Mortgage Prepayment in China and Counter-Productive Monetary Policy

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Abstract

Despite of the regulatory restriction on mortgage refinancing, Chinese households prepaid an unprecedented amount of mortgage loans between 2021 and 2023, when the government cut interest rates to combat economic slowdown. Using loan-level data from a major commercial bank in China, we find that prepayments are most likely to occur when the gap between households' own mortgage rate and the current rate becomes positive. Evidence further suggests that households use precautionary savings to prepay (rather than refinancing), and prepayment is associated with household deleverage and consumption reduction. Combining with data on total lending and UnionPay consumption, we find macro-level evidence that as the national lending rate decreases, cities with more existing borrowers having a positive gap tend to have greater prepayment, lending contraction, and consumption reduction, suggesting counter-productive monetary policy transmission.

1. Introduction

In response to the economic slowdown, China's central bank started to cut interest rates in 2021 to boost lending and support its real estate market. With the lowered loan rate, Chinese households rushed to prepay their mortgage loans. Unlike the case in other countries, since mortgage refinancing is banned in China, anecdotes report that the prepayment is financed by households' precautionary saving or investment, implying household deleverage—as opposed to the policy objective.[2] Market observers estimated that the total mortgage repayment in 2022 was 4.7 trillion RMB (700 billion USD), 12% of China's total outstanding mortgage loans.[3] The trend continued in the first half of 2023: based on our loan-level data from a major commercial bank, the ratio of mortgage prepayments to newly issued mortgage loans increased to 86%.

Such an unprecedented amount of mortgage prepayment in China not only concerned commercial banks for profitability but also the central bank for the effectiveness of their counter-cyclical policies. Over the period between 2021 and 2023, to combat economic downturn, PBC injected money supply and reduce the borrowing cost for several times. The 5-year loan prime rate (LPR)—a reference for home loans—was reduced to 4.20% in early 2023 from 4.85% in mid-2019. Households, however, are unlikely to benefit from the lowered borrowing cost. Most mortgage loans in China contain a fixed component and is subject to a delay to adjust to the latest LPR, and a more unique about the Chinese setting, the regulation forbids refinancing mortgages by obtaining new mortgage or business loans. At the same time, the rate of households' bank deposit or investment in wealth management products (WMP) is quickly adjusted to the new benchmark rate.

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[2] Cao, "Chinese Consumers' Lack of Confidence Is Causing a Rush of Mortgage Prepayments," Wall Street Journal, 2023 April.

[3] Liu and Zhang, "Five Things to Know About Early Mortgage Repayments in China," Caixin Global, 2023 April; According to the quarterly report from People's Bank of China (PBC), the outstanding mortgage loans was 38.8 trillion RMB at the end of 2022; see https://www.gov.cn/xinwen/2023-02/03/content_5739947.htm.

In this sense, the gap between the return on savings and the financing cost (mortgage rate) increases for many households when LPR is reduced, motivating mortgage prepayments with households' own savings. The unique regulatory setting and market environment make the phenomenon in China distinct from the mortgage repayments in other countries, where mortgage prepayments are typically refinanced with a new loan and prepaying households are financially constrained (e.g., Berger et al., 2021; Eichenbaum, Rebelo, and Wong, 2022).

In this paper, we use the loan-level data from one of the major banks in China to study households' motives for prepaying mortgages and its implications for macroeconomy and monetary policy transmission. This paper not only provides a systematic analysis on the unprecedented episode in the second-largest economy, but also offers important insights into how China's unique regulatory setting and household behavior could lead to unintended policy consequences.

The loan-level data is provided by one of the major, nationwide banks in China from 2019 to June 2023. This bank has branches all over the country with about a 25% share of the mortgage market. In the sample period, our data include over 10 million mortgage loan borrowers, over 0.5% of which have prepayment records over this period. Among the prepayment cases, about 60% were paid in full, and the rest are partial prepayment.[4]

We start by exploring the motivates for Chinese households to repay. Chinese households tend to keep precautionary savings while taking mortgage loans. According to the survey of PBC, more than 80% of Chinese households' financial wealth is invested in bank deposits and WMPs. The return of bank deposit and WMPs are closely benchmarked to LPR. On the financing side, the mortgage loan rate contains a fixed component, which is determined when the loan was issued and unchanged before maturity; also, the floating part of the mortgage rate is subject to a delay (a few months to a year) to be adjusted to the latest LPR. Therefore, as LPR is reduced, some

[4] In our analysis, we focus on partial prepayments, as those are less likely to be refinanced than full prepayment. See Section 2 for more details.

households' mortgage rate will be higher than LPR, motivating them to prepay with their precautionary savings.

To test this conjecture, we first regress a prepay dummy over the next six months at the individual level onto a set of interest rate variables, to explore the interest rate conditions under which households are motivated to make mortgage prepayment. Importantly, we control for year-month fixed effects to rule out the potential macroeconomic confounding effects. For example, it could be the case that both the central bank and households expect an economic downturn in the future, then the central bank cuts the rate and households decide to reduce borrowing by prepaying. Our identification tries to separate such effect by exploiting the cross-sectional variations in the fixed component of the mortgage rate, which depends on factors such as the timing of mortgage issuance, local branches' mortgage incentive policies, and so on. Our assumption is that the variation in the fixed component is orthogonal to households' current expectation of future economy.

We find that households are more likely to prepay as the difference between their current rate and new mortgage rate (proxied by LPR) increases (denote as *RateGap*), and such effect is non-linear and only significant when the difference turns positive. That is, households tend to repay when they find their existing mortgage rates becomes higher than the benchmark loan rate. This pattern seems to be aligned with the finding in the US; Berger et al., (2021), for example, show that the gap between existing and new mortgage rates can trigger a significant amount of prepayment, and the effect takes place as a step-like function around zero. But, the pattern in China has several important differences. First, the propensity to prepayment keeps increases as *RateGap* becomes larger, whereas in the US the effect mostly concentrates right above zero. Second, high net wealth households are more likely to prepay than low wealth ones, all else equal. Both findings are consistent with the conjecture that the prepayment is normally financed by households' own precautionary savings, as refinancing is not allowed. By comparison, US evidence shows it is mostly low-income households prepay as they are more financially constrained and motivated to reduce interest expense.

To link the micro-data evidence to macro-level effects, we aggregate individual prepayment behavior to the city level. We calculate the *PrepayCount* and *PrepayValue*, which are the fraction of mortgage borrowers that prepay and the fraction of outstanding mortgage loans prepaid from month t+1 to t+6, respectively. Similarly, our key explanatory variable is the city-level *RateGap*, which equals the average of all existing mortgage interest rate in the city minus LPR at month t. We control for local economic variables, including GDP growth rate and GDP per capita, and year-month fixed effects. That is, the identification is based on the cross-regional variations in the average existing mortgage rate. Results are consistent with the analysis at the individual level: as *RateGap* turns positive and rises, both *PrepayCount* and *PrepayValue* increase significantly. Following Berger et al., (2021), we also calculate the *Frac > 0*, the fraction of individuals in the city whose mortgage rates are greater than the current LPR. Higher values of *Frac > 0* are associated with more prepayments in the next six months. Later, we use *Frac > 0* as an IV to examine the causal effects on total lending and consumption

In the second part of the paper, we examine how the prepayments in China affect the transmission of monetary policies. In a market like the US, lowering interest rates will lead to mortgage prepayment/refinance (which likely means more leverage) and a reduction in household interest expenses, resulting in higher consumption after prepayment. This highlights an effective monetary policy transmission. For the case in China, however, decreases in interest rates caused households to prepay with precautionary savings, which led to household deleveraging and less borrowing. For the effect on consumption, on one hand, similar to the US case, mortgage prepayments could lower interest expenditure and in turn encourage consumption; on the other hand, households may have the motive to rebuild precautionary savings and thereby cut future consumption to save more. We show evidence that the latter dominated in this episode in China. Therefore, this suggests a counter-productive monetary policy: lowering mortgage rates for new loans led to less household borrowing and consumption.

