, we also ask about the following new scenario.

> Now consider a hypothetical situation where your monthly mortgage payments (or monthly bills if you do not currently have a mortgage) unexpectedly decrease by $250 per month, starting today and lasting for 10 years. We would like to know whether this extra income would cause you to change your spending behavior in any way over the next 3 months.

Subjects are then asked very similar questions to the one-time $5,000 gain scenario. Subjects who indicate that they would spend more are then asked, "How much more (per month) would you spend/donate than if you hadn't received this decrease?" Again, we define their MPC as their response to this question divided by 250 or 0 if they had answered that they would spend the same or less. The two hypothetical scenarios are presented in a random order in order to reduce potential ordering effects.

These scenarios give us two related measures of MPCs. In order to reduce measurement error, we also combine the two into a single variable using factor analysis. This generates a weighted average MPC variable equal to 0.81 times the MPC out of the one time payment and 0.19 times the MPC out of the decreasing monthly payment. Throughout our analysis, qualitatively similar results are found when we use a simple average or either of the individual measures.

Previous studies have found a strong relationship between MPCs elicited from similar hypothetical questions and MPCs estimated from responses to exogenous income shocks (Parker and Souleles, 2019). We therefore expect our elicited MPCs to be a reasonable proxy for actual MPCs.

To measure propensity to refinance one's mortgage, we use two main approaches. First and foremost, we ask each homeowner "How many times have you refinanced your mortgage in the last 20 years?" Our primary measure of refinancing is a binary variable equal to 1 if they have refinanced in the last 20 years and 0 otherwise. We follow-up by asking for the timing of each of these mortgages, their prior rate, and whether the refinancing was a cash-out refinancing.

Our second approach is to learn about the homeowners' financial literacy and familiarity with the mortgage refinancing process. Before any questions related to mortgages are asked, we ask all subjects, "Are you familiar with what it means to refinance a mortgage?" We create a binary variable titled "familiar with refinancing" for which we assign those who respond "Extremely familiar" or "Very familiar" a value of 1 and 0 to those who respond otherwise. If subjects were not familiar with the concept of refinancing, we redirected them to a page explaining the topic before continuing with the survey. We also ask the "Big 3" questions on financial literacy from Lusardi and Mitchell (2023). We use whether they answered all three questions correctly as a measure of financial sophistication.

In addition we collect a number of characteristics about the subject and their mortgage contract. For mortgage characteristics we collected purchase year, loan origination year, original loan size, original term, interest rate, and whether the loan is associated with any government programs. For homeowner characteristics, we collected credit score, income, zip code, race/ethnicity, gender, education, age, and household structure. We also want to test the possibility that MPCs and propensities to refinance are connected through borrowers' present bias as in the model of Maxted et al. (2025). To proxy for homeowners' degree of present bias (β), we use the index of impatience used by Aggarwal et al. (2022), which uses questions from the psychology literature (Tuckman, 1991; Lay, 1986) that have been found to predict real behaviors such as procrastination.

3.2 Linking Survey Data to Mortgage Performance Data

Collecting the MPCs of individual homeowners is a challenging exercise and is limited by budget and sample recruitment. Estimating propensities to refinance, on the other hand, is far less limited. Data on the prepayment performance of all US mortgage loans guaranteed by the three government sponsored entities (GSEs) is publicly available.

We take two approaches to utilizing this additional data. First, we can use our survey data on MPCs to calibrate a prediction model that takes variables available in the GSE data and provides a predicted MPC. We can then sort loans in the GSE data by their predicted MPCs and study the difference in refinancing behavior for high predicted MPC individuals

vs. low predicted MPC individuals. This exercise allows us to study the relationship between *actual refinancing behavior* and *predicted MPCs*.

We can also link the data in the opposite direction. We can estimate a model of refinancing behavior similar to that of Andersen et al. (2020), allowing for heterogeneity in both time-dependent and state-dependent frictions. We can use the GSE data to estimate the relationship between these refinancing model parameters and variables that are available in our survey. We can then use this relationship to predict the refinancing behavior of our survey participants and compare MPCs for subjects with different predicted refinancing parameters. As noted by Fuster et al. (2020) and Lewis et al. (2024), predicting MPCs based on observable characteristics is difficult due to large latent heterogeneity. We therefore prefer this latter method which allows us to study the relationship between *predicted refinancing behavior* and *actual MPCs*.

4 Results

4.1 Primary Survey Results

Below, we present reduced form results from the data collected in our survey. We document a small positive unconditional correlation between MPCs and refinancing activity. We then unpack this correlation and show that this appears to be the product of (a) a large positive correlation between MPCs and refinancing (especially cash-out refinancing) conditional on being aware of the possibility of refinancing and (b) a negative correlation between MPCs and awareness of the opportunity to refinance. We show that these underlying correlations are driven in part by measured characteristics such as credit scores, mortgage sizes, and our measure of impatience.

4.1.1 Summary Statistics

Our primary survey collected data from 1,027 homeowners who are geographically representative of the United States at the state level. Measuring MPCs for homeowners, specifically, is a useful exercise for policy-makers. We find that the average MPC out of a $5,000 lump sum payment was 0.099 (s.e. of 0.006) in our sample of homeowners. This is close to, if slightly below, estimates from Fuster et al. (2020), who find an analogous MPC of 0.12 among the general US public. We find that 31.3% of participants had a positive MPC, which is also consistent with the 36% found by Fuster et al. (2020). We estimate that the average MPC out of a $250 per month decrease in mortgage payments (or bills) is 0.120 (s.e. of 0.009). 20.5% of participants had a positive MPC by this measure. The two measures of MPCs are

significantly positively correlated. Figure 1 plots the distributions of these two measures of MPCs.

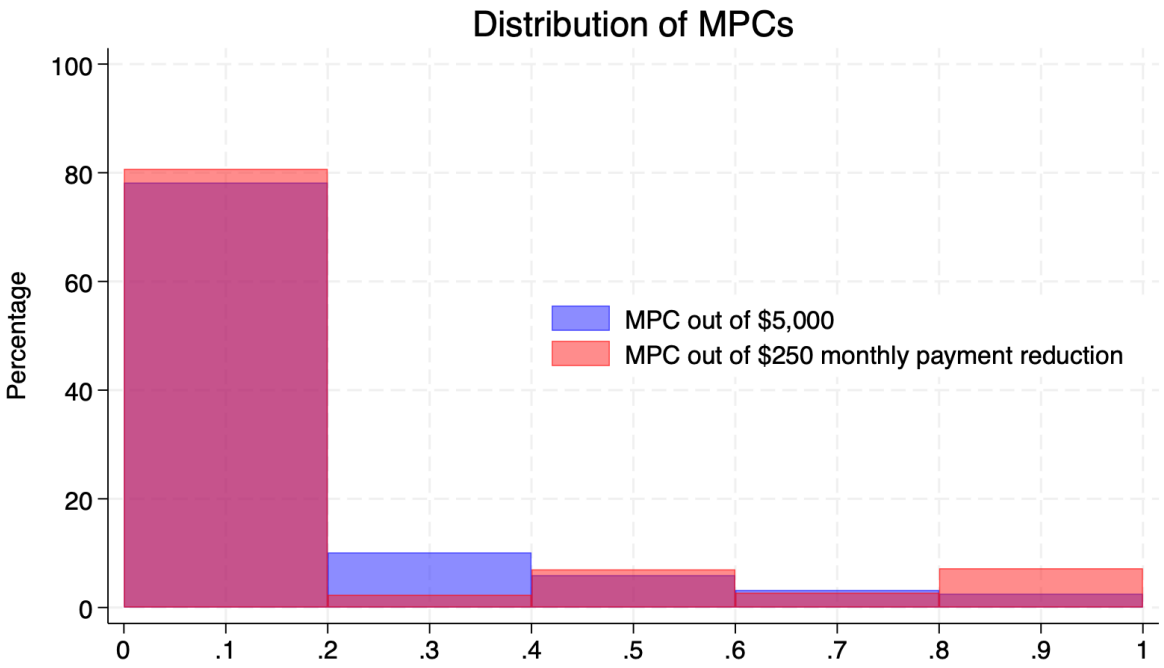


Figure 1: Homeowners' reported MPCs out of a hypothetical $5,000 payment and a $250 reduction in monthly mortgage payments (or bills). Histogram of both measures of MPC. Participants who report that they would not increase their spending following the change in wealth are assumed to have an MPC of 0. Participants who indicated that they would increase their spending are asked by how much they would increase their spending. Their MPC is then their response divided by the hypothetical change in wealth. We censor MPCs from above at 1.

We also collect data on the refinancing history for each homeowner. We find that 50.9% of our sample has refinanced at some point in the last 20 years for an average of 0.739 total refinancings.

