

The Stress of Debt: Mortgage Refinancing and Labor Supply

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Abstract

We combine a customized survey and randomized controlled trial to study the effect of mortgage refinancing on household labor supply. We find that an exogenous reduction in monthly mortgage payments increases working hours, labor income and spending, and reduces perceived stress levels at work. The effects are stronger for workers who are younger, have lower wealth or are more financially constrained before the experiment. Our results are consistent with a higher debt level decreasing labor supply through a financial stress channel.

JEL: E21, E24, J22, C93

Keywords: Refinance, labor supply, RCT, financial stress

I. Introduction

The wealth effect on labor supply is one of the most canonical predictions in economics: as households become wealthier, they take more leisure and work less. A reduction in household debt is a positive wealth shock, so debt relief, whether through mortgage refinancing, loan forbearance, or monetary easing, should, by this logic, lower labor supply. Yet for households that are financially stretched, debt is more than a claim on future resources; it is also a source of persistent stress that consumes attention and depletes the cognitive resources people rely on to work productively. Through this channel, easing a debt burden could raise productivity and, therefore, labor supply rather than lower it. Which force dominates is ultimately an empirical question, and a consequential one, since monetary policy and household debt-relief programs operate at scale precisely by changing what households owe. The main obstacle to answering it is the scarcity of exogenous variation in debt burdens, compounded by the difficulty of measuring labor supply, productivity, and stress at the household level.

We analyze a field experiment conducted by a large commercial bank in China to test the effects of mortgage refinancing on labor supply, focusing on a sample of 7000 borrowers with existing mortgages. To generate exogenous variation in the propensity to refinance, In April 2023 the bank sent out a text message to a random 60% of borrowers (treatment group) about an opportunity to refinance their mortgage to a lower interest rate, together with a reminder sent three days later. Our setting has two-sided non-compliance such that both treatment group and the rest (control group) can choose to refinance or not. We find that the notice increased the propensity to refinance significantly. Over the six months after sending out the notice, 71% in the treatment group refinanced their mortgages, compared with only 20% in the control group.

Given that the overall Chinese mortgage interest rate was decreasing around our experiment, refinancing reduced mortgage interest rate significantly. In particular, while average mortgage rate was around 5.6% before the experiment for both control and treatment groups, it decreased to around 4% for the treatment group, compared with around 5.2% for the control group, after the experiment. Equivalently, monthly mortgage payment reduced

by 16% for the treatment group in excess to that of the control group. The large average reduction in the cost of mortgage generates strong economic significance of the experiment, therefore permitting precise estimates of the effects of mortgage payment on economic outcomes.

We administered two customized surveys before and after the experiment to assess borrowers' weekly working hours and stress levels throughout the sampling period. Moreover, since bank account data provide income flows and spending based on transaction histories only at the individual-level and since spending data from a single source may be incomplete, we exploit our two survey waves to elicit total household income and consumption. The first survey was distributed between three to one week before the experiment. It allows us to measure information before the intervention. The second one was sent out six months after the experiment to assess participants' post-economic outcomes.

One concern is that the survey might act as a cue that alters the sensitivity of labor supply to mortgage refinance. To exclude this concern, we only randomly selected 75% of the borrowers to receive the surveys. We then test if there is any systematic difference between the responses of total income and spending between the surveyed and non-surveyed samples. To this end, we find no statistical difference in the effects of mortgage refinance on economic outcomes between these two groups.

Despite leveraging exogenous variations in refinancing generated by the information treatments, imperfect compliance poses a challenge to directly identify the Average Treatment Effect (ATE) of refinancing on labor supply. Due to two-sided non-compliance, we focus on estimating the Local Average Treatment Effect (LATE) for people who complied with the bank's refinancing notice. Specifically, we employ an IV specification where we regress economic outcomes on log changes in mortgage payments, using treatment status as an instrument. We find significant effects of reduced mortgage payments on total spending (excluding mortgage payments), working hours, and total income (excluding capital gains). Specifically, an average of around 30% decrease in post-refinancing mortgage payments translates into a 3.56% increase in spending, a 2.61%

increase in hours worked and a 6.37% increase in productivity (defined as income per hour), ultimately leading to a 9% rise in labor income.

To explore the heterogeneity in the responses of labor supply to payment reduction, we split our samples into different sub-groups by pre-experiment characteristics. We find that the effects are stronger for borrowers that are younger, have lower wealth, or more financially constrained. In addition, the effects are also stronger for people whose earnings consist of a larger fraction in non-salary components. This is expected as wages or salaries are largely stable due to pre-set wage rate (Grigsby et al. 2021). Although these results are informative, our conclusions should be interpreted as suggestive because subsample split along one characteristic could be correlated with another.

Our estimates indicate that negative shocks to mortgage payments result in an increased labor supply accompanied by higher productivity levels. This outcome deviates from the conventional understanding of wealth effects on labor supply. Although various mechanisms could account for why lower mortgage payments might lead to greater productive labor supply, our findings point to the alleviation of financial stress as the most plausible explanation. High stress levels due to poor financial stability can deplete cognitive resources and time, preventing financially stressed individuals from efficiently focusing on and performing economic tasks (Mani et al. 2013; Mullainathan and Shafir 2013; Kaur et al. 2019; Ong et al. 2019; Fink et al. 2020; Lichand and Mani 2020). Therefore, bad financial conditions could decrease labor productivity by depleting cognitive abilities (Sergeyev et al. 2023). Using novel subjective stress data from our surveys, we document significantly lower reported stress level after a decrease in mortgage payments. Additionally, post-refinancing improvements in financial situations, such as higher savings rates, net wealth and borrowing limits, further support a financial stress channel, consistent with the positive correlation between financial stress and financial constraints (Sergeyev et al. 2023).

Our study mainly contributes to two strands of literature. First, it adds to the empirical study of how wealth shocks affect labor supply. Consistent with traditional wealth effects, studies such as Kaplan (1987), Imbens et al. (2001), Arvey et al. (2004), Kuhn et al. (2008), Furaker et al. (2009), Cesarini et al. (2017), Picchio et al. (2018), and Golosov et al. (2024)

find that winning lotteries reduces working hours and labor earnings. Meanwhile, labor outcomes can also respond to the same direction of the wealth shocks. For example, Van Doornik et al. (2024) document that increased financial access enables households to work more by finding jobs that are farther away, consistent with the mitigation of household lock-in effects (Genesove et al. 1994). Research examining the impacts of reduced home equity on labor outcomes highlights that negative wealth shocks due to housing market distress can negatively impact entrepreneurship (Schmalz et al. 2017), small business employment (Adelino et al. 2015), labor mobility (Ferreira et al. 2010; Bernstein et al. 2022), job search (Brown and Matsa 2020) and productivity (Bernstein et al. 2021). Increased wealth can also help individuals with good business ideas but limited access to credit to start or expand businesses, thereby increasing their labor income through a self-employment liquidity effect.

Our study highlights the difference between wealth shocks resulting from asset increases (Balboni et al. 2022; Banerjee et al. 2015; Banerjee et al. 2020) and those stemming from persistent debt reductions.¹ We contribute to this literature by combining an RCT with surveys to study how positive wealth shocks in the form of reduced cost of mortgage affect labor supply and productivity for consumers with large debt burdens (mortgages). Moreover, our survey-based measure of stress allows us to enrich the recent literature suggesting that reduced financial distress improves cognition and focus among financially constrained individuals (Ong et al. 2019; Fink et al. 2020; Lichand et al. 2020; Bernstein 2021; Kaur et al. 2021).

We also add to the body of research studying how mortgage refinancing represents an important channel through which monetary policy affects the real economy (Altavilla et al. 2020; Berger et al. 2021; Zhang 2022; Fisher et al. 2024). The literature has mainly examined the consumption and financial responses associated with refinancing (Keys et al. 2014; Di Maggio et al. 2017; Jappelli and Scognamiglio 2018; Wong et al. 2019; Abel and

¹ For some examples, Dobbie and Song (2015) find that unsecured debt relief from bankruptcy protection limiting wage garnishment increases employment earnings, consistent with debt overhang mechanisms. Similarly, Bruijn et al. (2023) show that debt relief significantly boosts part-time employment among financially vulnerable individuals, many of whom are non-employed or receive welfare benefits. Di Maggio et al. (2017) demonstrate that improvements in household balance sheets, such as mortgage rate declines, positively affect local employment growth in non-tradable sectors. Gyongyosi and Verner (2024) show that debt relief increases labor income.

Fuster 2021). In addition, Zator (2025) shows notable increases in labor supply following interest rate hikes, particularly among borrowers with low bankruptcy rates and recourse loans. Our study contributes by leveraging exogenous information treatments, survey responses, and administrative information to study the causal effects of mortgage refinancing on labor supply through a behavioral channel.

The remainder of this paper is organized as follows: Section II describes the institutional background. Section III describes the experimental design, the surveys, and the data. Section IV presents a set of stylized facts and studies the effects of refinancing notice on mortgage terms. This section also presents the effects of reduction in mortgage payments on various economic outcome. Section V explores the channels underlying the findings. Section V concludes the study.

II. Institutional Background

We first give an overview of the mortgage market in China. China's mortgage market, in comparison to its counterparts in advanced economies, is of relatively recent origin. Prior to the late 1980s, housing was considered a part of social welfare and distributed by the government without the option for private ownership. The landscape then began to shift. This change was spurred by reforms aimed at transitioning to a market-driven housing system, thus ending the state-owned enterprises (SOEs) being the primary distributors of housing.

The withdrawal of housing provision by SOEs led to a significant gap in housing finance, prompting the establishment of the first mortgage bank in China, the Yantai Housing Savings Bank, in 1987. The evolution continued in 1998 with the People's Bank of China (PBC) introducing the Residential Mortgage Lending Regulations. These regulations aimed to nurture the private real estate sector by offering subsidized mortgage rates to borrowers, further incentivized by the PBC's decision to reduce mortgage rates five times from 1998 to 2002.