We are aware of other possible confounding effects around this period. For example, it could be all driven by an expectation channel. That is, both the central bank and households expect an economic downturn in the future, then the central bank cuts the rate and households choose to reduce borrowing and consumption. We acknowledge that this expectation channel is plausibly at work during this period in China, but it is not exclusive to our repayment channel. To identify the effect we are interested in and separate it from other factors, our identification strategy relies on the cross-regional variation in *Frac > 0*. The adjustment of LPR is national, but the local average rates of existing mortgage loans are heterogeneous and path-dependent on many local factors such as the composition of mortgage loans issued at different years and rates, which is likely to be orthogonal to households' current expectation on local economy. Specifically, we use *Frac > 0* at the city-level as an instrument variable (IV) for *PrepayCount*, and in the second-stage regression, we use the instrumented *PrepayCount* to predict the future growth of local total lending and consumption.

We first examine the effect on total lending at the city level. The left-hand side variable is the 6-month growth rate of total outstanding loans by all banks and financial institutions. In this analysis, monetary policy serves as the shock variable, i.e., LPR rate cut, which changes *Frac > 0* and further *PrepayCount,* and we use the instrumented *PrepayCount* to predict local total lending growth. In the OLS setting, we find a negative correlation between *PrepayCount* and the subsequent lending growth. The IV regressions show a consistent pattern but a more significant economic magnitude: a 10% increase in *PrepayCount* is associated with 0.45% lower growth rate in total lending.

Next, we examine the effects on household consumption. Here we use spending through the UnionPay system to proxy city level total consumption. We replace the left-hand variable with the growth rate of total consumption over the subsequent six months. In both OLS and IV settings, we find a negative correlation between *PrepayCount* and the subsequent consumption. Also, we find that the consumption is mostly reduced from spendings on durable goods. Taken together, the city-level analyses show

supportive evidence that the restriction in mortgage in refinancing leads to counter-productive monetary policies in China.

Literature Review Our paper is related to the literature on several fronts. First, our paper contributes to the literature on the effect of interest rate changes on mortgage prepayment and refinancing (e.g., Dunn and McConnell (1981), Green and Shoven (1986), Schwartz and Torous (1989), and Deng, Quigley, and Order (2000)). More recently, scholars have explored the heterogeneity in responses to interest rate changes and the obstacles faced in making prepayment decisions, such as financial frictions and inattention (Agarwal, Rosen, and Yao, 2016; Bhutta and Keys, 2016; Keys, Pope, and Pope, 2016; Andersen et al., 2020). Our paper is primarily connected to two studies that investigate the distribution of mortgage rates to generate state-dependent prepayment decisions (Berger et al., 2021; Eichenbaum, Rebelo, and Wong, 2022). However, the lack of refinancing options in China introduces a distinctive element, which alters the consequences of prepayment and affects the effectiveness of monetary policy in this context.

Second, we contribute to the literature on the role of mortgages in the transmission of monetary policy. Previous studies, such as Iacovelo (2005), Rubio (2011), Garriga, Kydland, and Sustek (2017), and Greenwald (2018), examine how changes in monetary policy are transmitted through the mortgage market within a representative framework. Recent studies, utilizing more detailed cross-sectional data, such as Agarwal et al. (2015), Di Maggio, Kermani, and Palmer (2016), Di Maggio et al. (2017), Auclert (2019), Beraja et al. (2019), and Cloyne, Ferreira, and Surico, have explored the heterogeneity effect of monetary policy transmission through mortgage markets. While our study also confirms that households' decision to prepay their mortgages is influenced by the historical pattern of interest rates and the distribution of mortgage rates and is thus path- and state-dependent, as noted by Berger et al. (2021) and Eichenbaum, Rebelo, and Wong (2022), the outcome of monetary policy through the prepayment channel in China diverges entirely from the findings documented in the

literature for the US. Specifically, households in China reduce their borrowing and consumption rather than increase them after mortgage prepayment induced by interest rate cuts.

Third, our paper makes a substantial contribution to the extensive literature on household borrowing and consumption, with a particular focus on the relationship between consumption, household leverage, and precautionary savings. Notable studies, such as Mian, Rao, and Sufi (2013) and Chen, Michaux, and Roussanov (2020), investigate the influence of household debt and housing-related assets on consumer spending during the housing boom. In our study, we empirically document a compelling deleveraging effect on household consumption through their precautionary savings during the economic downturn. We therefore also contribute to the empirical literature on precautionary savings and consumption such as Caballero (1990), Gourinchas and Parker (2001), Parker and Preston (2005), and Christelis et al. (2020).

Fourth, our study presents novel empirical evidence on mortgage prepayment in the context of China. Previous research on mortgage prepayment has predominantly focused on the US market. However, scholars such as Badarinza, Campbell, and Ramadorai (2016) have emphasized the importance of adopting an international comparative approach to studying household finance. While there are a few exceptions, such as Miles (2004) examining the UK, Bajo and Barbi (2018) investigating Italy, and Andersen et al. (2020) exploring Denmark, the literature on mortgage prepayment in non-US markets remains relatively limited and has little coverage on emerging markets. In line with findings from other markets, our study reveals that reductions in interest rates serve as an incentive for households in China to engage in mortgage prepayment. However, a distinctive characteristic of an emerging market like China is market frictions such as the lack of refinancing options. Consequently, prepayment in response to rate cuts in China leads to a reduction rather than an increase in household borrowing and consumption, highlighting an unintended consequence of mortgage prepayment.

Lastly, our study makes a valuable contribution to the literature on understanding monetary policy in China. China's monetary policy exerts a significant influence on

both the domestic economy and global financial markets, yet it remains an area that is not thoroughly comprehended (Huang, Ge, and Wang, 2020). An emerging body of literature, including works by Chen, Ren, and Zha (2018), Chen, He, and Liu (2020), and Chen et al. (2023), has examined monetary stimulus with a specific focus on the banking system, particularly the rise of shadow banking in China. In our paper, we shift the focus to the transmission of monetary policy through the housing market in China. Real estate holds substantial importance not only in the country's economy but also as a vital component of its financial system (Liu and Xiong, 2023; Xiong, 2023). Surprisingly, the mortgage channel of monetary policy transmission in the Chinese context has received limited attention, despite the significant role played by real estate markets in driving China's economic growth. One exception is the study by Agarwal et al. (2022), which examines how "wealthy hand-to-mouth" consumers increase their credit card spending in response to a decrease in their mortgage interest expenses due to interest rate cuts. This finding aligns with existing studies conducted in the United States and other developed countries (e.g., Kaplan and Violante, 2014; Kaplan, Violante, and Weidner, 2014). In contrast, our paper focuses on the prepayment channel and uncovers a novel phenomenon, to the best of our knowledge, in the literature. We find that households who engage in early mortgage prepayment due to interest rate cuts for the new issued mortgages experience a decrease in their consumption, shedding light on a previously undocumented aspect of the relationship between mortgage prepayment and consumption behavior.