We also measure the consumers financial literacy and find that 62% of homeowners are familiar with the concept of refinancing. We also ask each participant the "Big 3" financial literacy questions from Lusardi and Mitchell (2023) and find that 69.5% answer all three correctly. This is higher than the 43.3% of the general US population that answer all three correctly, according to Lusardi and Mitchell (2023). These two measures of financial literacy are significantly positively correlated.

Finally, we collect additional mortgage characteristics and demographic variables that we use in our analysis including the index of impatience from Aggarwal et al. (2022), home

purchase year, original mortgage amount, credit scores, income, race, and gender. Summary statistics of all variables used can be found in the Appendix in Table 3.

	(1) MPC	(2) MPC
Impatience index (std)	0.038***	
	(0.009)	
Big Three financial literacy all correct	-0.042**	
	(0.020)	
FICO score (std)		-0.035***
		(0.010)
Original loan amount (std)		0.027**
		(0.013)
Income (std)		-0.028***
		(0.011)
White		0.024
		(0.022)
Male		0.009
		(0.018)
Purchase Year FE		✓
Observations	1027	1013
R^2	0.027	0.059

Standard errors in parentheses

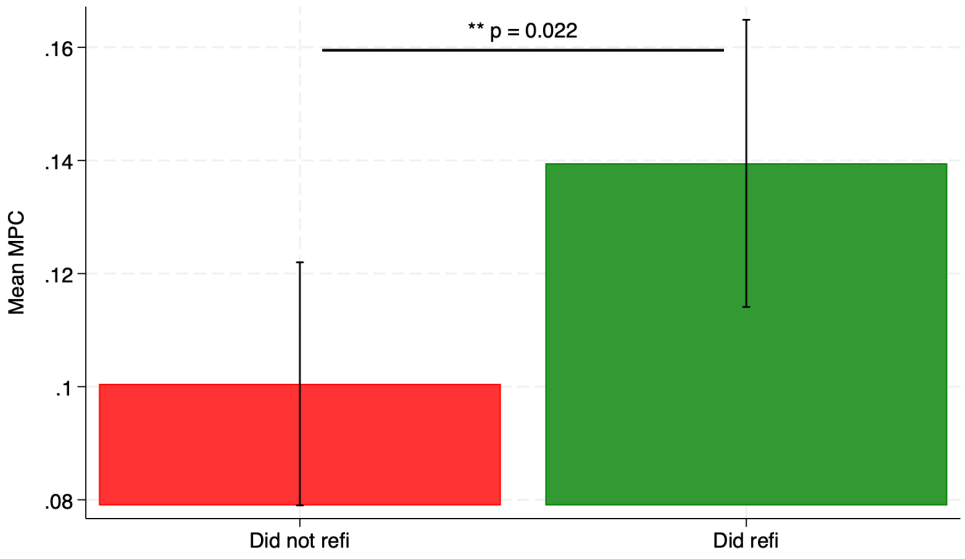
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 1: Explaining MPCs. Both columns report regressions of MPCs out of a $250 reduction in monthly mortgage payments (or bills) on other measured covariates. The first column reports a regression of MPCs on the index of impatience from Aggarwal et al. (2022) and whether the subject correctly answered all three of the "Big Three" questions from Lusardi and Mitchell (2023). The second column regresses MPCs on borrower and mortgage contract characteristics that are observable both in our survey and the GSE-HMDA mortgage data. All variables labeled (std) have been standardized. Their coefficients can be interpreted as the change in MPC associated with a 1 std. dev. change in the variable. Robust standard errors are reported in parentheses below the point estimates.

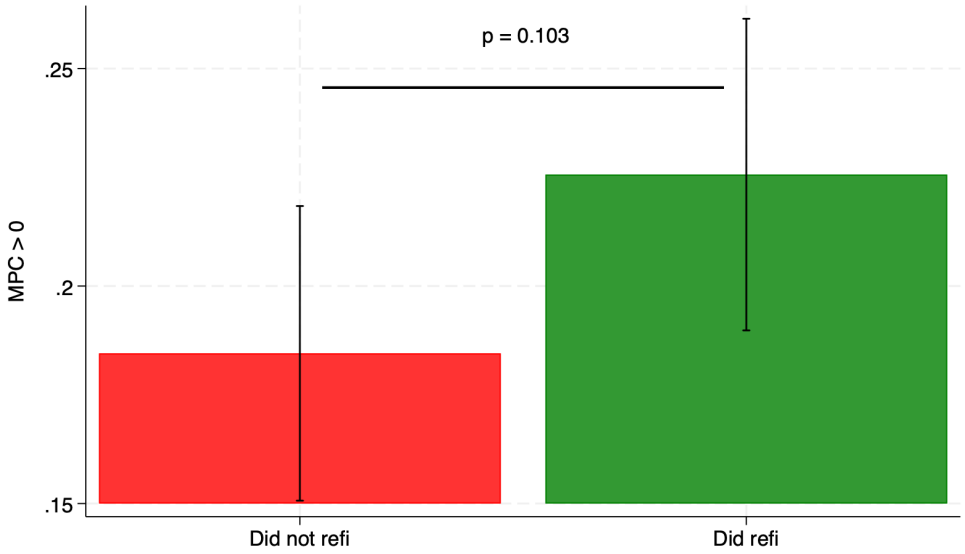
Table 1 reports simple linear relationships between measured MPCs out of a $250 reduction in monthly mortgage payments (or bills) and these other measured covariates. These relationships are in line what theory and previous empirical work would predict. The first column documents the relationship between MPCs and two latent individual characteristics, impatience and financial literacy. As predicted by the hypotheses in Section 2, we find a positive relationship between MPCs and impatience and a negative one between MPCs and financial literacy. The second column regresses MPCs on observable borrower characteristics. We find that MPCs are negatively correlated with credit scores and income but positively correlated with loan size (conditional on income). This is likely due to income and loan size having opposing effects on liquidity. All else being equal, wealthy borrowers have more liquid wealth and lower MPCs. However, larger mortgages, and thus larger mortgage payments, eat into this liquid wealth and increase MPCs. While, at first glance, many of these coefficients may seem small in magnitude, they should be compared to the mean MPC of 0.12.

4.1.2 Relationship between MPCs and Refinancing

A key finding of our primary survey is that the unconditional correlation between MPCs and LRMs is positive. Figure 2 compares MPCs out of monthly payment reductions for homeowners who have refinanced in the past to those who have not. The average MPC for individuals who have never refinanced in the past is 0.101 (s.e. of 0.011) compared to 0.139 (s.e. of 0.013) for those who have. This positive relationship between the two variables implies that, on the whole, the mortgage refinancing channel of monetary policy is more effective than it would be if the two were uncorrelated. A similar relationship holds when we compare whether individuals have a positive MPC. Among those who have not refinanced in the past, 18.5% (s.e. of 0.017) have a positive MPC compared to 22.6% (s.e. of 0.018) among those who have.



(a) Mean MPC out of a $250 reduction in monthly mortgage payments (or bills) by previous refinancing activity



(b) Proportion of MPC> 0 out of a a $250 reduction in monthly mortgage payments (or bills) by previous refinancing activity

Figure 2: Main results. Figures report mean MPCs and proportion of MPCs greater than 0, respectively, for borrowers who have and have not refinanced in the last 20 years. Black bars report the 95% confidence intervals for each estimate. P-values for comparison of means (proportions) tests are also reported.

This positive relationship holds when we control for a number of covariates. Table 2 columns 1 through 3 report regressions of whether or not the homeowner has refinanced on MPC out of $250 reduction in monthly mortgage payments (or bills) and measured covariates.

Coefficients are reported with robust standard errors. Columns 4 through 6 report the same regressions but with MPC as the dependent variable and refinancing as a dependent variable.

We find that even after controlling for purchase year, familiarity with refinancing, impatience, credit scores, loan amounts, race, and gender, a positive and significant relationship remains. We get a point estimate that implies an 0.1 increase in MPCs is associated with a 1.1 percentage point increase in the probability fo having refinanced. This implies that some of the latent component of refinancing behavior is positively related to MPCs.

Comparing the regressions with refinancing as the dependent variable to those with MPC as the dependent variable begins to reveal a few interesting patterns. First, the R^2 values for refinancing are generally higher, meaning we are able to explain more of refinancing behavior than we can MPCs. Next, we note that the relationship between refinancing and impatience is positive as is the relationship between MPCs and impatience. Therefore impatience may be a driver of the overall positive relationship between MPCs and impatience. On the other hand, familiarity with refinancing, credit scores, and income all appear (at least weakly) to go in the opposite directions for MPCs vs refinancing activity. These variables may all be weakening the relationship between MPCs and refinancing.