These measures were instrumental in propelling the growth of the mortgage market, with the outstanding residential mortgage loan balance soaring to RMB 2.7 trillion by the

end of 2007, making up 82.5% of total household debt and 11% of GDP (Agarwal et al. 2022). Commercial banks emerged as the predominant providers of mortgage loans, accounting for 82.5% of the residential mortgage loan balance by 2007. The remainder was covered by the Housing Provident Fund (HPF), which, despite offering lower interest rates, is limited by a cap on loan amounts that fails to meet the financial demands imposed by soaring housing prices. Consequently, many borrowers opt for hybrid mortgages, combining commercial loans with the maximum permissible HPF loans to meet their financing needs.

The mortgage rate structure in China is uniform across the board, governed by an adjustable-rate mortgage (ARM) system. The rates are calculated based on a predetermined formula that multiplies the benchmark interest rate by the mortgage rate multiplier, both of which are set by the PBC. Interest rates for most mortgage contracts are recalibrated annually. The benchmark rate for commercial loans is determined by the long-term rate for durations of five years or more, while HPF loans follow the HPF benchmark rate. Over the past two decades, the commercial loan multiplier has varied between 0.7 and 1.2, in contrast to the HPF loans' constant multiplier of 1.

Moreover, the central bank caps the loan-to-value ratio for mortgages at 80%, though banks often mandate down payments exceeding 30%. A 2007 survey across 20 major Chinese cities revealed an average down payment of 37.4% (Shen and Yan 2009). The maximum mortgage term is set at 30 years, constrained further by the borrower's age, which combined with the mortgage duration, must not exceed 65 years.

Mortgage down payments typically absorb twice the annual household income at the time of purchase, with mortgage debt servicing consuming up to 35% of a household's disposable income (Liu and Xiong 2020).

In August 2019, the PBC initiated the Loan Prime Rate (LPR) reform. Prior to this reform, the PBC set and adjusted the benchmark lending rates, which banks would then use as a reference to price mortgage loans. However, this system was criticized for its rigidity and inefficiency in responding to changes in economic conditions and monetary policy adjustments. The LPR reform makes the loan pricing process more market-oriented

by linking it directly to the medium-term lending facility (MLF) rate, which is the rate at which the PBC lends to commercial banks. This link aims to ensure that changes in the central bank’s policy stance are more effectively transmitted to the economy.

Under the new system, the LPR is set as the lowest referencing rate at which commercial banks charge their most creditworthy customers, and it is published on the 20th of each month by the National Interbank Funding Center. Interest rates to borrowers at origination are then set equal to the LPR with markups and markdowns based on banks’ assessment of the borrowers’ creditworthiness. Over the term of the loan, the interest rate is then adjustable according to the LPR with the same mark-ups or markdowns set at origination.

After 2019, the LPR on loans with maturity longer than 5 years (5-Y LPR) guides the interest rates banks set for new mortgages. However, due to factors that affect market demand and competition, average rates on new mortgages are generally different from the LPR rates. That is, the average markups to LPR rates could be positive when demand is high and negative when demand is low.

III. Data and Setting

A. Experiment design

We collaborate with a large Chinese commercial bank. The bank operates nationally and is among the top 10 commercial banks in China by total assets. In 2023, the bank’s total assets amounted to more than one trillion U.S. dollars with more than 70 million active account holders. Through this bank, we obtained transaction-level information and demographic information of a representative sample of the Chinese banked population.

For each account holder, we have also obtained data from the Credit Reference Center of the People’s Bank of China (China’s official credit registry) on total outstanding debt and its composition. The Credit Reference Center aggregates information from all financial institutions from which borrowers receive credit and not only the bank with which we cooperate, which allows us to observe the full size and structure of borrowers’ liabilities.

Therefore, in addition to the mortgage in this bank, we can also observe if the borrowers have adjusted their borrowing, including mortgages, from other financial institutions.

In April 2023, the partner bank notified eligible customers about the substantial savings they could achieve by refinancing their mortgages at lower interest rates. Figure 1 outlines the design of our experiment, which comprised four steps:

1. *Initial selection*: on March 25, we randomly selected 7000 individuals with an existing mortgage at the bank and qualify for a lower APR as the participants, from a pool of customers that satisfied a set of criteria. The set of criteria includes that the borrowers must 1. have a mortgage with existing balance greater than 300 thousand CNY, 2. with a remaining term more than 5 years, 3. a current APR of at least 4.35%, and 4. a credit score above the first quartile. All four criteria are set at the 25% percentile of the distribution. In the end, 60% were assigned into a treatment group.
2. *Pre-experiment survey*: on Mar 28, we sent out a survey to elicit a set of borrowers' characteristics, including their total wealth, total spending over the past six months, and a subjective stress level at work to a random 75% of the selected participants. The survey notice was sent through text message (Figure 3 Panel A) and had to be filled out electronically². The survey can be filled out by Apr 16. Upon completion, the participants received a 10-CNY compensation.
3. *Treatment*: on Apr 24, those in the treatment group received a notice through text message about a refinancing opportunity (Figure 3 Panel B). The information on the notice is

Dear customer, the current interest rate for your mortgage with our bank is X0%. You can adjust the interest rate of your mortgage to X1% in various ways. You can visit our bank branches to handle this matter. Click [URL](#) for details. [Bank Name]

where X0 and X1 are respectively the old APR and new qualified APR on the mortgage. A reminder was sent to the treatment on Apr 27.

² See Section I in the online appendix for the survey.

4. *Follow-up Survey*: on Nov 08, we sent out a follow-up survey to elicit the same information as in the pre-experiment survey. The survey was sent to those who received the first survey. The survey can be filled out by Nov 28. Upon completion, the participants received a 10-CNY compensation.

On average, survey participants spent about 3 minutes answering the survey. The reward was 10 CNY, which is above the 99th percentile of the hourly wage rate in China and led to a high response rate (73%).

The survey starts by describing its purpose. Besides ensuring informed participation, this step aims to eliminate any potential strategic motives in answers: without explanations, respondents might incorrectly infer that their answers are used to shape the types and quantities of financial services the bank would offer them going forward. To avoid this, respondents read the following paragraph:

This study is in collaboration with third-party research institutions. The data will only be analyzed for scientific research purposes and will not be evaluated by our bank. We will not disclose participants' personal information in any respect. We will not, to any extent, change the types of financial services we provide, including credit scores, credit limits, deposit and borrowing interesting rates, etc., based on the participants' personal answers. We hope you could answer the survey based on your true thoughts.

In addition to the disclosure, we also check for existence of any survey demand effects by comparing economic outcomes for those who were sent and were not sent the survey.

B. Refinancing strategy

The experiment was implemented in a period when the overall mortgage interest rate in China is decreasing. Figure 1 illustrates the trends of both the 5-Year Loan Prime Rate (LPR) and the bank's average interest rate on new mortgages. The latter is weighted by the loan size. Initially, the 5-Year LPR remained stable at approximately 4.65% until the onset of 2022. During the period from January to July 2022, it underwent three successive cuts,

culminating in a total reduction of 35 basis points. Concurrently, this period marked a significant decline in the overall demand for mortgages in China. This downtrend is reflected in the average interest rates for new mortgages, which decreased from roughly 4.9% at the end of 2021 to about 3.8% by the end of 2022.

Given the large decreases in average interest rate of newly originated mortgages in China. This refinancing strategy is expected to reduce interest cost sizably. However, it is not a common knowledge to homeowners because of slow information diffusion. From the bank's record, only around 15% of homeowners whose interest rate could be at least 1% lower after taking a new mortgage actually engaged in the refinance in the first half year of 2023.

Our study seeks to explore how positive wealth shock through reduction in mortgage payments affect individual behaviors. This is mostly achieved through cash-out refinancing in other economies. However, distinct from such economies including the US, China places strict restrictions on cash-out refinancing. Data from the Chinese Household Finance Survey in 2015 and 2017 indicates a very small percentage of around only 2.2% of all homeowners engaged in mortgage debt refinancing or had home equity lines of credit (Deng et al. 2021).

As an alternative way that is similar to refinancing, since late 2022, when the housing demand has been continuously glooming and competition begins to rocket, banks start to offer alternative products to indirectly help customers to refinance to a lower interest rate to retain market share. The most popular product is a consumer credit line with credit limit just large enough to cover the remaining mortgage amount. With this loan, the customers could borrow to repay the remaining mortgage, and apply for a new mortgage, with the proceeds from the new mortgage used to repay the consumer loan. Such practices are in general delegated to the bank, and the whole process usually takes around two business days.

C. Measurement of income, spending, and debt

We have four sources of income data: individual-level income from the bank and from the Chinese tax authority, as well as individual- and household-level income from our surveys.

In particular, with bank account information, we can compute income inflows and spending outflows from transaction-level data. To do this, we follow the steps the bank uses, which identify individual income following a classification rule of regular inflows. The bank calculates this number in one of two alternative ways. First, if income is paid as a direct deposit from the borrowers' employers into the bank account, the number is directly labeled as salary. Otherwise, the bank can identify income if the personal social security insurance, which is a fixed portion of the borrowers' income, is paid through the bank.³ We calculate income from business operations as the difference between total inflows and total outflows of transactions that the bank categorizes as business operations. Overall, 68.27% of all income in our sample is from salary and 31.73% from business cash flows.