2. Institutional Background

2.1 The BLIR-Based Mortgage Rates in China before October 8, 2019

Before October 8, 2019, the interest rates of mortgages in a city in China are the product of a national benchmark loan rate and a local multiplier of the city.[5] The benchmark rate, set by the People's Bank of China, is the *RMB Benchmark Loan Interest Rates for Financial Institutions (BLIR)*. It is the reference rate for financial institutions such as commercial banks to issue loans to individuals and corporations.[6] Adjustments to BLIR are applied to all existing and new mortgages. The local multiplier, on the other hand, is at the discretion of the prefecture-level cities and is essentially a home price control measure. Adjustments to local multipliers are only applied to new mortgages but do not affect the existing ones.[7]

This mechanism leads to substantial differences in interest rates between existing and new mortgages. For instance, the interest rate for a 30-year mortgage issued by banks in Beijing in October 2016 was "85% of the BLIR". The BLIR at that time was 4.90%, so the interest rate of the mortgage was 4.165%. In June 2017, Beijing raised the 85% multiplier to 110% due to concerns about an overheated real estate market. After this adjustment, the interest rates for the *new mortgages* issued after June 2017 were BLIR*110% = 5.39%, while the interest rates for the *existing mortgages* issued in October, 2016 remained at BLIR*90% = 4.165%.

2.2 The LPR-Based Mortgage Rates in China after October 8, 2019

PBC adopted a new pricing scheme based on Loan Prime Rate (LPR) on October 20, 2019. LPR is the average of lending rates for prime customers submitted by 20 quoting banks and is published by the National Interbank Funding Center on the 20th day of every month.[8] The interest rate of a mortgage issued after October 8, 2019 is

[5] For instance, the mortgage rate in Beijing in June 2018 was "110% of the benchmark rate" where 110% is the local multiplier.

[6] This rate can change over the life of a loan because of shifts in monetary policy. For instance, PBC made total 35 adjustments to BLIR between May, 1996 and October, 2015. But PBC did not make any adjustment to BLIR for the four years period between October, 2015 and October, 2019.

[7] Therefore, the local multiplier for a specific mortgage remains fixed for the life of the mortgage, but mortgages issued at different time periods in the same city can have different multipliers.

[8] On the 20th of every month, 20 quoting banks submit to National Interbank Funding Center (NIFC) the lending rates offered to their prime customers. The NIFC then calculates the arithmetic average of these rates after excluding the highest and lowest ones, and find its nearest integral multiple of 0.05% to be the LPR, which will then be published at 9:15 a.m. on the same day.

LPR plus or minus a local margin. For instance, the interest rate of a mortgage issued by banks in Beijing on October 10, 2019 was "LPR+55 bps". Like the local multiplier in the old system, the local margin (50 bps in the example) is set by prefecture-level cities and remains *fixed* for the life of a loan. Adjustments to the local margin are only applied to the future new mortgages but not the existing mortgages.

To facilitate the transition from the BLIR-based to the LPR-based system, all the existing mortgages are required to convert to either the new LPR-based floating rates or fixed interest rates before October 31, 2020. The conversion formula is designed in such a way that the interest rates do not change right after the conversion, whichever new pricing schemes the borrowers choose.[9] This ensures that the differences in interest rates among existing mortgages in the old BLIR-based system are inherited by the differences in the local margins in the new LPR-based system. Over 94% existing mortgages chose the LPR-based pricing scheme up to the end of October 2020.

Variations in local margins and LPRs can lead to substantial differences between existing mortgage rates and new mortgage rates. For instance, if a city lowers the local margins in a month, this change would be applied only to new mortgages but not to the existing mortgages. If PBC lowers the LPR, then new mortgages would immediately use the new LPR, while it can take up to 12 months for the existing mortgages to enjoy the lowered interest rate because of a typical annual frequency for adjustment.

2.3 Mortgage Refinancing and Prepayment in China

There are no official channels for mortgage borrowers to refinance their mortgages in China. The regulatory rules explicitly disallow banks or households to refinance mortgage loans. A few borrowers may take some short-term loans (such as consumer loans), which have lower interest rates, to prepay their long-term mortgages with high interest rates. However, these unofficial refinancing channels are not common, because

[9] For instance, a mortgage issued by banks in Beijing in 2018 pays 5.25% interest rate in December 2020 and the LPR at that time was 4.85%. If the borrower chooses the LPR-based rate, then the interest rate specified in the new contract would be "LPR + (5.25%-4.85%)". The local adjustment point is thus 40 bps for the rest life of the loan. If the borrower chooses a fixed-rate, then she would pay a fixed rate of 5.25% starting from January 2021. In both cases, the borrower pays the pre-conversion rate, 5.25%, right after the conversion in January 2021.

of the risks and costs.[10] First, using other types of loans to prepay mortgages is explicitly prohibited by commercial banks in China. Suspicious applications can be directly rejected, and banks can also terminate the loan contract if they find it is used for prepaying mortgages. Second, these loans are all of short-term, so borrowers must rollover the loans every one or two years. Banks may reject such applications if the borrowers' credit conditions worsen.

In this sense, prepayment with households' own saving is thus the most common way for borrowers to lower their interest expense. However, making prepayments is not frictionless in China. For instance, most commercial banks only allow each mortgage to have one prepayment in a calendar year. Borrowers thus often need to accumulate large amounts of money for the once-a-year prepayment. Moreover, it normally takes a few months to complete whole process of a prepayment. These frictions can have nontrivial impacts on household's saving and consumption behavior.

3. Data and Sample

Our data on mortgages is from a large commercial bank in China, which covers over 25% mortgages in China. The dataset includes detailed information on loan characteristics such as current interest rate, unpaid balance, appraisal value at origination and other demographic information of the borrowers including age, gender, education, marriage status, and total assets in the bank, etc. The data also include an indicator for prepayment, $Prepay_{i,t}$, which equals one if mortgage i makes a prepayment in month t and zero otherwise.

For the city-level analysis, we define the $PrepayCount_{j,t}$ as the ratio of the number of mortgages with prepayments to the total number of mortgages in city j in month t. We define the $PrepayValue_{j,t}$ as the ratio of the value of prepayment to the total value of mortgage payments in city j in month t. We follow Berger et al. (2021) and define $Frac{>}0_{j,t}$ as the fraction of city j's existing mortgages with interest rates higher than LPR in month t.

[Insert Table 1 and Figure I here.]

[10] According to an internal analysis of the bank, fewer than 1% of their clients may have used other types loans to finance mortgage prepayments.

Our data on household consumptions are drawn from UnionPay, which is a state-owned payment card company that manages the largest interbank card transaction settlement network in China. UnionPay was founded through a government initiative to build a unified, effective, and secure bank card network to connect all commercial banks in its association and process interbank settlement and clearing transaction information. As of 2022, UnionPay has more than one billion cardholders and is accepted in 181 countries and regions.

Most interbank card transactions in China are recorded in UnionPay's clearing system. The major types of transactions are credit/debit card consumptions through point-of-sale (POS) systems. Each transaction records the unique ID of the bank card, the unique ID of the transaction channel, the date of the transaction, the transaction type and value, and the location of the transaction. One of our main variables of interest, $Consumption_{j,t}$, is the natural logarithm of total consumptions made through UnionPay bank cards in city j in month t.

Other macro variables including total lending, GDP per capita, GDP growth, Purchasing Managers' Index (PMI), Inflation are from iFind and CSMAR, which are widely-used database on Chinese financial markets in the prior literature.

Table 1 presents the summary statistics of the city-level variables. Because LPR is used for mortgage pricing since October 2019, our sample period is from October 2019 to June 2023. The mean of *PrepayCount* is 0.37% and the mean of *PrepayValue* is 13.79%. The standard deviation of *PrepayCount* is 0.32% and the standard deviation of *PrepayValue* is 11.12%. These results suggest that both measures have substantial variations. To account for the skewness of these variables, we use the natural logarithm of the variables in our regression analysis.

We also plot the time-series trend of prepayments in Figure 1. The upward trend of the prepayment measures coincides with the decreasing trend of LPR rate which widens the gaps between existing mortgage rates and LPRs. The sudden drop of prepayments during the second half of 2022 is due to the country-wide lockdowns induced by resurgence of COVID-19 in China.