	(1) Has Refi	(2) Has Refi	(3) Has Refi	(4) MPC	(5) MPC	(6) MPC
MPC out of $250 monthly	0.131**	0.114*	0.113**			
	(0.056)	(0.058)	(0.055)			
Has refinanced				0.039**	0.039*	0.040**
				(0.017)	(0.020)	(0.020)
Familiar with refinancing			0.159***			0.005
			(0.030)			(0.019)
Impatience index (std)			0.052***			0.034***
			(0.015)			(0.009)
FICO score (std)			0.013			-0.030***
			(0.015)			(0.010)
Original loan amount (std)			0.045***			0.024**
			(0.017)			(0.012)
Income (std)			0.050***			-0.028***
			(0.017)			(0.011)
White			-0.037			0.021
			(0.035)			(0.022)
Male			-0.024			0.016
			(0.030)			(0.018)
Purchase Year FE		✓	✓		✓	✓
Observations	1027	1027	1013	1027	1027	1013
R^2	0.005	0.160	0.221	0.005	0.033	0.079

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Relationship between refinancing and MPCs. Columns 1-3 report regressions of whether the homeowner has refinanced in the last 20 years on covariates. Columns 4-6 report similar regressions with MPCs out of $250 reduction in monthly mortgage payments as the dependent variable. Columns 1 and 4 report the unconditional relationship between MPCs and LRMs. Columns 2 and 5 report the relationship between MPCs and LRMs controlling for year of home purchase fixed effects. Columns 3 and 6 report the relationship between MPCs and LRMs controlling linearly for a variety of observable homeowner and mortgage characteristics. All variables labeled (std) have been standardized. Their coefficients can be interpreted as the change in MPC associated with a 1 std. dev. change in the variable. Robust standard errors are reported in parentheses below the point estimates.

The positive unconditional correlation seems to indicate that homeowners' marginal utility from additional liquid wealth could be an important link between MPCs and refinancing behavior. If this were the case, we should see high MPC borrowers extracting equity from their homes in the form of cash-out refinances. To test this, we compare MPCs for borrowers who have not refinanced at all, borrowers who have done a non-cash-out refinancing, and borrowers who have done a cash-out refinancing. Figure 3 shows that homeowners who have done a cash-out refinance have significantly higher MPCs than the other two groups. In fact, once we separate out the two types of refinancings, non-cash-out refinancers do not have significantly different MPCs from those who have not refinanced. It therefore appears that homeowners wishing to take cash out of their home equity in order to fuel high marginal utility spending are driving the positive correlation between MPCs and refinancing behavior.

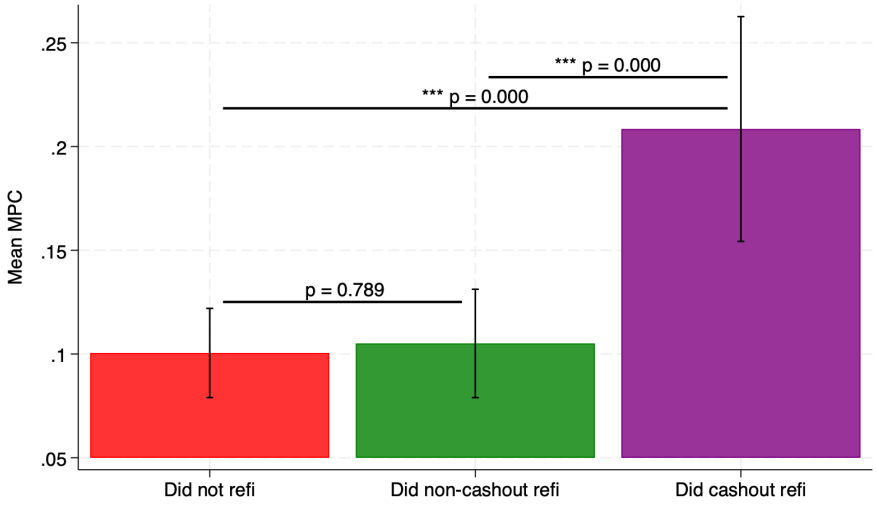
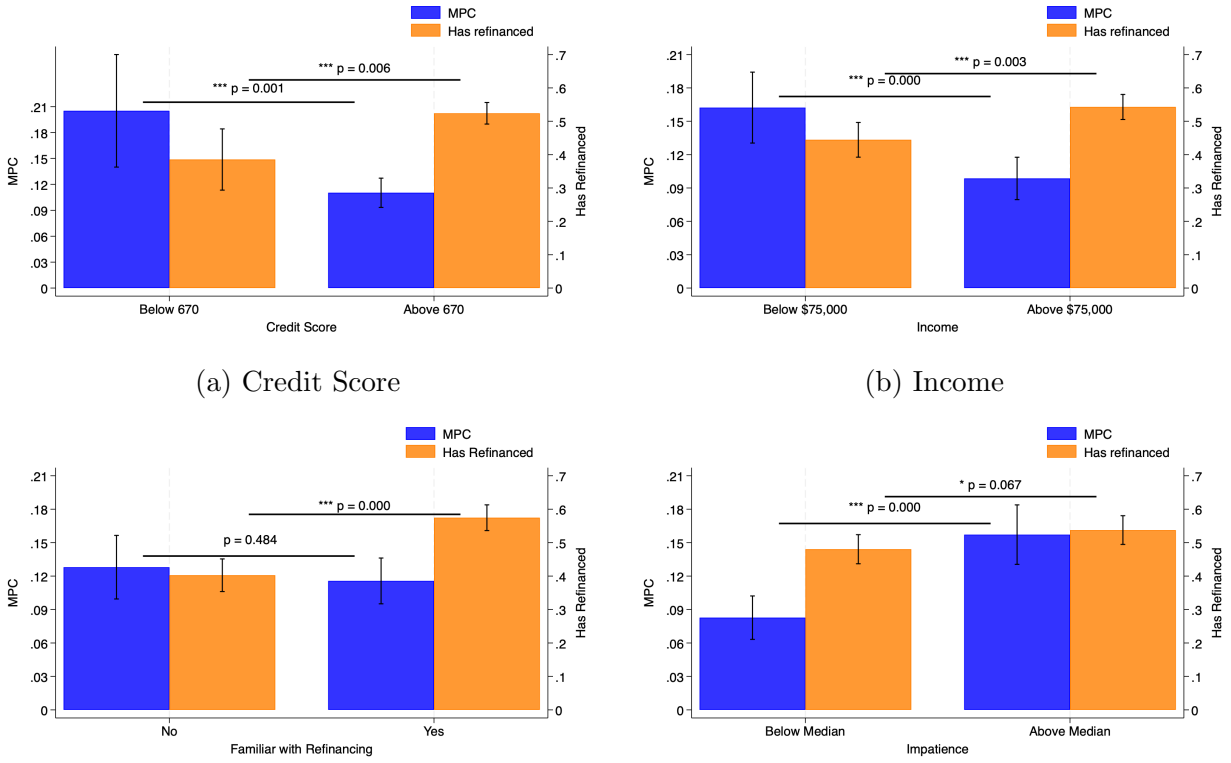


Figure 3: Mean MPCs out of a $250 reduction in monthly mortgage payments (or bills) by refinancing type. Black bars report the 95% confidence intervals for each estimate. P-values for comparison of means (proportions) tests are also reported.

4.1.3 Conditional Correlations and Covariates

Here, we explore the potential mediating role that these covariates play in the relationship between MPCs and refinancing. Figure 4 shows mean MPCs out of $250 reduction in monthly mortgage payments and proportions of homeowners who have refinanced, split by credit scores, incomes, familiarity with refinancing, and impatience.



(a) Credit Score

(b) Income

(c) Familiarity with Refinancing

(d) Impatience

Figure 4: Evidence on Mechanisms. Each subfigure reports mean MPCs out of $250 reduction in monthly mortgage payments and proportions of homeowners who have refinanced for different subgroups of our survey participants. Subfigure (a) splits the analysis into homeowners with a reported FICO score less than and greater than 670. Subfigure (b) splits the analysis into homeowners with a reported annual income less than and greater than $75,000. Subfigure (c) splits the analysis into homeowners who reported being familiar with refinancing and those who are not. Subfigure (d) splits the analysis into homeowners with above and below median values of the impatience index from Aggarwal et al. (2022). Black bars report the 95% confidence intervals for each estimate. P-values for comparison of means (proportions) tests are also reported.