To validate the accuracy of the income measures computed by the bank, we exploit individual income data from social security records. The results of this comparison are displayed in Figure 1a of the online appendix, where a binned scatter plot compares the bank-computed income with the one reported by account holders to the Chinese tax authority. The plot reveals a strong linear relationship between these two values, with an R^2 of 90%. This corroborates the reliability of our income data. For unmarried individual, we use individual income as household income. For married borrowers, we assign individuals with the same address as in the same households. We set household income as missing if we can only get income data for one but married individual.

Transactional information allows us to dissect income into different components. However, calculation from transaction history might still miss some income sources that are not credited to this bank account. To address this, we collect total household income over the past six months through the following survey question

³ In China, social security payments have six components: five types of insurance and a housing provident fund. The types of insurance are paid as a fixed proportion of the worker's monthly income. One such insurance is the retirement saving insurance, which is similar to retirement savings plans in the US. The monthly contribution is 8%. However, the income base for social security is usually capped at the two tails of the income distribution. The caps vary across space and are usually set between 30%–300% or 40%–400% of the previous year's average income in each location. The uncapped distribution covers most Chinese workers (~ 90%). We remove individuals in the capped regions from the final sample.

How much income did you and other family members of your family made over the past 6 months?

Note: income includes wages, salaries, bonuses, commission, etc., excluding earnings from financial investment.

We also use these survey responses to verify the accuracy of the household income measure constructed from bank data.

We compute total non-durable spending over the past six months based on the following question from the survey:

What was the total expenditure of your family on non-durable goods and services over the past 6 months.

Note: non-durable goods and services include items that are consumed or used up in a short period such as food and beverages, personal care products, and entertainment services, etc. Do not include spending on durable goods that last for long periods, such as appliances, furniture, or cars.

We also compute total durable spending over the past six months based on the following question from the survey:

What was the total expenditure of your family on durable goods and services over the past 6 months.

Note: durable goods and services include items that last for long periods, such as appliances, furniture, or cars. Do not include spending on non-durable goods or services.

For debt, we rely on data from the Chinese credit registry, as discussed above, which includes the debt issued by individuals across all banking relationships they have. We compute debt at the individual level as the sum of outstanding interest-incurring balances on all credit cards and other unsecured personal loans in the credit registry.

D. Measurement of working hours and stress

A novel part of our study is that we can also measure the intensive margin of labor supply through the number of hours the participants choose to work. In particular, we rely on the following question to measure labor supply:

How many hours do you usually work on average every week over the past 6 months?

A recent strand of literature documents that there is likely a financial stress channel through which low wealth affects labor productivity (Bernstein 2021; Kaur et al. 2021; Sergeyev et al. 2023). We measure subjective stress level at work to test the existence of financial stress in suppressing labor productivity. The question we use is

How would you rate your level of stress at work?

From 0 to 100, with 0 being no stress at all, and 100 being very stressful.

In the end, we drop observations with missing answers on the survey. This drops our sample by around 9%, which leads to a final sample with 3491 observations that have filled out the surveys.

IV. Results

A. Summary Statistics

Panel A of Table 1 and Figure 4 summarize the pre-experiment characteristics of the participants that have filled out the surveys. The age distribution is symmetric around a mean of 38 years, predominantly capturing individuals in their prime working years, as evidenced by an interquartile range of 34 to 41 years. The monthly household income is around 13.2 thousand CNY, monthly total household spending excluding mortgage payment is 7.4 thousand. The sample is relatively balanced in the gender composition, where 46% are females. The participants have a high education level, with about 75% having at least some college education. The mortgage volume is 553 thousand on average, with an average monthly mortgage payment of 4.36 thousand and interest rate of 5.6%.

The average monthly mortgage payment constitutes 32% of household average income, in line with Liu and Xiong. (2020), who observe that mortgage debt typically consumes up to 35% of a household's disposable income. The average down payment of 34.65% relative to the total home value is consistent with the 40% found in a 2007 survey of 20 major Chinese cities (Shen and Yan 2009).⁴

In terms of working condition, on average, the participants work 40 hours a week. Around 37% of the answers are exactly 40 hours. The remaining 63% ranges between 20 hours to 64 hours a week. This distribution of working hours is consistent with several findings in the literature (Fan et al. 2023; Haizheng Li et al. 2003; Hongbin Li et al. 2015). For instance, Haizheng Li et al. (2003) show that the labor supply behavior of urban Chinese workers aligns with standard economic theory, even within the context of a developing economy and a partially reformed labor market. Their study identifies an average workweek of approximately 42 hours - longer than in most developed countries - and notes a consistent⁵ pattern across individuals with different household responsibilities. A key finding from Haizheng Li et al. (2003), supported by our data and illustrated in Panel C of Figure 2a in the online appendix, is the negative correlation between wages and working hours. This suggests that negative income effects more than offset the potential increase in labor supply that might result from higher wages making leisure more costly. It is worth noting that, despite legal regulations limiting full-time employees to a standard 40-hour workweek (with allowances for an average of 44 hours under specific conditions), data from the National Bureau of Statistics of China indicates that actual weekly working hours averaged between 46 and 49 hours from 2022 to 2024.

⁴ For a cross-country perspective, ATTOM's *United States Real Estate Overview* for May 2024 indicates a median down payment of 15.6%, while in the UK most households put down 5% (Benetton et al. 2022), with approximately 25% providing a down payment of 10% or more (Tracey et al. 2021). Additionally, first-time buyers in the UK have seen their average down payment increase from 15% before the financial crisis to over 25% by 2010 (Benetton et al. 2018).

⁵ However, their results also reveal disparities, with unskilled or lower-status workers generally working longer hours than managers and professionals. Moreover, workers in enterprises owned by the central or provincial government tend to have shorter work weeks compared to those in locally-owned or non-public sector enterprises.

The qualitative measure of stress at work from the surveys, ranging from 0 (not concerned) to 100 (extremely concerned), has an average value of 34, a median value of 31, an interquartile range from 17 to 52 and a standard deviation of 20. Since it is a scale measure, the magnitude is not suggestive. Still, Panel F of Figure 4 illustrates that the distribution of reported stress levels among Chinese workers is fairly uniform, with only a small proportion of respondents experiencing extremely high stress. In comparison, Sergeyev et al. 2023 document that U.S. households spend a median of six hours per week worrying about their financial situation, with 15% reporting extreme concern and just 7% indicating no concern. Their financial stress, measured on a scale from 1 to 10, exhibits a more symmetrical and concentrated distribution, with a mean of 5.88, a median of 6 and a standard deviation of 2.83. Similarly, Kaur et al. 2019 underscore the substantial stress financial burdens place on workers, with 70% reporting being “very worried” about their finances and 52% expressing concern at least once daily. Their study also shows that financial worries are persistent, with 43% of workers dwelling on financial issues for hours and 10% for an entire day. For a more direct comparison to our measure of work-related stress, Kaur et al. 2019 find that financial concerns frequently disrupt workers’ focus during the workday, with 50% spontaneously mentioning financial thoughts while working and 83% confirming this when asked directly.

Our data further reveal that work-related stress is more prevalent among younger workers, men and married people, particularly when they lack full-time employment. Additionally, stress levels increase with the number of weekly hours worked and, consistent with the findings of Sergeyev et al. 2023, are more pronounced among workers with lower liquid wealth and labor income, as well as higher levels of mortgage and debt. These results suggest that financial constraints are a significant predictor of elevated stress levels.

In general, the surveyed sample has similar characteristics with the non-surveyed sample. The only difference is that the non-surveyed sample has a higher income and credit limit. Specifically, average income and credit limit are about 20% higher. In most of our analysis, we focus on the surveyed sample due to the availability of labor supply decisions.

However, lower income or borrowing constraint might indicate that our surveyed sample has a larger MPC to wealth shocks. In the online appendix, we verify that our results hold when only using the non-surveyed sample.

Panels A2 and A3 in Table 1 compare borrowers' characteristics between the control and treatment groups for the surveyed sample. Analogously, panels B2 and B3 compare these variables for the non-surveyed sample. Column 7 gives the p -value testing the difference in means. For both samples, the pre-experiment characteristics pre-experiment the two groups are statistically insignificant at 10% level for all the characteristics. This indicates the success of the randomization.

B. Refinancing Notice and Mortgage Terms

Our intervention design sends a random group of mortgage borrowers notice for refinancing opportunity. However, for those in the treatment group, they may choose not to refinance. Meanwhile, for those in the control group, borrowers can choose to refinance even without receiving the notice. This setting is similar to that in Bryne et al. (2023), which use different types of mailing notice to motivate more refinancing. We first study if our intervention has generated significant effects of treatment status. That is, if the refinancing notice has induced more refinancing in the treatment group, which then leads to a lower average monthly mortgage payment. We define that a borrower has refinanced if the existing mortgage is refinanced within six months after sending out the notice.⁶

Table 2 presents the frequency of refinancing for the control and treatment group. Panels A and B respectively give the results for the surveyed and non-surveyed sample. In both samples, the refinancing notice significantly increased refinancing rates. Among people who completed the surveys, 2121 participants out of 3491 were randomly notified to refinance, with 70.6% complying (1498 out of 2121) within two months of receiving the notice. Additionally, 19% of the individuals not subject to direct prompting from the bank's notifications refinanced their mortgages (263 out of 1370), likely due to the general

⁶ Over the three to six months after the experiment, only 1.9% (2.1%) more participants in the treatment (control) group refinanced.

downtrend in interest rates detailed in Figure 1. This finding closely aligns with the partner bank's records, which show that only 15% of eligible homeowners took advantage of at least a 1% interest rate reduction through refinancing in the first half of 2023. Hence, our text message-based notice and reminder significantly boosted people's propensity to refinance.

In comparison, mail-based notices by Bryne et al. (2023) increase refinancing from 8.9% to 15.7%. The larger effects could be that the total saving from refinancing is very large given the much smaller average new mortgage rates. For example, from Table 1, the average qualified new rate is 1.37 percentage point lower than the current rate. Compared with the 5.60% per-experiment average, this is equivalent to an around 25% decrease. In addition, since refinancing is relative uncommon in China, borrowers could be more willing to take advantage to this possibly one-shot chance.