4. Interest Rate Gap and Mortgage Prepayments

4.1 Individual-level Analysis

We first examine whether the baseline effect holds at the individual level. We estimate the following regressions using data from 100,000 mortgages between October 2019 and June 2023:

$$Prepay_{i,t+1\ t+6} = LPR_t + INTRT_{i,t} + Controls$$

$$Prepay_{i,t+1\ t+6} = RateGap_{i,t} + Controls$$

$$Prepay_{i,t+1\ t+6} = Max(RateGap, 0)_{i,t} + Min(RateGap, 0)_{i,t} + Controls$$

where $Prepay_{i,t+1,t+6}$ is a dummy variable which equals one if borrower *i* makes a mortgage prepayment between month *t+1* to month *t+6*, and zero otherwise. $INTRT_{i,t}$ is the individual *i*'s current mortgage rate at month *t*. *RateGap* equals *INTRT* minus *LPR*. To examine the asymmetries in the effects around the zero-interest rate gap, we construct two piece-wise functions of *RateGap*: $Max(RateGap,0)_{i,t}$ and $Min(RateGap,0)_{i,t}$. $Max(RateGap,0)_{i,t}$ equals the interest rate gap if the gap is positive and 0 otherwise; $Min(RateGap,0)_{i,t}$ equals the interest rate gap if the gap is negative and 0 otherwise.[11] The control variables include age, asset under management (AUM), education status, marriage status, and mortgage balance. Standard errors are adjusted for heteroscedasticity and clustered by time.

[Insert Table 2 here.]

Table 2 presents the empirical results. In the first column, the coefficient on *LPR* is negative and statistically significant, suggesting a lower *LPR* motivates the household to do prepayments. The coefficient on *INTRT* is positive and statistically significant. Taken together, the two coefficients suggest that a larger interest gap motivates prepayment. To exclude time-varying factors, for example a worsening expectation coupling with easing monetary policy that could bias our interpretation, we include Year-Month fixed effects and the results are present in the second column of Table 2. The coefficient of *RateGap* is positive and statistically significant. In terms of economic magnitude, the coefficient suggest that a 15-basis-points increase in *RateGap* increases prepayment probability by 0.05%, which account for 1.17% of the standard deviation

[11] We do not do piece-wise analysis in city-month regression because 98% of city average mortgage existing rate is higher than LPR, leaving the corresponding regression analysis with low statistical power. Instead, we follow Berger et al. (2021) and use the fraction of existing mortgage having a rate higher than LPR to study which part is driving the results.

of the dependent variable. Moreover, the coefficient on *Max(RateGap, 0)* is 0.0049 (*t*-value=10.22) while the coefficient on *Min(RateGap, 0)* is 0.0003 (*t*-value=1.33). The contrasting coefficients indicate that the baseline effect is mainly contributed by households with higher-than-LPR mortgage rates.

We further plot the relation between the interest rate gap and prepayments in Figure 2. We follow Berger et al. (2021) and estimate a nonparametric relationship between interest rate gaps and prepayments. Panel A of Figure 2 shows the results. The vertical line represents the fraction of prepayments in each 30 bps gap bins and the horizontal line are the 30-bps gap bins ranging from -150 bps to +150 bps. The figure shows that mortgage prepayments are only positively correlated with positive interest rate gaps but are unrelated to negative gaps. This pattern is highly consistent with the results in Table 2 where only *Max(RateGap, 0)* affects mortgage prepayments. In Panel B, we redo the analysis in borrowers with high assets under management (AUM) and in borrowers with low AUM, respectively. We find that the baseline relationship between interest rate gaps and prepayments is more pronounced in high-AUM borrowers. This suggests that it is the unconstrained borrowers who are actively prepaying their mortgages when interest rate gaps widen. This contrasts with the U.S. evidence that financially constrained borrowers have stronger incentives to refinance their mortgages when interest rate decreases.

4.2 The City-level Analysis

Next, we perform the baseline analysis at the city-level. We estimate the following regressions:

$$Log\ Prepay_{j,t+k} = LPR_t + INTRT_t + Controls$$

$$Log\ Prepay_{j,t+k} = RateGap_{j,t} + Controls$$

where the dependent variable is either the log of the fraction of prepaying borrowers to the total number of mortgage borrowers ($PrepayCount_{j,t,t+k}$) or the log of prepayment values to total mortgage payment ($PrepayValue_{j,t,t+k}$) of city *j* between month *t* and month *t+k*. We also include inflation, PMI, GDP growth, GDP per capita, and city fixed effects. We include time fixed effects when the key independent variable is *RateGap* to control for time-varying factors that could bias result interpretation. Standard errors are adjusted for heteroscedasticity and clustered by time.

[Insert Table 3 here.]

Table 3 shows that the results are consistent with our predictions. Panel A presents the overall influence of interest rates on prepayment in the following next 6 months. The coefficients on *LPR* are consistently negative and statistically significant at the 1% level, with values being -0.960 and -1.102 for Columns (1) and (3), respectively. These numbers are also economically significant. Since we take the log for the dependent variable, a 15 basis-point reduction in *LPR* is associated with a 14.40% increase of the fraction of prepayment numbers and a 16.53% increase in the fraction of prepayment values, respectively. On the other hand, the coefficients on *RateGap* are 1.425 (*t*-value=28.71) and 0.997 (*t*-value=17.79) when the dependent variables are the fractions of prepayment numbers and values in columns (2) and (4), respectively. This suggests that a 15-basis-points increase in the rate gap is associated with a 21.38% increase of the fraction of prepayment numbers and a 14.95% increase of the fraction of prepayment values. In Panel B, we present the results for each month $t + k$, $k = 1,2,\ldots,6$. The coefficients of *RateGap* are all positive and statistically significant, suggesting our results are robust and persistent over the time window.

Overall, the city-level results confirm that an expansionary monetary policy with decreased interest rates is associated with more mortgage prepayments in China. As introduced in the institutional background, the mortgage prepayments in China are not the same as the mortgage refinancing in the U.S. market where high mortgage rates are directly replaced with low rates. The prepayments in China mainly lower the amount of the outstanding loans of the borrowers but do not lower the cost of these loans. This key difference can lead to different impacts on monetary policy transmission in the Chinese market, which would be examined in Section 5.

4.3. Market-level Analysis

In this section, we examine how monetary policy affects mortgage prepayments using data at the market aggregate level. We estimate the following regressions for the time-series dataset:

$$Prepay_{t,t+k} = LPR_t + INTRT_t + Controls$$

$$Prepay_{t,t+k} = RateGap_Mkt_t + Controls$$

The dependent variable is either the average market fraction of prepayments in volume ($PrepayCount_{t,t+k}$) or in value ($PrepayValue_{t,t+k}$) between month t and month $t+k$. LPR_t

is the loan prime rate in month *t*. $INTRT_t$ is the average interest rate across all existing mortgages. $RateGap_Mkt_t$ is the difference between the average existing mortgage rate and the LPR in month *t*. We include inflation, PMI, and GDP growth as control variables. We correct standard errors for autocorrelation using the Newey and West (1987) standard errors with 12 lags.

[Insert Table 4 here.]