Figure 4 (a) shows that homeowners with low credit scores had higher MPCs and lower refinancing rates than borrowers with higher credit scores. Figure 4 (b) shows a similar pattern for relatively low income vs high income homeowners. Both of these are consistent with the financial sophistication hypothesis that MPCs and refinancing rates are negatively correlated. Both of these observable characteristics therefore reduce the overall correlation and partially offset the overall positive correlation. Figure 4 (c) shows that (obviously) homeowners who are familiar with the process of refinancing are significantly more likely to have refinanced than those who are not. These individuals have slightly lower MPCs though the difference is far from significant.

Figure 4 (d) shows that borrowers with above median scores on our impatience index have higher MPCs and higher refinancing rates than those with below median impatience. This is consistent with impatient or present biased borrowers having a higher marginal utility from a liquid dollar and therefore having a higher MPC and higher willingness to refinance. Overall this effect, both through impatience and the unexplained components of MPCs and refinancing, outweighs the above negative effects.

4.2 Linked Data Results

Below we connect our survey results to the GSE-HMDA mortgage performance data. Here we can use the GSE data to predict the refinancing behavior of homeowners in our survey, or we can use our survey data to predict the MPCs of borrowers in the GSE data. In either case, we use a shared set of observable characteristics, (mortgage size, income, credit score, purchase year, race, and gender), to explain and predict refinancing or MPCs. As we cannot directly link the two datasets, we are unable to use the remaining latent variation in one of the datasets.

First, we use the GSE data to predict refinancing. We regress whether or not individuals with at least a 1% rate incentive refinanced on the above observable characteristics to get a simple predictive model of refinancing that can be used with our survey data. Figure 5 shows that survey participants who are predicted to be more likely to refinance are in fact more likely to have refinanced and have lower MPCs. This implies a negative correlation between refinancing behavior and MPCs. There are two main caveats to this result. First, this only looks at predicted refinancing rates based on the observables that we have access to. Therefore, it ignores any latent variation in refinancing propensity. It also only looks at refinancing for a specific incentive. We can get a more complete picture of refinancing behavior by linking our data sets in the opposite direction.

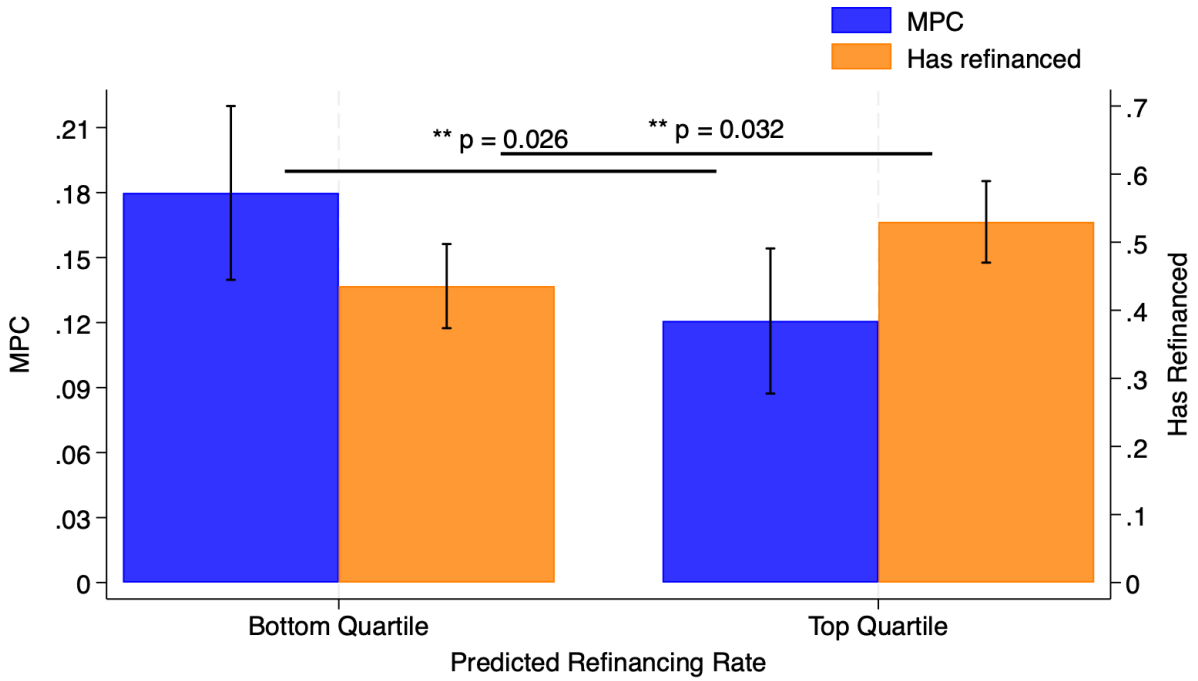


Figure 5: MPCs by predicted refinancing. GSE-HMDA data is used to fit a predictive model of probability of refinancing conditional on a 1% interest rate incentive using covariates found in both the GSE-HMDA and our survey data. This model is then used to predict LRMs for survey participants. We then plot MPCs out of $250 reduction in monthly mortgage payments and proportions of homeowners who have refinanced for participants in the bottom and top quartiles of predicted LRMs. Black bars report the 95% confidence intervals for each estimate. P-values for comparison of means (proportions) tests are also reported.

Next, we use our survey data to predict MPCs. We regress MPCs out of $250 reduction in monthly mortgage payments on the above observable characteristics to get a simple predictive model of MPCs that can be used with the mortgage data. We then generate a predicted MPC for every loan in the GSE data. Figure 6 shows "S-curves" for borrowers in the highest and lowest quartiles of predicted MPCs. S-curves plot the empirical probability of refinancing by interest rate spread, the difference between the borrowers' rate and the prevailing market interest rate. These S-curves give us a more nuanced look at refinancing behavior than our aggregated total probabilities can.

We note two patterns in the S-curves. First, the S-curve has a higher "peak" for borrowers with a low MPC than those with a high MPC. Conditional on a large rate incentive, refinancing activity appears to be negatively correlated with MPCs. When interpreted through the lens of a model of refinancing with state and time dependent frictions such as Andersen et al. (2020), this implies that high MPC borrowers have more inaction than low MPC borrowers.

This is consistent with the negative correlation implied by the hypothesis of financial sophistication. High MPC borrowers may have lower financial sophistication and are therefore less likely to consider refinancing their mortgage, independent of the incentives to do so.

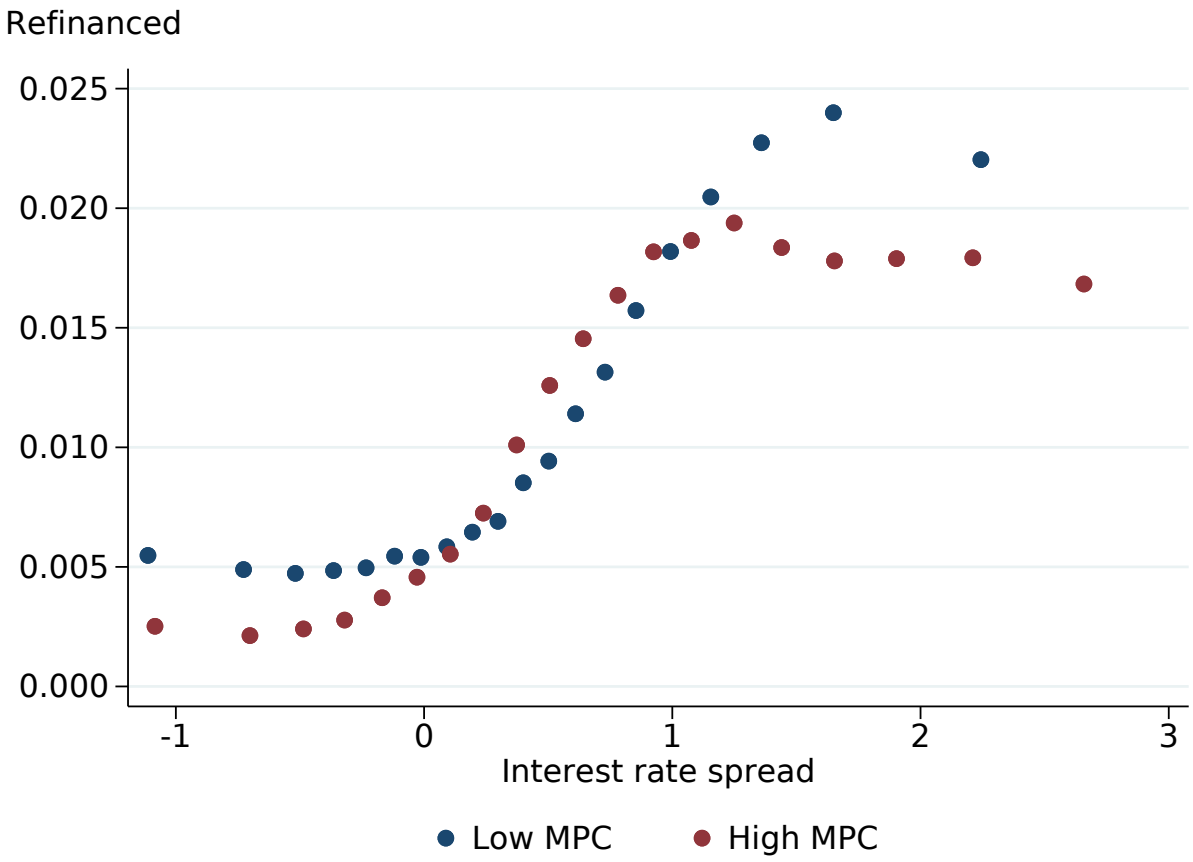


Figure 6: S-curves. We plot the empirical probability of refinancing for borrowers in the GSE-HMDA data at different rate spreads, defined as the difference between a borrowers current mortgage rate and the Freddie Mac PMMS rate. Our survey data is used to fit a predictive model of MPCs using covariates found in both the GSE-HMDA and our survey data. This model is then used to predict MPCs for GSE-HMDA borrowers. We then plot S-curves for borrowers in the bottom and top quartiles of predicted MPCs.