Panel A of Figure 5 summarizes the mortgage interest rates for the control and treatment groups before and after the experiment. The segments are the interquartile range and the dots are the averages. Before the experiment, more than half of the interest rates are between 5% to 6%. After the experiment, there is an around 50 basis points decrease in the average mortgage interest rates for the control group. For the treatment group, average interest rate decreases by around 1.5 percentage points. In Panel B of Figure 5, we plot the distribution of changes in interest rates conditional on refinancing. As shown, other than a smaller frequency for the control group, the distribution between the two groups mostly overlaps. This indicates that the difference between the average changes in interest rates between the control and treatment groups is driven by more people choosing to refinance at the extensive margin, instead of treatment group refinancing to a lower qualified new interest rate at the intensive margin.

This study leverages exogenous variation in refinancing behavior induced by information treatments to instrument the propensity that a household chooses to refinance. Panel A of Figure 6 depicts the cumulative fraction of participants who refinanced their mortgages around the time of the experiment, while Panel B illustrates the corresponding average interest rates. The red solid line represents the group notified by the bank to

refinance (treatment group), while the green dashed line corresponds to the control group. As participants had not refinanced before the experiment, there are no effects prior to the intervention. Following the treatment, there is a substantial and immediate increase in refinancing among the treated group. In contrast, the control group shows no immediate change in refinancing propensity, gradually reaching 20% refinancing after six months due to the overall decrease in Chinese mortgage interest rates. Additionally, while the average pre-experiment mortgage rate was around 5.6%, it decreased to approximately 4% for the treatment group, compared to around 5.2% for the control group. These results underscore the success of the randomization and the absence of spillover effects between the two groups.

Our aim is to identify the effects of a reduction in mortgage payments on various economic decisions including total spending, working hours, labor productivity, etc. To address potential endogeneity in the log changes of monthly mortgage payments ($\Delta \log Pay_i$) and to solve the imperfect compliance of our randomized controlled trial (RCT), we follow the Instrumental Variable (IV) approach proposed by J. D. Angrist et al. (1996). Our analysis employs two-stage least squares (2SLS) to incorporate several control variables, enabling more precise estimates (J. Angrist et al. 1996). The first stage is specified as

$$\Delta \log Pay_i = \alpha Treatment_i + \gamma X_i + e_i, \quad (1)$$

where $Treatment_i$ is a dummy variable indicating if borrower i belongs to the treatment group and the vector X_i includes a constant and a set of pre-experiment control variables: liquid wealth, credit limits, debt, stress levels, as well as dummy variables for gender, age below the median and college education. This equation estimates the predicted value of the log change in monthly mortgage payments given the exogenous information treatment via an ordinary least-squares regression of $\Delta \log Pay_i$ on $Treatment_i$, which yields $\Delta \log \widehat{Pay}_i$ for each participant. The ordinary least-squares estimator of α is consistent for the Intent-To-Treat (ITT) effect of the refinancing notice on log monthly mortgage payments. The second stage is specified as

$$\Delta Y_i = \beta \Delta \log \widehat{Pay}_i + \omega X_i + \epsilon_i, \quad (2)$$

where ΔY_i denotes the change of the economic variable of interest. The ordinary least-squares estimator of β is a consistent estimator of the Local Average Treatment Effect (LATE) under the assumptions of instrument relevance, independence, monotonicity and exclusion.⁷ In essence, the OLS estimate captures the average causal response of ΔY_i to the exogenously induced $\Delta \log \widehat{P}a y_i$ for individuals who complied with the bank's offer but would not have otherwise engaged in refinancing.

In Table 3, we first estimate the first-stage effects of refinancing notice on mortgage terms. In addition to the Δ , we also present results for interest rates and the level of mortgage payments. In the odd columns, we exclude any control variables. In the even columns, we include control variables to presumably absorb the noises measured in the left-hand-side variables. In general, there is a large negative effect of the refinancing notice on the interest costs of the mortgages. Focusing on the even columns, relative to the control group, the treatment group's average interest rate decreased by 1.14 percentage points, monthly payments decreased by around 540 CNY, which is equivalent to a 16% decrease. The estimates hardly change when excluding the controls. The results confirm a significant first-stage effect of the intervention on the interest cost of mortgages.

C. *The Effects of Mortgage Refinancing on Borrower Decisions*

Refinancing to a lower mortgage interest rate is akin to a positive wealth shock. Studying the effects of such wealth shock on individual economic decisions is particularly important given that refinancing after central banks lower benchmark interest rate is usually an important tool to spur economic condition (Keys et al. 2014; Di Maggio et al. 2017; Wong et al. 2019; Amromin et al. 2020; Abel and Fuster 2021; Berger et al. 2021; Eichenbaum et al. 2022). While in general, the effects of a positive shock to wealth on spending is less disputable, how changes in wealth affect labor supply are more controversial. On the one hand, through the traditional wealth effects, positive wealth shock increases the marginal

⁷ If the instrument has a valid first stage, is randomly assigned, satisfies the exclusion restriction by influencing the dependent variable solely through the first-stage channel and the monotonicity restriction by affecting the causal channel in only one direction, then the ITT effects divided by the difference in compliance rates between the treatment and control groups can be interpreted as the causal effect of refinancing for those who complied with the bank's offer but would not have refinanced otherwise.

utility over leisure, which reduces labor supply. Consistent with this prediction, previous literature find that a positive wealth shock reduces hours worked.⁸ On the other hand, some studies propose that there is a psychological factor through which higher financial burden depresses labor productivity and reduces labor supply (Bernstein 2021; Kaur et al. 2021; Sergeyev et al. 2023). In this section, we exploit our experimental setting to study how a positive wealth shock in terms of reduced debt payments affects labor outcomes.

Table 4 studies the effects of refinancing on consumption, hours worked, and total individual and family non-financial income. We also study labor productivity as the ratio between total individual non-financial income and hours worked, which serves as a proxy for hourly wage rates. Panel A gives the ITT effects. It shows that, over the six months after the experiment, those in the treatment group, as compared to the control group, see a 1.83% increase in total spending and 1.34% increase in working hours. In addition, labor productivity also increases by 3.32%. As a result, total income increased by 4.53% at the individual level and by 4.68% at the household level. In Panel B, we estimate the average causal response of the percentage changes in the economic variables to a 1% increase in monthly mortgage payment. The specification follows equation (2). The findings largely confirm those in Panel A. From Column 1, spending elasticity to mortgage payment is -0.12. This is to say, for each 10% decrease in mortgage payment, total spending increases by 1.2%, aligning with existing literature (Di Maggio et al. 2017; Keys et al. 2014; Abel and Fuster 2021). Analogously, Columns 2 to 4 imply that for each 10% decrease in mortgage payment, the borrower would increase working hours by 0.9% with a 2.1% higher wage rate. As a result, total income increases by 3%. Overall, the positive response of labor supply and productivity to positive wealth shock among our sample provides empirical support for a counterfactual negative wealth effect on labor supply.

D. Heterogeneous Effects on Labor Supply and Labor Productivity

This section examines whether refinancing has different effects on the labor supply and labor productivity of borrowers with different characteristics. To do so, we split

⁸ Imbens et al. (2001), Arvey et al. (2004), Kuhn and Lozano (2008), Furaker and Hedenus (2009), Cesarini et al. (2017), Picchio et al. (2018), and Golosov et al. (2024) for some examples.

participants into different groups based on their pre-experiment characteristics and refit the 2SLS specification based on equations (1) and (2) for each sub-group. Since the subsample split along one characteristic could be correlated with another, we view our results as suggestive.

The results are in Table 5. Despite a smaller sample size, the first-stage F statistics exceed 100 across all columns, indicates the strong significance in the first stage. In general, the effects of lower mortgage payments on labor supply and productivity are larger for people with younger age, less wealth, or tighter borrowing constraints, in line with results from Abel et al. 2021 and Keys et al. 2014. Specifically, these groups show productivity elasticity to mortgage payments above -0.2, whereas this elasticity is about half as large and not statistically significant for older, wealthier or less financially constrained individuals. The findings for working hours are qualitatively similar. A possible explanation for the lack of effects among financially unconstrained workers may be that refinancing does not represent a substantial financial event for them. The results along gender, education, and income are more nuanced. While for male, non-college, or low-income borrowers, the effect of lower mortgage payments on productivity is larger, that on working hours are smaller.

The pattern in Table 5 is consistent with prior literature, where Imbens et al. (2001), Cesarini et al. (2017), Picchio et al. (2018), and Golosov et al. (2024) report similar earnings responses to wealth changes across genders. Moreover, previous studies provide mixed evidence on how labor earnings respond to increased wealth across income levels. For example, Andersen et al. (2023) and Golosov et al. (2024) find labor supply and earnings responses increasing in income, also aligning with the idea that higher labor supply is skewed toward better-paid jobs (Zator 2025). However, Amberg et al. (2022) observe that expansionary monetary policy primarily boosts labor income for low-income workers in Sweden.

Another dimension of heterogeneity we test is whether the participants are salary workers. Although Figure 3a (Online Appendix) shows similar standard deviations in hours worked across salaried and non-salaried groups, the nature of salaried employment

suggests a different dynamic in labor supply flexibility. Salaried workers typically have fixed incomes in the short run, making their working hours less adjustable (Ganong et al. 2024). Therefore, one would expect a smaller labor-supply response for workers who rely more on salaries. To do so, we construct two proxies for the importance of salary in a worker's income composition. First, we calculate the amount of salary as a fraction of total income, and then define salary worker as those whose salary fraction of total income is above the median. Since transaction-level income information is only available for around 60% of the sample, we also define a borrower as working in a salary industry if the industry average salary fraction of total income is above the median. The results are in Columns 25 to 32. Consistent with the conjecture, the effects are larger for those that salary has a smaller weight in their total income. In particular, for non-salary workers, or those who work in a non-salary industry, for each 10% less mortgage payments, working hours increases by around 1.5%. This number is about one-third for salary workers on those who work in a salary industry. The results are qualitatively similar for productivities.