The results are presented in Table 4. In Panel A, the dependent variables are the average of prepayment indicators between *t+1* and *t+6*. The coefficients on *LPR* are all negative and highly significant in Columns (1) and (3), with *t*-values being -3.55 and -2.49, respectively. Economically, these coefficients suggest that a 15 basis-point decrease in *LPR* increases the number fraction of prepayment by 17.84%, or value fraction of prepayment by 10.93%. This suggests that lower *LPR* is associated with more mortgage prepayments. We further examine how the difference between mortgage rate and *LPR* (*RateGap_Mkt*) affects mortgage prepayments. The coefficients on *RateGap_Mkt* are 1.0956 (t-value=3.60) and 0.679 (t-value=2.48) in Columns (2) and (4), respectively. These numbers are also economically significant: a 15-basis-points increase in *RateGap_Mkt* increase *PrepayCount* by 16.43% and increase in *PrepayValue* for 10.19%. Overall, the evidence suggests that a larger difference between existing mortgage rate and *LPR* motivates more mortgage prepayments. In Panel B we present the results for each month within 6 months after the interest rate are used. The coefficients of *RateGap_Mkt* are all positive and statistically significant. Overall, the results suggest that higher mortgage rate gap is related with higher prepayment.

4.4 Robustness Test

We conduct two robustness tests using alternative measures of interest rate gaps. First, in Panel A of Table 5, we replace *LPR* with the average newly issued mortgages of a city in a given month ($New\ Rate_{j,t}$). Correspondingly, the interest rate gap is then the difference between the existing mortgage rates and the new mortgage rates. Consistent with our baseline results, the coefficient on the new mortgage rates is negative and statistically significant at the 1% level, while the coefficient on the interest rate gap is positive and statistically significant at the 1% level. Second, in Panel B, we

follow Berger et al., (2021) and calculate the fraction of existing mortgage with interest rates higher than the *LPR* ($Frac>0_{j,t}$). The coefficient on *Frac>0* is positive and highly statistically significant. Economically, a 10% increase in the fraction of higher-than-*LPR* population increases the fraction of prepayment numbers by 4.38%. Because *Frac>0* is less related to borrowers' expectations about future economic conditions, we also use it as an instrument variable for mortgage prepayment to alleviate concerns over endogeneity in the following analysis.

[Insert Table 5 here.]

5. Macro-level Consequences

If low interest rates motivate more mortgage prepayments with no refinancing, the real effects of expansionary monetary policy could be counter-productive. That is, following lower interest rates, households reduce, instead of increase, leverage by prepaying mortgages with their precautionary savings. This reduction in liquidity may have further negative impacts on households' consumptions. To test these predictions, we examine the relations between prepayments and total lending and consumption in this section.

5.1 The Impacts on Total Lending

We first examine the impacts of prepayments on total lending using data at the city-level. It is possible that following low interest rates, households simply borrow more from banks to make investments or consume, regardless of prepaying mortgages or not. Moreover, though prohibited by commercial banks, a few borrowers may also use short-term loans to replace the mortgages, which achieves de facto refinancing. If these effects play a more important role than do the mortgage prepayments, the efficiency of monetary policy transmission can still be maintained. It is thus an empirical question which effects would dominate in the real-world data. To examine this question, we estimate the following regression model:

$$LendingGrowth_{\,j,t+1\;t+6} = PrepayCount_{\,j,t+1\;t+6} + Controls$$

where the dependent variable is the growth rate of total lending of city *j* from month *t+1* to month *t+6*. *PrepayCount* of city *j* is the average fraction of prepayment numbers over month *t+1* to month *t+6*. In addition to the simple OLS regression, we also use *Frac>0* of city *j* at the beginning of time *t* as the instrument variable for *PrepayCount* to alleviate endogeneity concerns. Control variables are the same with the previous city-level regressions. The results are present in Table 6.

[Insert Table 6 here.]

In Panel A of Table 6, the coefficient on the fraction of prepayments is negative and statistically significant at 5% level (*t*-value=-2.43). This suggests that higher mortgage prepayments are associated with lower net lending. In Panel B, we further instrument the fraction of prepayments with *Frac>0*. The first-stage regression shows that the *F*-statistic is 13.05, which confirms that *Frac>0* is not a weak instrument. In the second stage regression, the coefficient on the fraction of prepayments is -0.045 (*t*-value=-4.55), which is consistent with the OLS results. The IV analysis in fact shows an even stronger negative relation between prepayments and net lending. Overall, the evidence here suggests that mortgage prepayments following low interest rates lead to less lending and thus make the monetary policy counter-productive. This also suggests that the anecdotal (illegal) refinancing channel or other legal loans driven by low rates is likely dominated by the mortgage prepayment channel at the aggregate level.

5.2 The Effects on Consumption

In this section, we analyze the effects of mortgage prepayments on households' consumption. Because refinancing is almost infeasible in China, households respond to low interest rates by making prepayments with their liquid assets. After the prepayments, the household are left with insufficient savings in hand, so they may reduce consumption to rebuild precautionary savings. We test the prediction in this section.

We estimate the following regressions to test the consumption hypothesis:

$$ConsumptionGrowth_{j,t+1\,t+6} = PrepayCount_{j,t} + Controls$$

The dependent variable is the growth of total consumption of city *j* from month *t+1* to month *t+6*. The independent variable is the fraction of prepayment volume of city *j* at month *t*. To address the potential endogeneity problems, we further instrument

prepayment with *Frac>0* following Berger et al., (2021). Other control variables are the same as the baseline regressions. The results are shown in Table 7.

[Insert Table 7 here.]

In both specifications, the coefficients of the fraction of prepayment volumes are negative and statistically significant. In the OLS specification, the coefficient of the fraction of prepayments is -0.1457. This suggests that a 10% increase in the fraction of prepayments is associated with a 1.46% decrease in consumption growth. In the IV specification, the same coefficient increases to -0.5917. Economically, a 10% increase in the fraction of prepayments is related to a 5.92% decrease in consumption. Overall, the evidence here indicates that households indeed reduce their consumptions after making mortgage prepayments. In this case, low interest rates weaken, instead of stimulate, household consumptions. Again, this is opposite to the goal of an expansionary monetary policy.

To further analyze the relationships between monetary policy, prepayment, and consumption, we estimate the following regression model:

$$ConsumptionGrowth_{j,t+1\ t+6} = HighFrac_{j,t-1} * \Delta LPR_t + HighFrac_{j,t} + Controls$$

The key variable of interest is $HighFrac_{j,t-1} * \Delta LPR_t$, which is the interaction between change in *LPR* at time *t* and a dummy variable indicating high *Frac>0*. The $HighFrac_{j,t-1}$ equals one if the city *j* has a fraction of interest rate gap higher than the sample's 70th percentile within each month, and takes zero otherwise. The control variables are the same with the previous city-level results. The results are present in Table 8. The coefficient of the interaction term is 0.264 (*t*-value=1.85). The positive number indicates that consumptions in cities with more households with above-*LPR* mortgage rate are less responsive to easing monetary policy. Because these cities are exactly the ones that would have more mortgage prepayments when interest rates decrease, the evidence supports a causal relation between mortgage prepayments and decreases in household consumptions.

[Insert Table 8 here.]

6. Conclusion

Despite of the regulatory restriction on mortgage refinancing, Chinese households prepaid an unprecedented amount of mortgage loans between 2021 and 2023, when the government cut interest rates to combat economic slowdown. Using loan-level data from a major commercial bank in China, we find that prepayments are most likely to occur when the gap between households' own mortgage rate and the current rate becomes positive. Evidence further suggests that households use precautionary savings to prepay (rather than refinancing), and prepayment is associated with household deleverage and consumption reduction. Combining with data on total lending and UnionPay consumption, we find macro-level evidence that as the national lending rate decreases, cities with more existing borrowers having a positive gap tend to have greater prepayment, lending contraction, and consumption reduction, suggesting counter-productive monetary policy transmission.

References

Agarwal, Sumit, Yongheng Deng, Quanlin Gu, Jia He, Wenlan Qian, and Yuan Ren. 2022. Mortgage Debt, Hand-to-Mouth Households, and Monetary Policy Transmission*. *Review of Finance* 26 (3): 487–520.