Second, we note that the high MPC S-curve is above the low MPC S-curve for small positive incentives. This implies that high MPC borrowers have lower state dependent frictions and are more responsive to incentives, conditional on paying attention. Figure 7 plots the two S-curves rescaled by the peak value of each curve. One can interpret this as the probability of refinancing, conditional on considering refinancing at all. Here, the adjusted high MPC S-curve is generally above the low MPC S-curve for positive incentives. This is consistent with the hypothesis of the marginal utility of a liquid dollar. Conditional on

considering refinancing, borrowers with high MPCs value additional liquid wealth relative to the non-financial effort costs of refinancing more than low MPC borrowers.

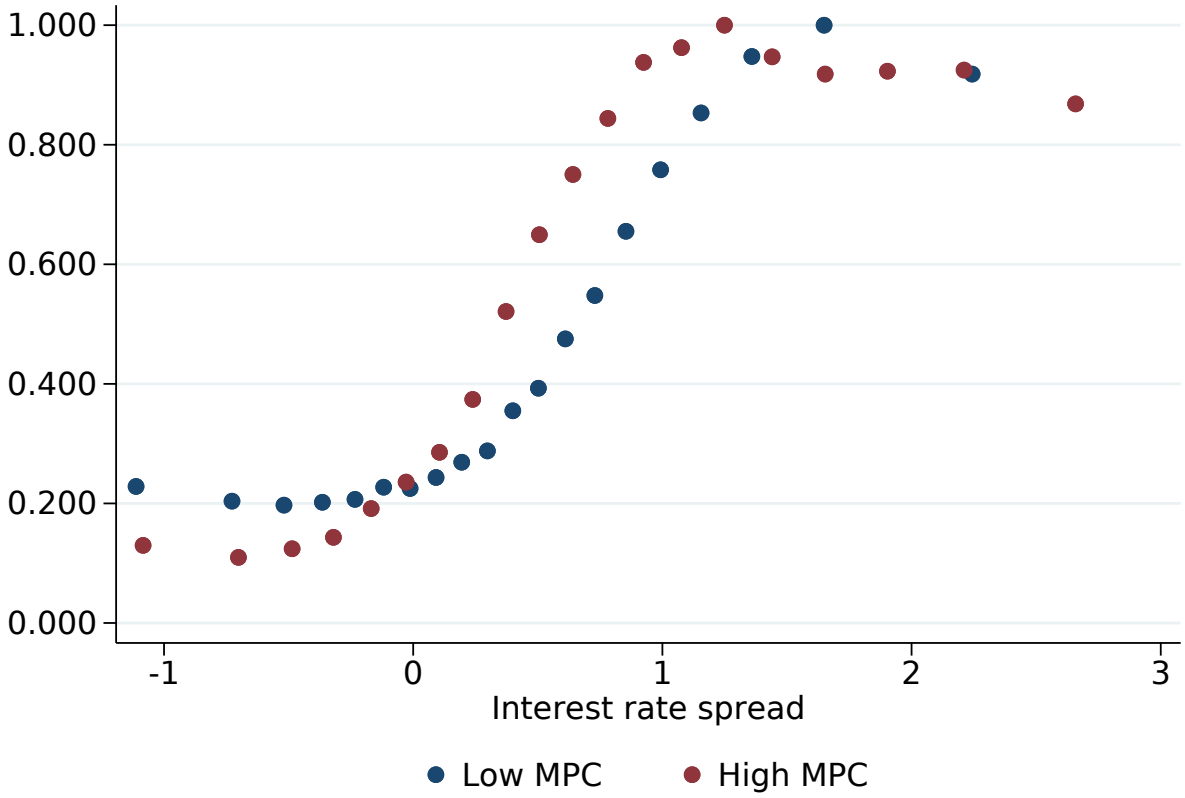


Figure 7: Adjusted S-curves. We plot the same data as in Figure 6, but with each probability value divided by the probability of a borrower in that group refinancing with a 150-200 basis point incentive. This is an attempt to capture the probability of refinancing, conditional on attending to the decision of whether to refinance or not.

We therefore find additional evidence in favor of both hypotheses. These effects push the relationship between refinancing and MPCs in different directions. However, they do so in subtly different ways. The financial sophistication hypothesis implies high MPC borrowers are less likely to refinance, regardless of the magnitude of incentives. The marginal utility of a liquid dollar hypothesis implies that high MPC borrowers are more likely to respond to the monetary incentives of refinancing. These opposing and different effects suggest that estimating a structural model of mortgage refinancing that allows for heterogeneity could prove useful. Doing so will allow us to estimate the aggregate relationship between MPCs and refinancing, but also estimate policy relevant counterfactuals such as the increase in aggregate demand implied by different paths of interest rates.

5 Structural Estimation and Counterfactuals

This section is a work in progress. We are currently estimating a model of refinancing with state and time dependent frictions similar to that of Andersen et al. (2020). We allow for heterogeneity in these state and time dependent frictions based on either (a) the observable characteristics shared by our two data sets, or (b) predicted MPCs. We can then use these models to estimate the stimulus generated by different interest rate scenarios and compare these predictions to a model in which refinancing and MPCs are uncorrelated.

5.1 Theoretical Framework

Our model features borrowers who choose whether or not to refinance by maximizing a utility function, conditional on paying attention. If borrower i attends to the decision as to whether or not to refinance in time t, they compare utility from refinancing

$$u_{1,i}(r_t) = \beta_i x_{i,t} + \epsilon_{1,i,t}, \tag{2}$$

to utility from not refinancing

$$u_{0,i}(r_t) = \epsilon_{0,i,t}. \tag{3}$$

The vector $x_{i,t}$ contains borrower characteristics, but most importantly, it contains the rate incentive the borrower faces in time t (the gap between the rate the borrower has and the current market rate). We allow β_i to vary across borrowers according to either borrower characteristics or estimated MPCs. The ϵ terms are distributed iid Type I Extreme Value, giving us the familiar logit probability of refinancing, conditional on paying attention.

This utility function captures, in a reduced form, the costs and benefits of refinancing. It allows for heterogeneity in both the fixed costs of refinancing and the sensitivity to the incentive of refinancing. It abstracts from the dynamic problem of refinancing and is therefore unable to model borrowers' expectations of future interest rates and the related decision to wait to refinance in a later period. This part of the model captures state dependent frictions to refinancing.

The borrower faces this decision to refinance if and only if they are paying attention. We model whether the borrower pays attention similarly. Borrower i pays attention in time t if

$$\alpha z_i + \nu_{1,i,t} > \nu_{0,i,t}. \tag{4}$$

The vector x_i contains static borrower characteristics and **not** any time varying incentives to refinance. Both ν terms again are distributed iid Type I Extreme Value. Each borrower

therefore has a constant probability of paying attention in any period, but this probability can vary across borrowers based on their characteristics. This part of the model captures time dependent frictions to refinancing.

The borrowers probability of refinancing in a given period is then the product of the probability of paying attention and the probability of refinancing conditional on paying attention. Both of these probabilities can vary with borrower characteristics which may be correlated with MPCs. Therefore, this model allows us to study how MPCs and refinancing behavior might be related.

5.2 Estimating the Model

We estimate this model using mortgage data from the Government Sponsored Entities (GSEs). This data contains borrower characteristics and the monthly prepayment history of all loans guaranteed by the GSEs (a majority of the US mortgage market). We estimate the model using Maximum Likelihood Estimation.