V. Why Do Labor Supply Increases

With a negative shock to mortgage payment, borrowers react by increasing labor supply facing a higher productivity. This finding contradicts the conventional wealth effects of labor supply, which propose that a positive wealth shock reduces labor supply. However, several factors could explain why we observe a positive relationship between net wealth and working hours. In this section, we study which causes are more like to be driving our findings.

A. Financial Stress

One potential channel is that a large amount of debt through mortgage worsens individuals' financial situation. Therefore, a positive wealth shock alleviating financial pressures could free up time and/or cognitive resources for productive work, as supported by empirical evidence from Kaur et al. (2019), Banerjee et al. (2020) and Fink et al. (2020). The potential rise in effective wage rates may prompt borrowers to allocate more hours to work according to a substitution effect. Although standard economic approaches typically neglect the role

of stress when analyzing liquidity constraints, Sergeyev et al. (2023) bridge behavioral and traditional perspectives by incorporating financial stress into a standard dynamic model of intertemporal decisions. Their work highlights a strong correlation between financial stress and financial constraints. Then, if financial stress is indeed a significant channel, we should observe larger adjustments among workers with lower net wealth or more liquidity constrained. Consistent with this conjecture, in Columns 17 to 24 of Table 5, we find that the effects of reduced mortgage payments on labor supply and productivity is larger for people with lower ex ante net wealth or tighter borrowing constraint.

Furthermore, if financial stress is driving these outcomes, enhanced financial stability after refinancing should lead to a reduction in stress levels, particularly among workers with lower net wealth or greater financial constraints. As shown in Table 6, a 30% reduction in mortgage payments lead to a 4 percentage points increase in saving rates (Column 1), an 8% increase in the likelihood of accumulating more net wealth (Column 3)⁹ and a 0.06 standard deviation decrease in stress levels (Column 4)¹⁰ over the six months following the experiment. The heterogeneity analysis in Table 3a (Online Appendix) further reveals that reductions in work-related stress and increases in the probability of positive changes in net wealth are concentrated among workers with lower assets and greater financial constraints (Columns 17 to 24). Overall, these results support the hypothesis that financial stress is a driver for the positive¹¹ effects of refinancing on labor supply.

B. Collateral, Borrowing Constraints, and Entrepreneurship

Higher net wealth through less mortgage related cost could also influence labor market choices through entrepreneurial activities. In particular, a reduction in the required total

⁹ Although Column 2 does not report significant increases in net wealth, it should be noted that this variable is measured with interval answers and is expected to have large measurement errors. Hence, substantial standard errors are expected.

¹⁰ Due to non-positive values, we use level changes.

¹¹ In contrast, less stressed individuals, such as those who are older and less financially constrained, might have reduced their labor supply, as standard models predict. However, we likely do not observe significant reductions in working hours and productivity among this group because the savings from refinancing were not substantial enough to influence their behavior.

mortgage payment with unchanged home value, could increase the value of collateral from positive home equity (Adelino et al. 2015; Corradin and Popov 2015; Schmalz et al. 2017), especially when home equity is crucial for the initiation and success of entrepreneurs and small business development. In addition, Jensen, Søren Leth-Petersen, and Nanda (2022) find that an exogenous mortgage reform in Denmark provides entrepreneurs with greater access to home equity lines of credit, thereby unlocking a home equity source of finance to start a business.

Column 5 of Table 6 shows that refinancing increases borrowing limits. Specifically, a 30% reduction in mortgage payments is associated with a rise in total credit limits by approximately 1,310 CNY. Furthermore, from Column 6, higher credit limits are accompanied with higher credit scores, likely driven by a lower debt-to-income ratio. Still, Column 10 reveals that the likelihood of starting a new business is not significantly affected by reductions in mortgage payments. Moreover, refinancing leads to a significant 1 percentage point reduction in credit line utilization rates (Column 7), suggesting increased savings. Hence, while a higher credit limit is consistent with more available credit for entrepreneurship, it may also indicate loosened financial stress from enhanced economic stability or an improved ability to borrow in the future.

As an alternative way to test if entrepreneurship is a potential driver, we study the labor supply elasticity for self-employed and non-self-employed workers. The results are in Columns 1 to 4 of Table 7. The effects of mortgage payments on labor supply and productivity are only slightly larger for self-employed individuals. However, this is likely a result of self-employed individuals are less likely salary workers, therefore are more flexible in adjusting labor supply. At the same time, the effects are not significantly smaller for non-self-employed individuals. In sum, more entrepreneurship after relaxed borrowing constraints does not seem to be the driver behind our findings.

C. Housing Lock

Borrowers facing financial constraints may experience "housing lock," which prevents them from moving (Genesove and Mayer 1994; Stein 1995). Reduced mobility due to lack of liquidity can limit labor market opportunities, potentially leading to lower income due

to longer periods of unemployment, poorer job matches or increased monopsony power by employers who are aware of the worker's limited ability to search for new employment. Loosened borrowing constraint and increased net wealth could improve mobility, which enables workers to find jobs that have a higher productivity (Di Maggio et al. 2019; Bernstein 2021). In general, evidence is mixed on the effects of mortgage or credit constraints on housing lock. For example, Schulhofer-Wohl (2012) and Mumford and Schultz (2014) find no evidence of reduced mobility. Modestino and Dennett (2013) note that although the non-financial costs of immobility could be significant, few households need to move for employment in a given year. Recently, Fonseca and Liu (2024) document that a lower gain from re-mortgaging decreases moving rate. Van Doornik et al. (2024) find that access to more credit enables individual to find jobs across a broader geographical area. This results in higher employment rate and salaries. In our setting, after refinancing, net wealth increases and borrowing limit is relaxed. As a result, households have more resources to invest in finding jobs with a higher return at the different location.

Column 11 of Table 6 indicates that a 30% reduction in mortgage payments increases the likelihood of changing jobs by 2 percentage points. However, to explore whether housing lock contributes to our findings, we first study if lower mortgage payments enable the borrowers to match with jobs that are further away from their home. If the increase in income were due to borrowers finding more productive jobs in distant areas, we would expect to see an increase in the distance to work when mortgage payments decrease. Yet, as shown in Column 12, there is no significant change in the distance to work, suggesting that while some borrowers are changing jobs, their increased liquidity is not expanding their labor market opportunities through enhanced mobility.

As an alternative measure, we study if the effects differ for those who have to go to the office to work and those who can work at home. We categorize participants as office workers if they go to the office at least four days a week and as remote workers if they do not. Our definition is based on the following survey question:

How many days to you go to the office to work.

Columns 5 to 8 of Table 7 display the effects of mortgage payment reductions on labor supply and productivity for both groups. The results reveal minimal differences in their responses, suggesting that housing lock is not a primary factor driving our findings

D. Home Production

Theories about home production and wealth shocks suggest that individuals may shift from home production to consumption spending in response to a positive wealth shock (Becker 1965), especially during retirement (Aguiar et al. 2005; Been et al. 2020) or unemployment (Burda et al. 2010; Taskin 2011; Guler et al. 2013). For example, Been et al. (2020) show that credit-constrained households are more likely to cut consumption in response to a negative wealth shock, consistent with the results of Mian et al. 2011, and that only about 11% of total consumption allocated to durable goods (such as cars or washing machines) and non-durable goods (such as food, home repair or gardening services) could potentially be replaced by home production. As a result, they argue that the role of home production in smoothing well-being may be overstated in analyses that focus solely on the elasticity of substitution between home production and market consumption. Our context suggests that a reduction in mortgage payments might encourage a shift from home production to market-purchased goods, potentially freeing up time and/or cognitive resources for productive labor. Indeed, Benhabib et al. 1991 demonstrate that incorporating home production into economic models influences labor supply elasticities, as the reduced-form utility function may imply that leisure behaves as an inferior good.

If this channel were at play, following refinancing we would expect to see an increase in spending on market goods that replace home production, especially among financially constrained workers. Assuming that any productivity gains are more likely driven by increased spending on durables, such as washing machines or cars, rather than nondurables (e.g., assuming that food preparation is as time-consuming as dining out), this substitution effect would likely manifest as an increased share of spending on durables after the experiment. Yet, Column 9 of Table 6 does not report significant effects in this regard. Combined with the limited role of substitutable goods highlighted by Been et al.

2020, this suggests that replacing home production with market-purchased goods is unlikely to be a significant factor influencing our results.

VI. Conclusion

Understanding how labor supply responds to wealth shocks is crucial for evaluating macroeconomic policies including mortgage refinancing and loan forbearance. However, identifying causal effects is challenging due to limited exogenous variation in debt levels and difficulties in measuring labor supply. This study uses an RCT and surveys to examine how lower mortgage payments affect labor supply and productivity. Our results show that Chinese workers significantly increased working hours, productivity, and spending while experiencing reduced stress following mortgage rate reductions. These effects were strongest among younger, lower-wealth, and financially constrained individuals, supporting the idea that lower debt boosts labor supply by alleviating financial stress.

Future research should further explore how mortgage rate reductions influence economic behavior and whether similar mechanisms apply to other forms of debt. Given the central role of mortgage refinancing in monetary policy, integrating financial stress into macroeconomic models could enhance our understanding of its effects on aggregate labor supply. In addition, our one-time RCT examines behaviors during a period of high unemployment, where reducing mortgage payments eased financial stress, allowing individuals to work more productively. Presumably, labor supply to reduced stress level could be different when the labor market is strong (Zator 2025). Future research could study how the responses of labor supply to mortgage refinancing would be different during a booming economy.