Agarwal, Sumit, Richard K. Green, Eric Rosenblatt, and Vincent Yao. 2015. Collateral Pledge, Sunk-Cost Fallacy and Mortgage Default. *Journal of Financial Intermediation* 24 (4): 636–52.

Agarwal, Sumit, Richard J. Rosen, and Vincent Yao. 2016. Why Do Borrowers Make Mortgage Refinancing Mistakes? *Management Science* 62 (12): 3494–3509.

Andersen, Steffen, John Y. Campbell, Kasper Meisner Nielsen, and Tarun Ramadorai. 2020. Sources of Inaction in Household Finance: Evidence from the Danish Mortgage Market. *American Economic Review* 110 (10): 3184–3230.

Auclert, Adrien. 2019. Monetary Policy and the Redistribution Channel. *American Economic Review* 109 (6): 2333–67.

Badarinza, Cristian, John Y. Campbell, and Tarun Ramadorai. 2016. International Comparative Household Finance. *Annual Review of Economics*: 111–44.

Bajo, Emanuele, and Massimiliano Barbi. 2018. Financial Illiteracy and Mortgage Refinancing Decisions. *Journal of Banking & Finance*: 279–96.

Beraja, Martin, Andreas Fuster, Erik Hurst, and Joseph Vavra. 2019. Regional Heterogeneity and the Refinancing Channel of Monetary Policy*. *The Quarterly Journal of Economics* 134 (1): 109–83.

Berger, David, Konstantin Milbradt, Fabrice Tourre, and Joseph Vavra. 2021. Mortgage Prepayment and Path-Dependent Effects of Monetary Policy. *American Economic Review* 111 (9): 2829–78.

Bhutta, Neil, and Benjamin J. Keys. 2016. Interest Rates and Equity Extraction during the Housing Boom. *American Economic Review* 106 (7): 1742–74.

Caballero, Ricardo J. 1990. Consumption Puzzles and Precautionary Savings. *Journal of Monetary Economics* 25 (1): 113–36.

Chen, Hui, Michael Michaux, and Nikolai Roussanov. 2020. Houses as ATMs: Mortgage Refinancing and Macroeconomic Uncertainty. *The Journal of Finance* 75 (1): 323–75.

Chen, Kaiji, Jue Ren, and Tao Zha. 2018. The Nexus of Monetary Policy and Shadow Banking in China. *American Economic Review* 108 (12): 3891–3936.

Christelis, Dimitris, Dimitris Georgarakos, Tullio Jappelli, and Maarten Van Rooij. 2020. Consumption Uncertainty and Precautionary Saving. *The Review of Economics and Statistics* 102 (1): 148–61.

Cloyne, James, Clodomiro Ferreira, and Paolo Surico. 2020. Monetary Policy When Households Have Debt: New Evidence on the Transmission Mechanism. *The Review of Economic Studies* 87 (1): 102–29.

Deng, Yongheng, John M. Quigley, and Robert Van Order. 2000. Mortgage Terminations, Heterogeneity and the Exercise of Mortgage Options. *Econometrica* 68 (2): 275–307.

Di Maggio, Marco, Amir Kermani, Benjamin J. Keys, Tomasz Piskorski, Rodney Ramcharan, Amit Seru, and Vincent Yao. 2017. Interest Rate Pass-Through: Mortgage Rates, Household Consumption, and Voluntary Deleveraging. *American Economic Review* 107 (11): 3550–88.

Di Maggio, Marco, Amir Kermani, and Christopher Palmer. 2016. Unconventional monetary policy and the allocation of credit. Columbia Business School Research Paper 16-1.

Dunn, Kenneth B., and John J. McConnell. 1981. Valuation of GNMA Mortgage-Backed Securities. *The Journal of Finance* 36 (3): 599–616.

Eichenbaum, Martin, Sergio Rebelo, and Arlene Wong. 2022. State-Dependent Effects of Monetary Policy: The Refinancing Channel. *American Economic Review* 112 (3): 721–61.

Garriga, Carlos, Finn E. Kydland, and Roman Šustek. 2017. Mortgages and Monetary Policy. *The Review of Financial Studies* 30 (10): 3337–75.

Gourinchas, Pierre-Olivier, and Jonathan A. Parker. 2001. The Empirical Importance of Precautionary Saving. *American Economic Review* 91 (2): 406–12.

Green, Jerry, and John B. Shoven. 1986. The Effects of Interest Rates on Mortgage Prepayments. *Journal of Money, Credit and Banking* 18 (1): 41.

Greenwald, Daniel. 2018. The Mortgage Credit Channel of Macroeconomic Transmission. SSRN Scholarly Paper. Rochester, NY.

Huang, Yiping, Tingting Ge, and Chu Wang. 2019. Monetary policy framework and transmission mechanism. Handbook of China's financial system.

Iacoviello, Matteo. 2005. House Prices, Borrowing Constraints, and Monetary Policy in the Business Cycle. *American Economic Review* 95 (3): 739–64.

Kaplan, Greg, and Giovanni L. Violante. 2014. A Model of the Consumption Response to Fiscal Stimulus Payments. *Econometrica* 82 (4): 1199–1239.

Kaplan, Greg, Giovanni L. Violante, and Justin Weidner. 2014. The Wealthy Hand-to-Mouth. Working Paper. Working Paper Series. National Bureau of Economic Research.

Keys, Benjamin J., Devin G. Pope, and Jaren C. Pope. 2016. Failure to Refinance. *Journal of Financial Economics* 122 (3): 482–99.

Mian, Atif, Kamalesh Rao, and Amir Sufi. 2013. Household Balance Sheets, Consumption, and the Economic Slump*. *The Quarterly Journal of Economics* 128 (4): 1687–1726.

Miles, David. 2004. The UK mortgage market: Taking a longer-term view. Final report and recommendations.

Parker, Jonathan A., and Bruce Preston. 2005. Precautionary Saving and Consumption Fluctuations. *American Economic Review* 95 (4): 1119–43.

Rubio, Margarita. 2011. Fixed- and Variable-Rate Mortgages, Business Cycles, and Monetary Policy. *Journal of Money, Credit and Banking* 43 (4): 657–88.

Schwartz, Eduardo S., and Walter N. Torous. 1989. Prepayment and the Valuation of Mortgage-Backed Securities. *The Journal of Finance* 44 (2): 375–92.

Xiong, Wei. 2023. Derisking Real Estate in China's Hybrid Economy. Working Paper. Working Paper Series. National Bureau of Economic Research.

Figure 1. The time series of mortgage prepayments

This figure plots the time series of mortgage prepayments from October 2019 to June 2023. *PrepayValue* is the ratio of the value of mortgage prepayments to the value of all mortgage repayments in a month. *PrepayCount* is the ratio of the number of mortgage prepayments to the number of all mortgages in a month. *PrepaytoNew* is the ratio of the value of mortgage prepayments to the value of newly-issued mortgages in a month. Both *PrepayValue* and *PrepaytoNew* are the left vertical axis, while the *PrepayCount* is the right vertical axis.