We estimate heterogeneity in refinancing behavior through the model in two ways. First, we use the borrower characteristics that are found in both the GSE data and our survey data (mortgage size, income, and credit score) as the variables in $x_{i,t}$ and z_i. This allows us to estimate the relationship between these characteristics and the state and time dependent frictions in refinancing. We can then use the estimated parameters of this model to predict the refinancing probability of any individual in our survey data given any incentives. This allows us to generate model predicted refinancing behavior to accompany self-reported MPCs.

Second, we use our survey data to predict MPCs. We regress MPCs out of \$250 reduction in monthly mortgage payments on the above observable characteristics to get a simple predictive model of MPCs that can be used with the mortgage data. We then generate a predicted MPC for every loan in the GSE data. We can then estimate the model using predicted MPCs as the variables in $x_{i,t}$ and z_i. We can then study how the predicted MPCs are related to the estimated refinancing frictions.

Both of these estimated models will allow us to run counterfactual exercises in which we can study the consumption response to various rate cut scenarios. Furthermore, we can compare the consumption response in our estimated model to one in which MPCs and refinancing behavior are uncorrelated in order to estimate the total effect this correlation has on the mortgage refinancing channel of monetary policy.

6 Conclusion

In this paper we demonstrate that the correlation between the Likelihood of Refinancing a Mortgage (LRM) and the Marginal Propensity to Consume (MPC)—determines the strength of the refinancing channel. We collect novel survey data on the LRMs and MPCs of over 1,000 US homeowners and reveal a small positive correlation, implying a more effective channel than previously accounted for. We find evidence for two opposing effects. Heterogeneity in financial sophistication generates a negative relationship and liquidity preferences generate a larger, positive one. We use a structural model of refinancing to estimate these effects and explore their implications on the size and speed of monetary policy pass-through.

We see two fruitful paths forward in this research agenda. First, one could use individual level financial account data to estimate this important relationship between LRMs and MPCs using a revealed preference approach to estimation rather than our hypothetical scenario approach. Second, one could incorporate our findings into a general equilibrium model of the economy, and explore the implications beyond our partial equilibrium approach.

References

Aaronson, D., Agarwal, S., and French, E. (2012). The spending and debt response to minimum wage hikes. *American Economic Review*, 102(7):3111–3139.

Agarwal, S., Ben-David, I., and Yao, V. (2017). Systematic mistakes in the mortgage market and lack of financial sophistication. *Journal of Financial Economics*, 123(1):42–58.

Agarwal, S., Driscoll, J. C., Gabaix, X., and Laibson, D. I. (2009). The Age of Reason: Financial Decisions over the Life Cycle and Implications for Regulation. *Brookings Papers on Economic Activity*, 2009:51–101.

Agarwal, S., Liu, C., and Souleles, N. S. (2007). The reaction of consumer spending and debt to tax rebates—Evidence from consumer credit data. *Journal of Political Economy*, 115(6):986–1019.

Agarwal, S. and Qian, W. (2014). Consumption and Debt Response to Unanticipated Income Shocks: Evidence from a Natural Experiment in Singapore. *American Economic Review*, 104(12):4205–4230.

Agarwal, S., Rosen, R. J., and Yao, V. (2016). Why do borrowers make mortgage refinancing mistakes? *Management Science*, 62(12):3494–3509.

Aggarwal, S., Dizon-Ross, R., and Zucker, A. (2022). Designing incentives for impatient people: An rct promoting exercise to manage diabetes.

Amromin, G., Bhutta, N., and Keys, B. J. (2020). Refinancing, monetary policy, and the credit cycle. *Annual Review of Financial Economics*, 12(Volume 12, 2020):67–93.

Andersen, S., Campbell, J. Y., Nielsen, K. M., and Ramadorai, T. (2020). Sources of Inaction in Household Finance: Evidence from the Danish Mortgage Market. *American Economic Review*, 110(10):3184–3230.

Auclert, A. (2019). Monetary policy and the redistribution channel. *American Economic Review*, 109(6):2333–67.

Baker, S. R. (2018). Debt and the Response to Household Income Shocks: Validation and Application of Linked Financial Account Data. *Journal of Political Economy*, 126(4):1504–1557.

Baker, S. R. and Yannelis, C. (2017). Income changes and consumption: Evidence from the 2013 federal government shutdown. *Review of Economic Dynamics*, 23:99–124.

Baugh, B., Ben-David, I., Park, H., and Parker, J. A. (2021). Asymmetric consumption smoothing. *American Economic Review*, 111(1):192–230.

Beraja, M., Fuster, A., Hurst, E., and Vavra, J. (2019). Regional heterogeneity and the refinancing channel of monetary policy*. *The Quarterly Journal of Economics*, 134(1):109–183.

Berger, D., Milbradt, K., Tourre, F., and Vavra, J. (2021). Mortgage prepayment and path-dependent effects of monetary policy. *American Economic Review*, 111(9):2829–78.

Bernheim, D. (1995). Do Households Appreciate Their Financial Vulnerabilities? An Analysis of Actions, Perceptions, and Public Policy. In *Tax Policy and Economic Growth*, pages 1–30, Washington, DC. American Council for Capital Formation.

Bernheim, D. (1998). Financial illiteracy, education and retirement saving. In Mitchell, O. and Schieber, S., editors, *Living with Defined Contribution Pensions*, pages 38–68. University of Pennsylvania Press, Philadelphia.

Bhutta, N. and Keys, B. J. (2016). Interest rates and equity extraction during the housing boom. *American Economic Review*, 106(7):1742–74.

Campbell, J. (2023). Mortgage Choice and Monetary Policy. Keynote Address at the Georgia Tech-Atlanta Fed Household Finance Conference.

Campbell, J. Y. (2016). Restoring rational choice: The challenge of consumer financial regulation. *American Economic Review: Papers & Proceedings*, 106(5):1–30.

Di Maggio, M., Kermani, A., Keys, B. J., Piskorski, T., Ramcharan, R., Seru, A., and Yao, V. (2017). Interest rate pass-through: Mortgage rates, household consumption, and voluntary deleveraging. *American Economic Review*, 107(11):3550–88.

Di Maggio, M., Kermani, A., and Palmer, C. J. (2020). How quantitative easing works: Evidence on the refinancing channel. *The Review of Economic Studies*, 87(3):1498–1528.

Eichenbaum, M., Rebelo, S., and Wong, A. (2022). State-dependent effects of monetary policy: The refinancing channel. *American Economic Review*, 112(3):721–61.

Friedman, M. (1957). The Permanent Income Hypothesis. In *A Theory of the Consumption Function*, volume I, pages 20–37. Princeton University Press.

Fuster, A., Kaplan, G., and Zafar, B. (2020). What would you do with $500? spending responses to gains, losses, news, and loans. *The Review of Economic Studies*, 88(4):1760–1795.

Gagnon, J., Raskin, M., Remache, J., and Sack, B. P. (2011). Large-scale asset purchases by the Federal Reserve: Did they work? *FRBNY Economic Policy Review*, 17(1):41.

Gathergood, J. (2012). Self-control, financial literacy and consumer over-indebtedness. *Journal of Economic Psychology*, 33(3):590–602.

Gelman, M., Kariv, S., Shapiro, M. D., Silverman, D., and Tadelis, S. (2018). How individuals respond to a liquidity shock: Evidence from the 2013 government shutdown. *Journal of Public Economics*, 189:103917.

Gertler, M. and Karadi, P. (2015). Monetary policy surprises, credit costs, and economic activity. *American Economic Journal: Macroeconomics*, 7(1):44–76.

Gilchrist, S., López-Salido, D., and Zakrajšek, E. (2015). Monetary policy and real borrowing costs at the zero lower bound. *American Economic Journal: Macroeconomics*, 7(1):77–109.

Hall, R. E. (1978). Stochastic Implications of the Lifecycle Permanent Income Hypothesis: Theory and Evidence. *Journal of Political Economy*, 86(6):971–987.

Jappelli, T. and Pistaferri, L. (2010). The consumption response to income changes. *Annual Review of Economics*, 2(1):479–506.

Johnson, D. S., Parker, J. A., and Souleles, N. S. (2006). Household expenditure and the income tax rebates of 2001. *American Economic Review*, 96(5):1589–1610.

Jørring, A. T. (2024). Financial sophistication and consumer spending. *The Journal of Finance*, 79(6):3773–3820.

Kaplan, G., Moll, B., and Violante, G. L. (2018). Monetary policy according to hank. *American Economic Review*, 108(3):697–743.

Keys, B. J., Pope, D. G., and Pope, J. C. (2016). Failure to refinance. *Journal of Financial Economics*, 122(3):482–499.