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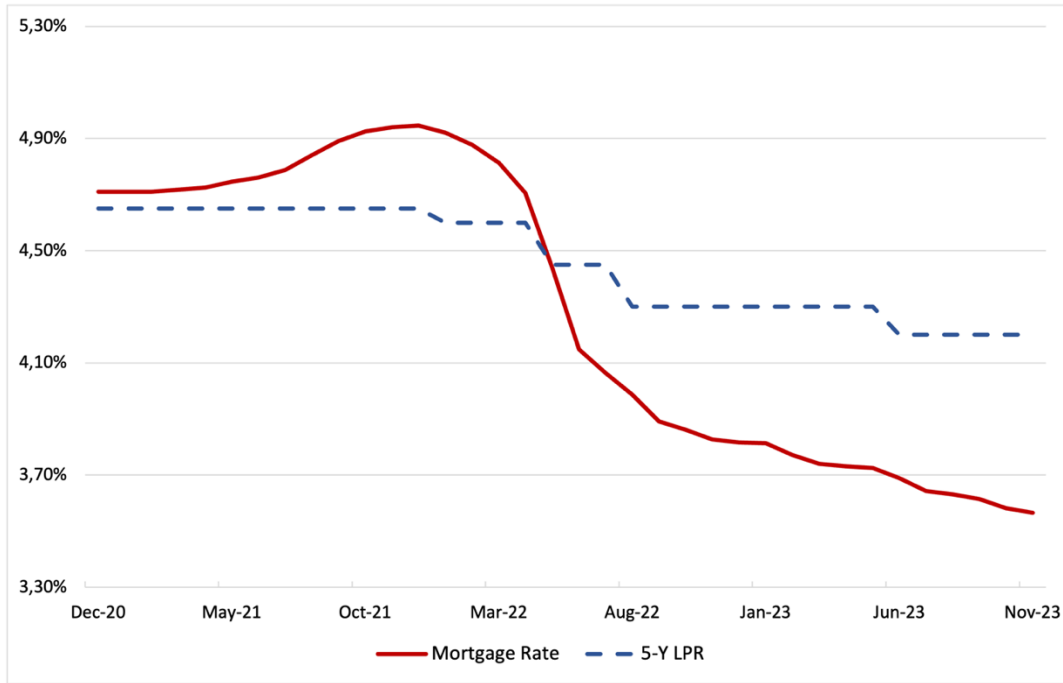
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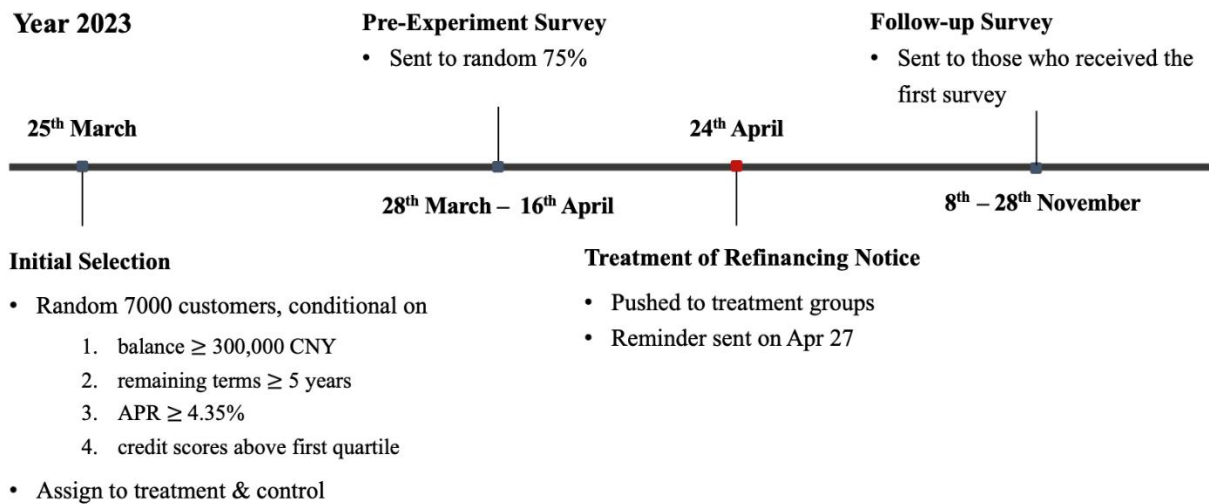
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Figure 1: LPR and Average Interest Rates on New Mortgage



Note: In this figure, the blue dashed line is the 5-year loan prime rate. The red solid line plots the average interest rate on the outstanding mortgages from the bank, weighted by outstanding mortgage value.

Figure 2: Experimental Design



Note: This figure gives the timeline and setting of the study.

Figure 3: Participation Messages

A: Survey Recruitment Notice

诚邀您参与填写居民消费问卷调查。
[11月17日](#)前填写此问卷，可享10元红包！问卷填写预计需要5分钟。点击
【[参与活](#)
动 [银行](#)】

We cordially invite you to participate in a survey on households consumption. Fill in this questionnaire before Nov 17 to enjoy a 10 Yuan red envelope! Filling out this questionnaire should take about 5 minutes. Click [URL](#) to participate. [Bank Name]

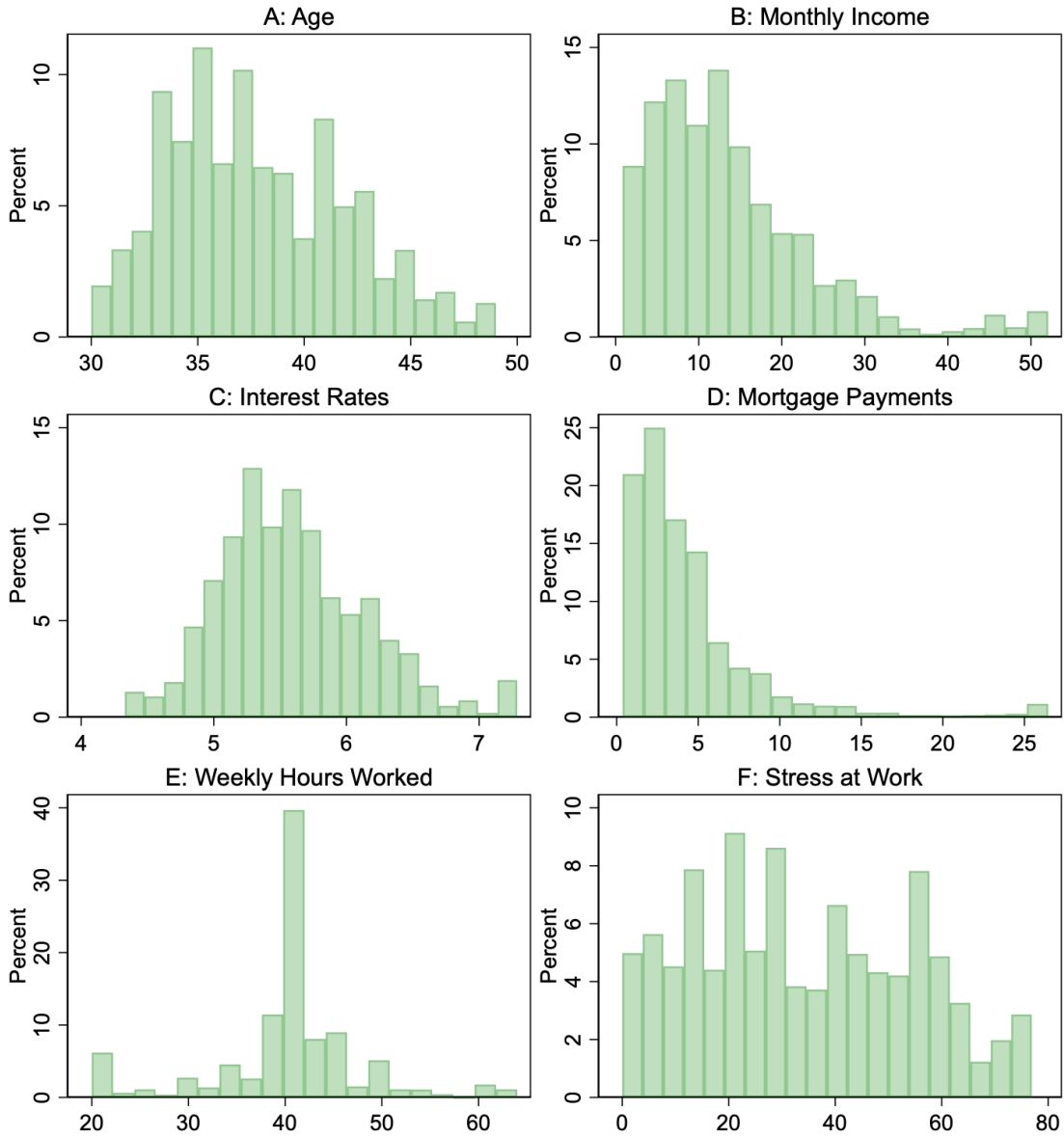
B: Refinancing Notice

尊敬的客户，您在我行的现有住房贷款利率为5.25%。您可通过多种方式将您在我行的住房贷款利率调整至3.65%。您可前往我行网点办理业务。点击
【[查看详情](#)。 [银行](#)】

Dear customer, the current interest rate for your mortgage with our bank is 5.25%. You can adjust the interest rate of your mortgage to 3.65% in various ways. You can visit our bank branches to handle this matter. Click [URL](#) for details. [Bank Name]