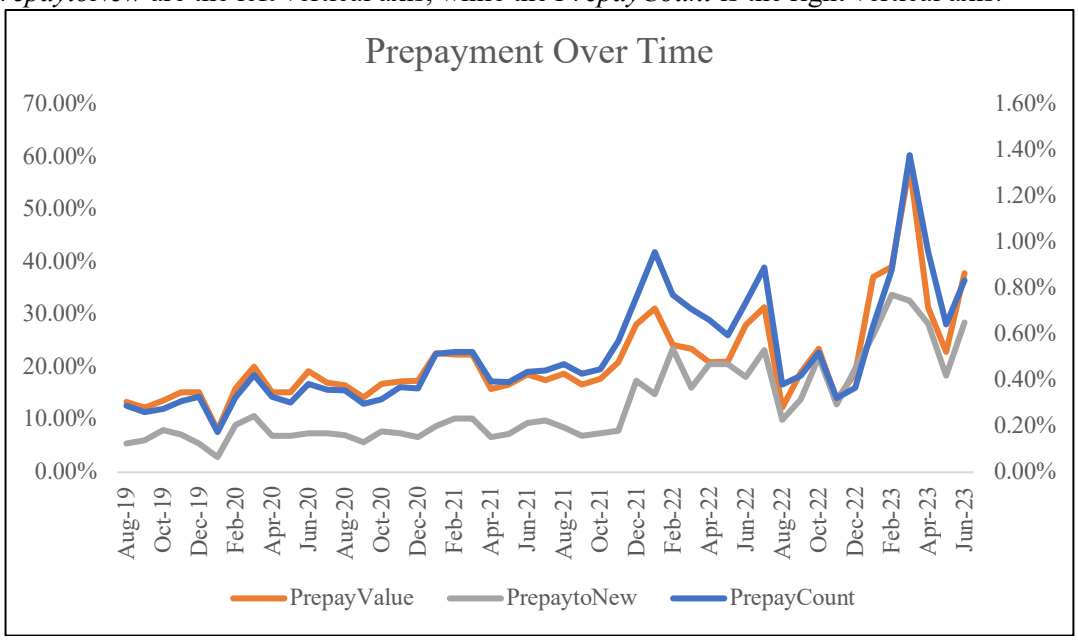
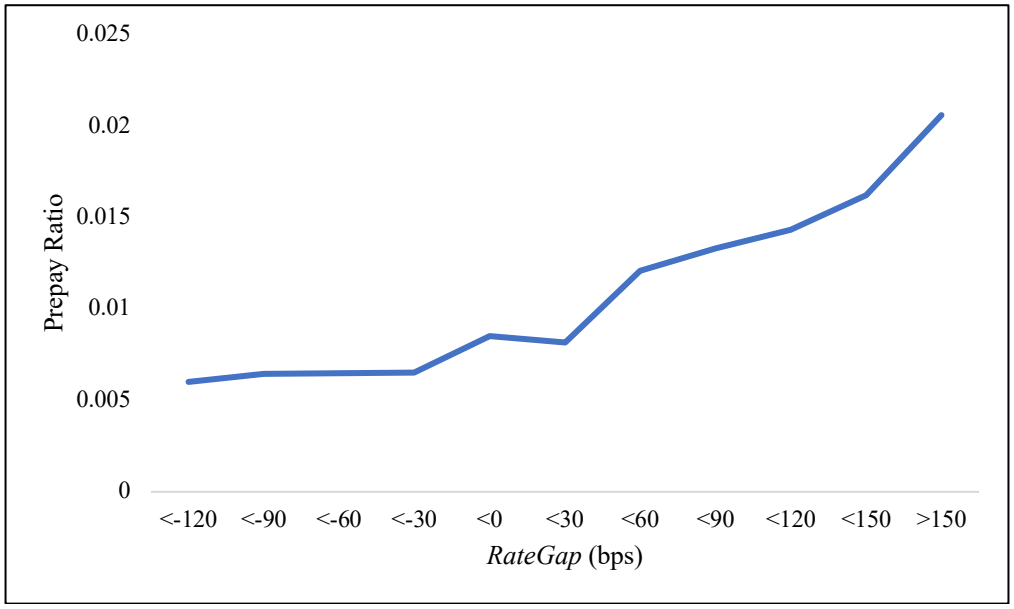


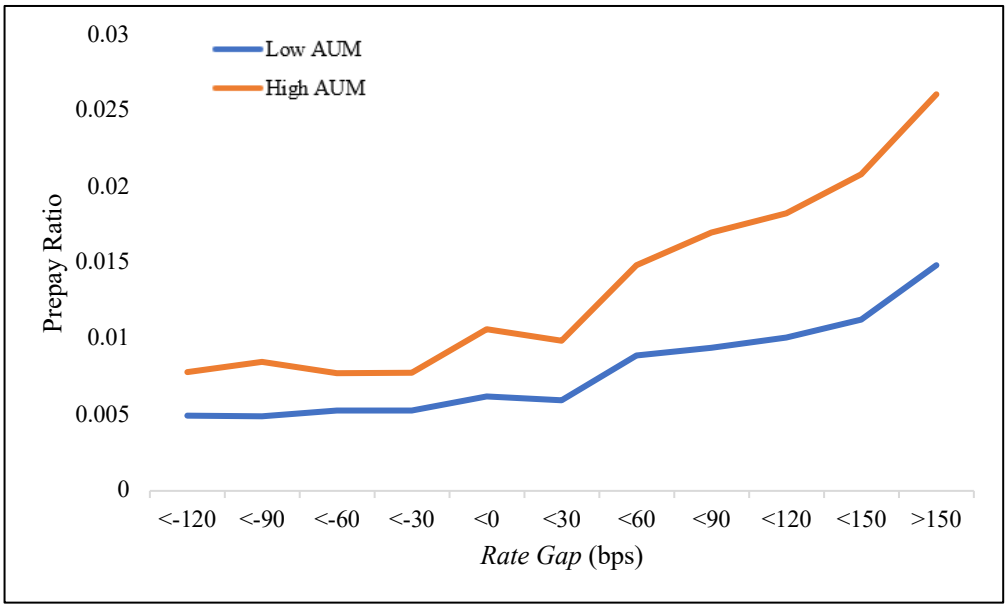
Figure 2. Interest rate gaps and mortgage prepayments: A non-parametric analysis
This figure shows the prepayment fraction of each 30-bps interest rate gap bin between -120 bps and +150 bps. The x-axis is 30-bps gap bins based on the difference between households' mortgage rate and existing LPR. The y-axis is the fraction of mortgage prepayment (in decimal). The fraction is estimated using the following regression at the individual-level:

$$Prepay_{i,t} = \beta_{gapbin}\, \mathbf{1}(RateGap\ bin)_{i,t} + Controls_{i,t}$$

The dependent variable is the dummy variable for prepayment, which equals one if the individual i prepays his/her mortgage between month $t+1$ and $t+6$ and zero otherwise. $\mathbf{1}(RateGap\ bin)_{i,t}$ is a dummy variable that indicates the 30-bps gap bins ranging from -120 bps to +150 bps. Following Berger et al., (2021), the controls include loan to value (LTV), LTV^2, loan age, age^2, log AUM, gender, education, and marriage status. In Panel A, the results are based on the full sample; In Panel B, the results presented for the high-AUM individuals (AUM>70th percentile) and low-AUM individuals separately.



Panel A Prepayment fractions and interest rate gaps



Panel B Prepayment fractions and interest rate gaps in groups with different wealth

Table 1. Summary statistics

This table reports summary statistics of the main variables at city-month level in this paper. The sample covers 267 cities from October 2019 to June 2023. *PrepayCount* is the number of mortgage prepayments scaled by the total number of mortgage payments of a city in a given month. *PrepayValue* is the value of mortgage prepayments scaled by value of mortgage repayments of a city in a given month. *AvgPrepayValue* is the average of *PrepayValue* . *AvgPrepayCount* is the average of *PrepayCount*. *LPR* is the Loan Prime Rate. *INTRT* is the average interest rates of existing mortgages of a city in a given month. *RateGap_Mkt* is the difference between the average mortgage rate in a city and the *LPR*. *Frac>0* is the fraction of existing mortgage having a mortgage rate higher than the LPR. *Consumption* is the total consumption through UnionPay cards in a city in a given month. *GDP Growth* is the real GDP Growth for a city. *GDP per Capita* is the natural logarithm of GDP per capita of a city. *CPI* is the year-on-year change of China's Consumer Price Index. *PMI* is China's Purchasing Managers' Index.