Krishnamurthy, A. and Vissing-Jorgensen, A. (2011). The effects of quantitative easing on interest rates: Channels and implications for policy. *Brookings Papers on Economic Activity*, 43(2):215–287.

Lay, C. H. (1986). At last, my research article on procrastination. *Journal of research in personality*, 20(4):474–495.

Lewis, D., Melcangi, D., and Pilossoph, L. (2024). Latent heterogeneity in the marginal propensity to consume. Technical report, National Bureau of Economic Research.

Liu, L. (2019). Non-salient fees in the mortgage market. *Working Paper*.

Lusardi, A. and Mitchell, O. S. (2011). Financial literacy around the world: An overview. *Journal of Pension Economics and Finance*, 10(4):497–508.

Lusardi, A. and Mitchell, O. S. (2014). The Economic Importance of Financial Literacy: Theory and Evidence. *Journal of Economic Perspectives*, 52(1):5–44.

Lusardi, A. and Mitchell, O. S. (2023). The importance of financial literacy: Opening a new field. *Journal of Economic Perspectives*, 37(4):137–54.

Maxted, P., Laibson, D., and Moll, B. (2025). Present bias amplifies the household balance-sheet channels of macroeconomic policy. *The Quarterly Journal of Economics*, 140(1):691–743.

Nakamura, E. and Steinsson, J. (2018). High-frequency identification of monetary non-neutrality: The information effect*. *The Quarterly Journal of Economics*, 133(3):1283–1330.

Olafsson, A. and Pagel, M. (2018). The liquid hand-to-mouth: Evidence from personal finance management software. *Review of Financial Studies*, 31(11):4398–4446.

Parker, J. A. (1999). The reaction of household consumption to predictable changes in Social Security taxes. *American Economic Review*, 89(4):959–973.

Parker, J. A. (2017). Why don't households smooth consumption? Evidence from a 25 million dollar experiment. *American Economic Journal: Macroeconomics*, 9(4):153–183.

Parker, J. A. and Souleles, N. S. (2019). Reported effects versus revealed-preference estimates: Evidence from the propensity to spend tax rebates. *American Economic Review: Insights*, 1(3):273–290.

Parker, J. A., Souleles, N. S., Johnson, D. S., and Mcclelland, R. (2013). Consumer spending and the economic stimulus payments of 2008. *Amercian Economic Review*, 103(6):2530–2553.

Souleles, N. S. (1999). The response of household consumption to income tax refunds. *American Economic Review*, 89(4):947–958.

Stephens, M. (2006). Paycheque receipt and the timing of consumption. *Economic Journal*, 116(513):680–701.

Stephens, M. (2008). The consumption response to predictable changes in discretionary income: Evidence from the repayment of vehicle loans. *Review of Economics and Statistics*, 90(2):241–252.

Tuckman, B. W. (1991). The development and concurrent validity of the procrastination scale. *Educational and psychological measurement*, 51(2):473–480.

Woodward, S. E. and Hall, R. E. (2012). Diagnosing consumer confusion and sub-optimal shopping effort: Theory and mortgage-market evidence. *American Economic Review*, 102(7):3249–76.

Appendix A Additional Analysis

	Mean	Std. Dev.	N
MPC out of $5000	0.099	0.208	1027
MPC out of $250 monthly	0.120	0.273	1027
Has refinanced in 20 years	0.509	0.500	1027
Count of refinancings in 20 years	0.739	0.906	1027
Is familiar with concept of refinancing	0.620	0.486	1027
Answered all Lusardi-Mitchell Big 3 correctly	0.695	0.461	1027
Count of correct Lusardi-Mitchell Big 3	2.593	0.687	1027
Impatience Index	3.140	1.154	1027
Home purchase year	2013.145	8.889	1027
Original mortgage size	267.969	179.522	1024
FICO score	758.257	69.666	1027
Income	101.255	49.070	1016
White	0.770	0.421	1027
Male	0.421	0.494	1027

Table 3: Summary Statistics

Appendix B Study Materials

Survey materials are attached below.

Brandeis
UNIVERSITY

Consent

Informed Consent Document

For the research study: **The Effect of Financial Sophistication on Monetary Policy**

This study is being conducted by Dr. Ryan Westphal of Brandeis University.

Please read this form carefully – it tells you about your rights in this study. Ask questions if you want more information about this form or the study.

If you decide to participate in this study you will check a box on this form – please make sure you understand it completely before doing so. Keep a copy of this form for your records – it has important information like whom to contact if you have questions later.

What is this study about?

People's financial decisions and how they influence optimal monetary policy.

Who are we asking to participate?

Anyone at least 18 years old who owns their primary residence.

What will you be asked to do?

We will ask you to complete a survey that will take you about 15 minutes.

Are there any possible risks to you?

While there are no questions that can directly identify you, your responses may be made public during the publication process. You can quit the study completely at any time.

Will you benefit from participation?

No – you will not.

Will it cost you anything to participate?

Just your time (15 minutes for the survey).

Will you receive anything for participating in the study?

You will be paid $5 for the survey upon completion.

What will happen with your answers after this study?

We will store your answers – without information that can identify you – indefinitely.

If you agree, we would like to store your de-identified answers in a place where we can share them with other researchers (called a digital repository). This allows other researchers to use this information in their own future research.

What if you don't want to participate or change your mind partway through?

Participating in this study is completely voluntary. You can refuse to participate or quit at any time.

Who can you contact if you have more questions?

If you have any questions about the research or your participation in the study, feel free to contact Dr. Westphal at westphal@brandeis.edu.

This research was approved by an office/committee that oversees the ethics of human subjects research at Brandeis University. If you have any questions about your rights or concerns about the study, you may contact them at 781-736-8133 or hrpp@brandeis.edu.

Subject Consent

I have read this consent form completely. I have been encouraged to ask questions, and have received helpful answers. I understand that:

- My participation is voluntary
- I may quit at any time without penalty

☐ By checking this box, I voluntarily agree to take part in this study.

Mortgage

Do you own the primary residence that you live in?

- ○ No
- ○ Yes

Do you currently or have you in the past had a mortgage on the primary residence that you live in?

- ○ Yes, I currently have a mortgage on my home
- ○ Yes, I did have a mortgage on my home, but I have paid it off in full
- ○ No, I never had a mortgage on my home

Are you the primary financial decision maker in your household?

- ○ No, someone else is

- Yes, I am
- I am equally responsible for financial decisions along with someone else in my household

Lusardi-Mitchell

Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?

- More than $102
- Exactly $102
- Less than $102
- Do not know
- Refuse to answer

Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?

- More than today
- Exactly the same
- Less than today

- Do not know
- Refuse to answer

Please tell me whether this statement is true or false. "Buying a single company's stock usually provides a safer return than a stock mutual fund."

- True
- False
- Do not know
- Refuse to answer

KnowRefi

Are you familiar with what it means to refinance a mortgage?

- Not familiar at all
- Slightly familiar
- Moderately familiar
- Very familiar
- Extremely familiar

NoKnowRefi

What Does It Mean To Refinance A Mortgage?

"Refinancing the mortgage on your house means you're essentially trading in your current mortgage for a newer one – often with a new principal and a different interest rate. Your lender then uses the newer mortgage to pay off the old one, so you're left with just one loan and one monthly payment.

There are a few pros and cons of refinancing. You can use a refinance to make use of your home's equity, get a better interest rate and/or lower monthly payment. A refinance could also allow you to remove another person from or add them to the mortgage.

But the upfront costs required for refinancing may mean the lower monthly payment isn't worth your while. That's why it's important to understand the refinancing process and make sure it's the right move for you."

- Victoria Araj at Rocket Mortgage

Mortgage

When did you purchase your (primary) home?

1990 1993 1997 2000 2004 2007 2010 2014 2017 2021 2024

I purchased it in (please select 1990 if you purchased earlier than 1990)

When did your current home mortgage begin? (If you have refinanced your mortgage, choose the year in which you most recently refinanced.)

1990 1993 1997 2000 2004 2007 2010 2014 2017 2021 2024

It began in

What was the original size of your mortgage?

- $0 - 99,999
- $100,000 - 199,999
- $200,000 - 299,999
- $300,000 - 399,999
- $400,000 - 499,999
- $500,000 - 599,999
- $600,000 - 699,999
- $700,000 - 799,999

- $800,000 or greater
- I don't know

What was the original term of your (primary) home mortgage?

- 30 years
- 20 years
- 15 years
- 10 years
- Other
- I don't know

Is your (primary) home mortgage a fixed or adjustable rate mortgage?

- Fixed
- Adjustable (includes hybrid loans that are fixed and become adjustable rate)
- I don't know

Is your (primary) home mortgage associated with any of the following government programs?

- FHA
- VA
- USDA (Rural)
- None

To the best of your knowledge, which of the following ranges of credit scores do you fall into?