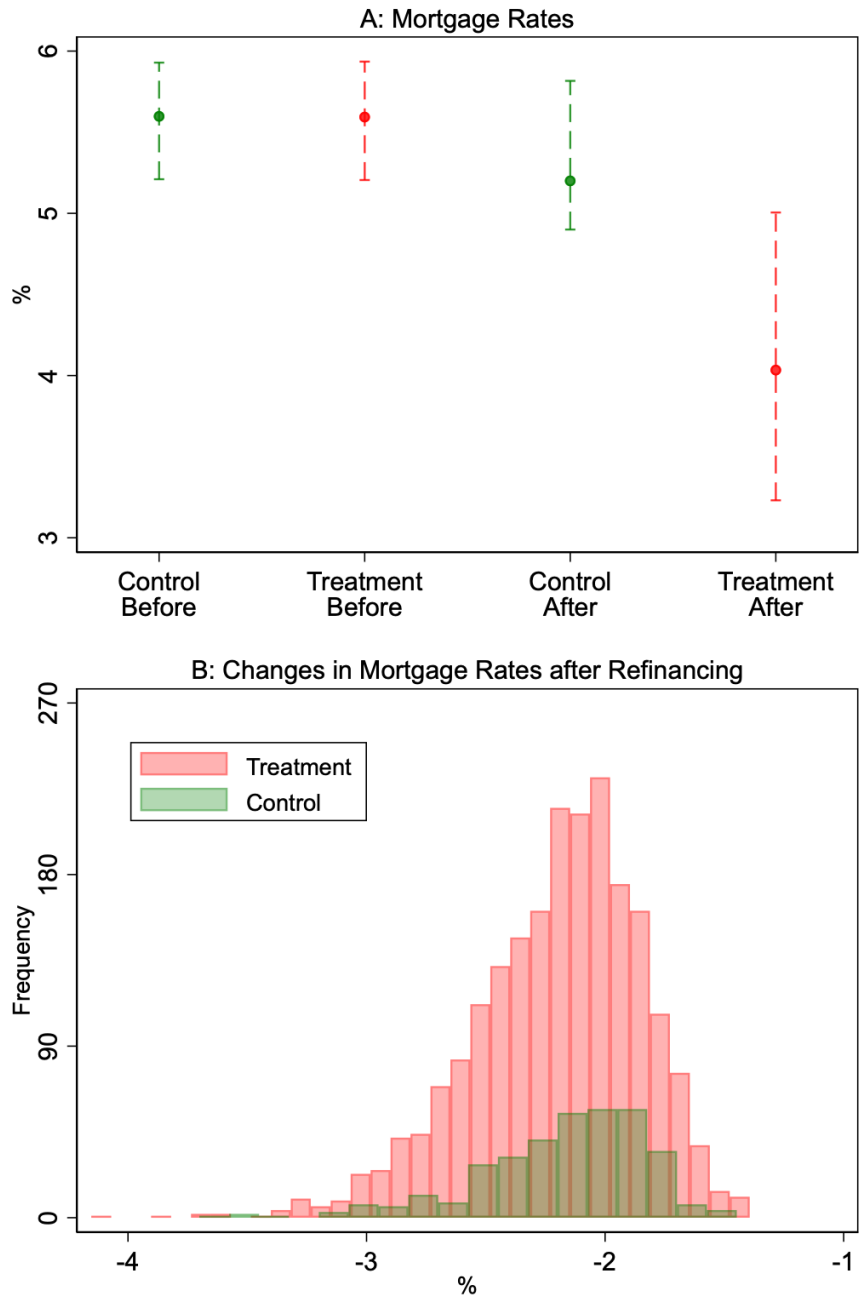
Note: Panel A is a screenshot of the text message inviting the borrowers to complete the survey. Panel B is a screenshot of the refinancing notice. The right side is the English translation of the messages.

Figure 4: Distribution of Participant Characteristics



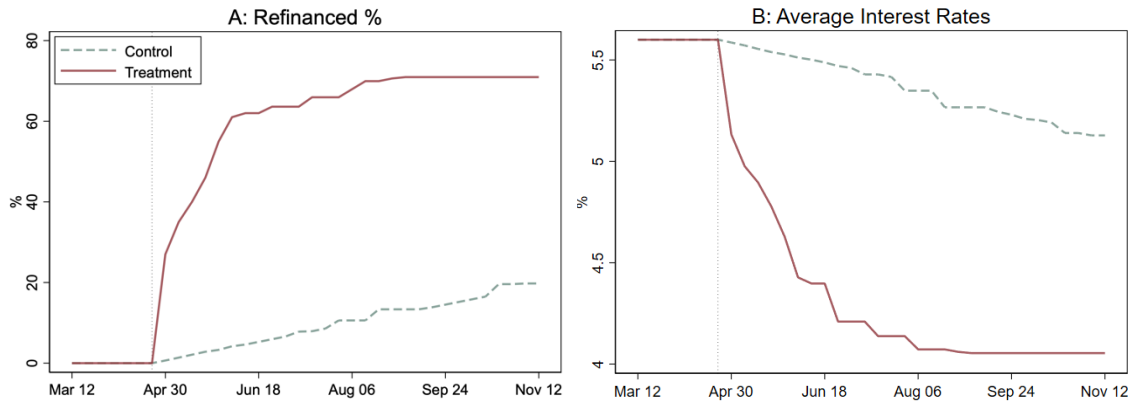
Note: This figure plots the pre-experiment characteristics of the participants. Monthly income is in thousand CNY. Interest Rates is the mortgage APR in percentage. Mortgage Payments is the monthly mortgage payment in thousand CNY. All variables are winsorized at 1% - 99% level.

Figure 5: Changes in Mortgage Rate



Note: Panel A plots the distribution of mortgage interest rates. The dots are the averages, and the segments are the interquartile ranges. Panel B plots the distribution of the changes in interest rates conditional on refinancing the mortgage after the experiment.

Figure 6: Refinancing and Interest Rates after Intervention



Note: Panel A plots the fraction of participants that refinanced their mortgages. Panel B gives the average interest rates. The vertical dotted line gives the time of the intervention.

Table 1: Summary Statistics

	Mean	SD	Mean	SD	Mean	SD	<i>p</i> -values
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: With Survey							
	Panel A1: All		Panel A2: Control		Panel A3: Treatment		
Age	37.78	4.46	37.74	4.43	37.81	4.48	0.62
Female	0.46	0.50	0.47	0.50	0.46	0.50	0.80
College	0.75	0.43	0.76	0.42	0.75	0.44	0.21
Full-time	0.86	0.35	0.86	0.35	0.86	0.35	0.92
Down Payment	34.65	5.20	34.61	5.24	34.68	5.18	0.72
Interest Rate	5.60	0.56	5.60	0.56	5.60	0.56	0.96
Mortgage	553.95	475.87	546.81	474.00	558.57	477.13	0.48
Monthly Payment	4.36	4.23	4.28	4.15	4.41	4.27	0.36
Qualified New Rate	4.23	0.54	4.27	0.59	4.20	0.51	0.21
Total Debt	624.56	635.44	626.46	627.61	623.34	640.60	0.89
Credit Limit	155.13	161.99	155.64	164.59	154.81	160.33	0.88
Income	13.18	9.70	13.10	9.82	13.23	9.63	0.70
Net Wealth	441.53	2098.28	443.81	1800.57	440.06	2270.33	0.96
Spending	7.40	6.98	7.49	7.09	7.35	6.90	0.58
Working Hours	39.98	7.89	40.23	7.86	39.82	7.90	0.14
Stress Level	34.09	20.11	34.42	20.21	33.87	20.05	0.43
N	3491		1370		2121		
Panel B: Without Survey Sample							
	Panel B1: All		Panel B2: Control		Panel B3: Treatment		
Age	37.67	4.46	37.70	4.43	37.64	4.48	0.81
Female	0.47	0.50	0.49	0.50	0.46	0.50	0.25
College	0.77	0.42	0.78	0.42	0.77	0.42	0.61
Full-time	0.85	0.36	0.86	0.35	0.84	0.36	0.32
Down Payment	34.94	5.28	35.00	5.42	34.89	5.19	0.71
Interest Rate	5.59	0.56	5.59	0.57	5.58	0.55	0.68
Mortgage	574.62	489.05	577.57	493.68	572.66	486.23	0.85
Monthly Payment	4.47	4.33	4.50	4.33	4.45	4.33	0.83
Qualified New Rate	4.29	0.55	4.32	0.56	4.27	0.54	0.29
Total Debt	604.73	608.18	593.47	608.12	612.21	608.46	0.57
Credit Limit	190.35	181.26	187.62	176.10	192.17	184.69	0.64
Income	16.07	10.74	16.32	11.00	15.91	10.57	0.47
N	1449		578		871		

Note: College is a dummy variable for having some college education or above. Full-time is a dummy variable for working full time. Done Payment is the amount of down payment on the mortgage. Interest Rate is the APR on the mortgage. Monthly Payment is the monthly mortgage payment. Total Debt is the total level of debt including mortgage. Credit Limit is sum of credit limit from all credit cards and personal loan. Income is average monthlt income over the past 6 months. Net wealth is the difference between total wealth excluding real estates and cars and total consumption debt. Spending is the average monthly spending over the past 6 months excluding payments on mortgage. Working Hours is the average number of hours worked over the past 6 months. Stress Level is the reported level of stress at work. All variables are winsorized at the 1% - 99% level.

Table 2: Treatment and Refinancing Decisions.

	Panel A: With Survey		Panel B: Without Survey	
	Control	Treatment	Control	Treatment
Refinancing	263	1498	93	616
Not Refinancing	1107	623	485	255

Note: This table gives the number of participants by treatment status and post-treatment refinancing decisions.