- 300 to 579: Poor
- 580 to 669: Fair
- 670 to 739: Good
- 740 to 799: Very Good
- 800 to 850: Excellent
- Do not know
- Refuse to answer

Current Rate

What is the current monthly payment (in dollars) that you are paying on your (primary) home mortgage? If you do not know, please put your best guess.

What is the current interest rate that you are paying on your (primary) home mortgage? Please enter your rate as a number (e.g. if your interest rate is 5.5%, please enter 5.5). If you do not know, please put your best guess.

How confident are you that your interest rate is ${q://QID13/ChoiceTextEntryValue}%?

Not very confident Very Confident

0 1 2 3 4 5 6 7

Confidence

CurMarketRate

Without checking, what do you think is the average 30 year mortgage rate being offered to refinancing borrowers today? Please enter the rate as a number (e.g. if you think

the average mortgage rate is 5.5%, please enter 5.5). If you do not know, please put your best guess.

How confident are you that the market refinancing rate is ${q://QID14/ChoiceTextEntryValue}%?

Not very confident Very Confident

0 1 2 3 4 5 6 7

Confidence

Refinancing History 1

How many times have you refinanced your mortgage in the last 20 years?

- Never
- Once
- Twice
- Three times
- Four or more times

Refi1

When is the most recent time that you refinanced the mortgage on your primary residence?

	Month	Year
Month/Year		

What was the interest rate on your mortgage before you refinanced? Please enter your rate as a number (e.g. if your interest rate was 5.5%, please enter 5.5).

Was this a "cash-out" refinancing?

- Yes
- No
- I don't know

Refi2

When is the second most recent time that you refinanced the mortgage on your primary residence?

	Month	Year
Month/Year		

What was the interest rate on your mortgage before you refinanced? Please enter your rate as a number (e.g. if your interest rate was 5.5%, please enter 5.5).

Was this a "cash-out" refinancing?

- Yes
- No
- I don't know

Refi3

When is the next most recent time that you refinanced the

mortgage on your primary residence?

	Month	Year
Month/Year		

What was the interest rate on your mortgage before you refinanced? Please enter your rate as a number (e.g. if your interest rate was 5.5%, please enter 5.5).

Was this a "cash-out" refinancing?

- Yes
- No
- I don't know

MPC1

Now consider a hypothetical situation where you unexpectedly receive a one-time payment of $5,000 today. We would like to know whether this extra income would

cause you to change your spending behavior in any way over the next 3 months.

Please select only one

- Over the next 3 months, I would **spend/donate** more than if I hadn't received the $5,000
- Over the next 3 months, I would **spend/donate** the same as if I hadn't received the $5,000
- Over the next 3 months, I would **spend/donate** less than if I hadn't received the $5,000

Please select only one

- Over the next 3 months, I would **pay off more debt (or borrow less)** than if I hadn't received the $5,000
- Over the next 3 months, I would **pay off the same amount of debt** as if I hadn't received the $5,000
- Over the next 3 months, I would **pay off less debt (or borrow more)** less than if I hadn't received the $5,000

Please select only one

- Over the next 3 months, I would **save** more than if I hadn't received the $5,000

- ○ Over the next 3 months, I would **save** the same as if I hadn't received the $5,000
- ○ Over the next 3 months, I would **save** less than if I hadn't received the $5,000

SpendMoreAmount

You indicated that you would increase your spending/donations over the next 3 months following the receipt of the $5,000 payment. How much more would you spend/donate than if you hadn't received the $5,000?

SpendMoreFollowup

You indicated that you would increase your spending/donations over the next 3 months by $${q://QID54/ChoiceTextEntryValue} following the receipt of the $5,000 payment. How would your spending change over time? I would increase my spending in...
(Please note: The numbers need to add up to ${q://QID54/ChoiceTextEntryValue}.)

the next 2 weeks by $	0
the 2 weeks after that by $	0
the second month by $	0
the third month by $	0
Total	0

MPCmonthly

Now consider a hypothetical situation where your monthly mortgage payments (or monthly bills if you do not currently have a mortgage) unexpectedly decrease by $250 per month, starting today and lasting for 10 years. We would like to know whether this extra income would cause you to change your spending behavior in any way over the next 3 months.

Please select only one

- Over the next 3 months, I would **spend/donate** more than if I hadn't received the $250 per month
- Over the next 3 months, I would **spend/donate** the same as if I hadn't received the $250 per month

- Over the next 3 months, I would **spend/donate** less than if I hadn't received the $250 per month

Please select only one

- Over the next 3 months, I would **pay off more debt (or borrow less)** than if I hadn't received the $250 per month
- Over the next 3 months, I would **pay off the same amount of debt** as if I hadn't received the $250 per month
- Over the next 3 months, I would **pay off less debt (or borrow more)** less than if I hadn't received the $250 per month

Please select only one

- Over the next 3 months, I would **save** more than if I hadn't received the $250 per month
- Over the next 3 months, I would **save** the same as if I hadn't received the $250 per month
- Over the next 3 months, I would **save** less than if I hadn't received the $250 per month

SpendMoreAmount Monthly

You indicated that you would increase your spending/donations over the next 3 months following your

mortgage payment decreasing by $250 per month. How much more (per month) would you spend/donate than if you hadn't received this decrease?

SpendMoreFollowup Monthly

You indicated that you would increase your spending/donations over the next 3 months by $${q://QID65/ChoiceTextEntryValue} following the receipt of the $250 monthly payments. How would your spending change over time? I would increase my spending in... (Please note: The numbers need to add up to ${q://QID65/ChoiceTextEntryValue}.)

the next 2 weeks by $	0
the 2 weeks after that by $	0
Total	0

Fiftybpdrop

Earlier you indicated that your current mortgage rate is ${q://QID13/ChoiceTextEntryValue}%. Now consider a hypothetical situation where the mortgage rate being offered by lenders has fallen to - 0.5 }%. How likely would you be to refinance your current mortgage?

- Extremely unlikely
- Somewhat unlikely
- Neither likely nor unlikely
- Somewhat likely
- Extremely likely

Hundredbpdrop

Earlier you indicated that your current mortgage rate is ${q://QID13/ChoiceTextEntryValue}%. Now consider a hypothetical situation where the mortgage rate being offered by lenders has fallen to - 1 }%. How likely would you be to refinance your current mortgage?

- Extremely unlikely
- Somewhat unlikely
- Neither likely nor unlikely
- Somewhat likely
- Extremely likely

reficutoff

Earlier you indicated that your current mortgage rate is ${q://QID13/ChoiceTextEntryValue}%. What is the highest mortgage rate being offered by lenders at which you would definitely refinance your mortgage? If you would never consider refinancing your mortgage, please enter 0.

Impatience Index

To what extent do you agree with the following statements?

	Strongly disagree	Diagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I'm always saying: I'll do it tomorrow.	○	○	○	○	○	○	○
I usually accomplish all the things I plan to do in a day.	○	○	○	○	○	○	○

	Strongly disagree	Diagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I postpone starting on things I dislike to do.	○	○	○	○	○	○	○
I'm on time for appointments.	○	○	○	○	○	○	○
I often start things at the last minute and find it difficult to complete them on time.	○	○	○	○	○	○	○

Demographics

What is your US Zip Code?

Are you of Spanish, Hispanic, or Latino origin?

- ○ Yes
- ○ No

Choose one or more races that you consider yourself to be

- [ ] White or Caucasian
- [ ] Black or African American
- [ ] American Indian/Native American or Alaska Native
- [ ] Asian
- [ ] Native Hawaiian or Other Pacific Islander
- [ ] Other
- [ ] Prefer not to say

What is the highest level of education you have completed?

- ○ Some high school or less
- ○ High school diploma or GED
- ○ Some college, but no degree
- ○ Associates or technical degree
- ○ Bachelor's degree
- ○ Graduate or professional degree (MA, MS, MBA, PhD, JD, MD, DDS etc.)
- ○ Prefer not to say

What was your total household income before taxes during the past 12 months?

- Less than $25,000
- $25,000-$49,999
- $50,000-$74,999
- $75,000-$99,999
- $100,000-$149,999
- $150,000 or more
- Prefer not to say

How old are you?

- Under 18
- 18-24 years old
- 25-34 years old
- 35-44 years old
- 45-54 years old
- 55-64 years old
- 65+ years old

How do you describe yourself?

- Male
- Female

- ○ Non-binary / third gender
- ○ [ ] Prefer to self-describe
- ○ Prefer not to say

How many children under 18 live with you?

[ ]

What is your current marital status?

- ○ Married
- ○ Living with a partner
- ○ Widowed
- ○ Divorced/Separated
- ○ Never been married

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