Table 3: First-stage Effects of Refinancing Notice

	(1)	(2)	(3)	(4)	(5)	(6)
	Δr	Δr	ΔPay	ΔPay	$\Delta \log \text{Pay}$	$\Delta \log \text{Pay}$
Treatment	-1.14*** (0.03)	-1.14*** (0.03)	-533.74*** (33.09)	-542.58*** (28.26)	-0.16*** (0.01)	-0.16*** (0.00)
Control	No	Yes	No	Yes	No	Yes
N	3491	3491	3491	3491	3491	3491
R^2	0.24	0.25	0.06	0.32	0.19	0.26

Note: The table reports the Intention-to-Treat (ITT) estimates of the effect of refinancing notifications. Δr represents the change in mortgage APR (Annual Percentage Rate) expressed as a percentage. ΔPay and $\Delta \log \text{Pay}$ denote respectively the change and the log change in monthly mortgage payments in CNY. Treatment is a dummy that equals to one if the participants received the notice. Controls are pre-experiment and include gender, age is below median, at least college degree, liquid wealth level, credit limit, debt, and stress level at work. All variables are winsorized at 1% - 99% level. Robust standard errors are in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

Table 4: Effects of Refinancing Notice on Economic Outcomes

	(1)	(2)	(3)	(4)	(5)
	$\Delta \log C$	$\Delta \log \text{Hrs}$	$\Delta \log \text{Prod}$	$\Delta \log \text{IndivY}$	$\Delta \log \text{HouseY}$
Panel A: ITT					
Treatment	1.83*** (0.44)	1.34*** (0.44)	3.32*** (1.09)	4.53*** (1.10)	4.68*** (1.08)
Control	Yes	Yes	Yes	Yes	Yes
N	3491	3491	3491	3491	3491
R^2	0.01	0.11	0.00	0.02	0.03
Panel B: 2SLS					
$\Delta \log \text{Pay}$	-0.12*** (0.03)	-0.09*** (0.03)	-0.21*** (0.07)	-0.29*** (0.07)	-0.30*** (0.07)
First-stage F	882.77				
Control	Yes	Yes	Yes	Yes	Yes
N	3491	3491	3491	3491	3491

Note: The table reports the Intention-to-Treat (ITT) and IV 2SLS estimates of the effect of an exogenous reduction in monthly mortgage payments. $\Delta \log C$ is the log changes in monthly consumption excluding payments on mortgage or car loans. $\Delta \log \text{Hrs}$ is the log changes in weekly working hours. $\Delta \log \text{IndivY}$ is the log changes in total monthly income, excluding capital gains, at the individual level, while $\Delta \log \text{HouseY}$, represent the log changes in total monthly income at the household level. $\Delta \log \text{Prod}$ is the log changes in labor productivity, which is the ratio between IndivY and Hrs . Treatment is a dummy that equals to one if the participants received the notice. $\Delta \log \text{Pay}$ is the log changes in monthly mortgage payments. Controls are pre-experiment and include gender, age is below median, at least college degree, liquid wealth level, credit limit, debt, and stress level at work. All variables are winsorized at 1% -99% level. Robust standard errors are in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

Table 5: Changes in Working Hours and Productivity by Characteristics

	$\Delta \log \text{Hrs}$	$\Delta \log \text{Prod}$	$\Delta \log \text{Hrs}$	$\Delta \log \text{Prod}$	$\Delta \log \text{Hrs}$	$\Delta \log \text{Prod}$	$\Delta \log \text{Hrs}$	$\Delta \log \text{Prod}$
	Young		Old		Female		Male	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta \log \text{Pay}$	-0.12*** (0.04)	-0.32** (0.10)	-0.05 (0.04)	-0.08 (0.09)	-0.10*** (0.04)	-0.09 (0.09)	-0.06 (0.04)	-0.36*** (0.11)
First-stage F	450.5	450.5	417.24	417.24	473.62	473.62	406.27	406.27
N	1878	1878	1613	1613	1872	1872	1619	1619
	Not College		College		Lower Income		Higher Income	
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
$\Delta \log \text{Pay}$	-0.02 (0.06)	-0.28** (0.12)	-0.11*** (0.03)	-0.19** (0.08)	-0.04 (0.04)	-0.26*** (0.09)	-0.14*** (0.04)	-0.16 (0.11)
First-stage F	211.6	211.6	672.54	672.54	398.4	398.4	491.94	491.94
N	863	863	2628	2628	1741	1741	1750	1750
	Less Wealth		More Wealth		Less Constrained		More Constrained	
	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
$\Delta \log \text{Pay}$	-0.10*** (0.04)	-0.35*** (0.09)	-0.07* (0.04)	-0.06 (0.10)	-0.07 (0.06)	-0.13 (0.13)	-0.20*** (0.05)	-0.21** (0.12)
First-stage F	458.16	458.16	427.92	427.92	157.1	157.1	427.64	427.64
N	1746	1746	1745	1745	1707	1707	1679	1679
	Wage Worker		Non- Wage Worker		Wage Industry		Non- Wage Industry	
	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)
$\Delta \log \text{Pay}$	-0.06 (0.05)	-0.08 (0.13)	-0.13** (0.05)	-0.24** (0.12)	-0.05 (0.03)	-0.11 (0.08)	-0.15*** (0.05)	-0.37*** (0.13)
First-stage F	244.09	244.09	214.11	214.11	558.14	558.14	322.25	322.25
N	1062	1062	1032	1032	2150	2150	1341	1341

Note: The table reports the IV 2SLS estimates of the effect of an exogenous reduction in monthly mortgage payments. $\Delta \log \text{Hrs}$ is the log changes in weekly working hours. $\Delta \log \text{Prod}$ is the log changes in labor productivity, which is the ratio between individual monthly labor income and weekly working hours. $\Delta \log \text{Pay}$ is the log changes in monthly mortgage payments. Young, Lower Income, Less Wealth, and Less Constrained are respectively equal to one if age, monthly income, net wealth, credit constraint is below the sample median. Credit constraints represent the utilization ratio on personal loan and credit cards. All regressions include controls that are pre-experiment and include gender, age is below median, at least college degree, liquid wealth level, credit limit, debt, and stress level at work. All variables are winsorized at 1% - 99% level. Robust standard errors are in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

Table 6: Mortgage Payment and Other Economic Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
	Δ Saving Rate	Δ Net Wealth	Δ Net Wealth > 0	Δ Stress	Δ Credit Limit	Δ Credit Score
Δ log Pay	-0.13*** (0.03)	-88.78 (244.17)	-0.25** (0.11)	0.20*** (0.05)	-4.30** (2.10)	-0.14*** (0.05)
First-stage F	882.77	882.77	882.77	884.13	882.77	882.77
Control	Yes	Yes	Yes	Yes	Yes	Yes
N	3491	3491	3491	3488	3491	3491
	(7)	(8)	(9)	(10)	(11)	(12)
	Δ Utilization	Δ Cons Debt	Δ %Durables	Start Business	Job Change	Δ log Distance
Δ log Pay	0.04* (0.02)	7.14 (4.76)	-0.04 (0.03)	-0.01 (0.03)	-0.06* (0.03)	-0.01 (0.01)
First-stage F	843.52	882.77	882.77	882.77	882.77	882.77
Control	Yes	Yes	Yes	Yes	Yes	Yes
N	3386	3491	3491	3491	3491	3491

Note: The table reports the IV 2SLS estimates of the effect of an exogenous reduction in monthly mortgage payments. Δ stress is the changes in stress level, scaled by the pre-experiment standard deviation. Δ Saving Rate is the change in average monthly saving rate, where saving rate is one minus the ratio of total expenditure and total income. Δ Net Wealth > 0 is a dummy variable equal to 1 if changes in net wealth is positive. Δ Credit Limit is the changes in credit limit. Δ Credit Score is the changes in credit score, scaled by the pre-experiment standard deviation. Δ Cons Debt is the changes in consumption debt. Δ Utilization is the changes in credit line utilization rate. Δ %Durables represents the change in the proportion of total spending allocated to durable goods. Start Business is a dummy variable indicating if the borrower started a new business after the experiment. Job Change is a dummy variable equal to one if the participants have changed their job after the experiment. Δ log Distance is the log changes in the distance between home and company. Controls are pre-experiment and include gender, age is below median, at least college degree, liquid wealth level, credit limit, debt, and stress level at work. All variables are winsorized at 1% -99% level. Robust standard errors are in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

Table 7: Working Hours and Productivity by Work Type

	$\Delta \log \text{Hrs}$	$\Delta \log \text{Prod}$	$\Delta \log \text{Hrs}$	$\Delta \log \text{Prod}$
	Employee		Self-Employed	
	(1)	(2)	(3)	(4)
$\Delta \log \text{Pay}$	-0.08*	-0.19***	-0.11*	-0.24**
	(0.04)	(0.08)	(0.06)	(0.13)
First-stage F	752.28	752.28	140.55	140.55
N	2789	2789	702	702
	Remote Worker		Office Worker	
	(5)	(6)	(7)	(8)
$\Delta \log \text{Pay}$	-0.09**	-0.23***	-0.08**	-0.19**
	(0.04)	(0.11)	(0.04)	(0.10)
First-stage F	464.39	464.39	443.37	443.37
N	1193	1193	2298	2298

Note: The table reports the IV 2SLS estimates of the effect of an exogenous reduction in monthly mortgage payments. Employee is a dummy equal to 1 if the worker is not self-employed. Self-Employed are those who are self-employed. Workers are labeled as Remote Worker if the number of days they work at the office is below the sample median and labeled as Office Worker otherwise. Controls are pre-experiment and include gender, age is below median, at least college degree, liquid wealth level, credit limit, debt, and stress level at work. All variables are winsorized at 1% -99% level. Robust standard errors are in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.