Variables	Count	Mean	STD	Median
PrepayCount	11640	0.37%	0.32%	0.28%
PrepayValue	11640	13.79%	11.12%	11.43%
AvgPrepayValue	11640	13.11%	7.98%	12.27%
AvgPrepayCount	11640	0.36%	0.28%	0.32%
LPR (%)	11640	4.58	0.18	4.65
INTRT (%)	11640	5.09	0.26	5.08
RateGap (%)	11640	0.46	0.26	0.45
Frac>0	11640	0.84	0.12	0.86
Consumption (In Billion)	8443	5.64	9.91	2.12
GDP Growth	11640	-0.01	0.04	-0.01
GDP Per Capita	11640	10.97	0.48	10.91
CPI (%)	11640	1.90	1.49	1.50
PMI	11640	50.03	2.61	50.20

Table 2. Interest rate gaps and mortgage prepayments: individual-level analysis
This table shows the effect of interest rate levels and gaps on mortgage prepayments at the individual level. The dependent variable is the dummy variable for prepayment, which equals one if the individual prepays between *t+1* to *t+6* and zero otherwise. *INTRT* is the existing mortgage rate for the individual. *RateGap* is the difference between the individual's mortgage rate and LPR. *Max(RateGap,0)* is the larger value of *RateGap* and zero, *Min(RateGap,0)* is the smaller value of *RateGap* and zero. Control variables include age, mortgage balance and wealth (asset under management for the individual in this commercial bank), education status and marriage status. We also include Year-Month Fixed Effect to control for time-varying characteristics. The sample is from October 2019 to June 2023. The t-statistics are shown in parentheses, calculated from standard errors clustered by time. ∗∗∗, ∗∗ and ∗ denote significance at the 1%, 5% and 10% levels.

	$PrePay_{i,t+1,t+6}$		
LPR	-0.0085***		
	(-4.75)		
INTRT	0.0006***		
	(6.05)		
RateGap		0.0033***	
		(10.48)	
Max(RateGap,0)			0.0049***
			(10.22)
Min(RateGap,0)			0.0003
			(1.33)
Controls	YES	YES	YES
Time FE	NO	YES	YES
R2	0.26%	1.08%	1.09%
N	4554666	4554666	4554666

Table 3. Interest rate gaps and mortgage prepayments: city-level analysis

This table shows the effect of interest rate levels and gaps on mortgage prepayments at the city level. In Panel A, the dependent variable is the natural logarithm of average prepayment from t+1 to t+6 for a city, including *PrepayCount* and *PrepayValue*. *PrepayCount* is the natural logarithm of the ratio of the number of mortgage repayments to the number of mortgage repayments of a city in a given month. *PrepayValue* is the natural logarithm of the ratio of the value of mortgage prepayments to the value of all mortgage repayments of a city in a given month. In Panel B1, the dependent variable is the *PrepayCount* of each month from t+1 to t+6 for a city. In Panel B2, the dependent variable is the *PrepayValue* of each month from t+1 to t+6 for a city. *LPR* is the Loan Prime Rate. *INTRT* is the average existing mortgage rate. *RateGap* is the gap between average existing mortgage rate and LPR for a city. Control variables include *CPI* YoY change, *PMI*, city-level GDP Growth and GDP per capita of the city. We also include City Fixed Effect and Year-Month Fixed Effect to control for time-invariant characteristics for a city and time-varying characteristics. The *t*-statistics are shown in parentheses, calculated from standard errors clustered by time. ***, ** and * denote significance at the 1%, 5% and 10% levels.

Panel A: Interest rate gaps and average mortgage prepayments

	$PrepayCount_{t+1,t+6}$		$PrepayValue_{t+1,t+6}$	
LPR	-0.9603***		-1.1019***	
	(-3.92)		(-4.97)	
INTRT	0.8117**		0.0589	
	(2.04)		(0.23)	
RateGap		1.4251***		0.9967***
		(28.71)		(17.79)
CPI	-0.0897***		-0.0591***	
	(-3.74)		(-3.18)	
PMI	-0.0260**		-0.0179**	
	(-2.32)		(-2.38)	
GDP Growth	-1.1832*	-0 05145	-0.9757**	0.1641**
	(-1.94)	(-0.75)	(-2.14)	(2.05)
GDP Percap	0.3385**	-0.2285***	0.2154*	-0.0947**
	(2.31)	(-6.47)	(1.84)	(-2.55)
CITY FE	YES	YES	YES	YES
Year_Month FE	NO	YES	NO	YES
R2	85.31%	94.21%	86.24%	92.45%
N	10277	10277	10277	10277

Panel B1: Dynamic effect: The prepayment volume

	$PrepayCount_{t+1}$		$PrepayCount_{t+2}$		$PrepayCount_{t+3}$		$PrepayCount_{t+4}$		$PrepayCount_{t+5}$		$PrepayCount_{t+6}$	
LPR	-0.6506*		-0.5365		-0.4050		-0.3031		-0.5246		-0.7513*	
	(-1.75)		(-1.32)		(-0.97)		(-0.61)		(-1.11)		(-1.69)	
INTRT	0.1250		0.0050		-0.0466		0.3651		0.5909		0.3629	
	(0.32)		(0.01)		(-0.11)		(0.99)		(2.05)		(1.33)	
RateGap		1.3917***		1.3691***		1.3014***		1.1947***		1.1301***		0.9576***
		(8.45)		(7.77)		(6.53)		(5.80)		(5.35)		(4.28)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
R2	64.27%	81.20%	63.89%	81.04%	62.39%	80.78%	62.72%	80.53%	62.32%	80.36%	62.58%	80.52%
N	11640	11640	11123	11123	10862	10862	10606	10606	10356	10356	10097	10097

Panel B2: Dynamic effect: The prepayment value

	$PrepayValue_{t+1}$		$PrepayValue_{t+2}$		$PrepayValue_{t+3}$		$PrepayValue_{t+4}$		$PrepayValue_{t+5}$		$PrepayValue_{t+6}$	
LPR	-0.5412		-0.5277		-0.4448		-0.4021		-0.7785*		-0.8762*	
	(-1.39)		(-1.35)		(-1.07)		(-0.77)		(-1.74)		(-1.90)	
INTRT	-0.1888		-0.1517		-0.1471		0.3600		0.4593		0.1260	
	(-0.45)		(-0.37)		(-0.32)		(1.02)		(1.40)		(0.53)	
RateGap		0.9293***		0.8428***		0.8124***		0.7672**		0.6189*		0.7078**
		(3.49)		(2.92)		(2.55)		(2.20)		(1.97)		(2.34)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
R2	56.05%	67.53%	56.89%	67.33%	55.51%	67.10%	55.66%	67.23%	55.64%	66.52%	55.42%	67.45%
N	11640	11640	11123	11123	10862	10862	10606	10606	10356	10356	10097	10097

Table 4. Interest rate gaps and mortgage prepayments: market-level analysis
This table shows the effect of interest rate levels and gaps on mortgage prepayments at the market aggregate level. In Panel A, the dependent variable is the natural logarithm of the average prepayments from *t+1* to *t+6*, including *PrepayCount* and *PrepayValue*. *PrepayCount* is the natural logarithm of the ratio of the number of mortgage repayments to the number of mortgage repayments in a given month. *PrepayValue* is the natural logarithm of the ratio of the value of mortgage prepayments to the value of all mortgage repayments in a given month. In Panel B1, the dependent variable is the *PrepayCount* of each month from *t+1* to *t+6*. In Panel B2, the dependent variable is the *PrepayValue* of each month from *t+1* to *t+6*. *LPR* is the Loan Prime Rate. *INTRT* is the average existing mortgage rate. *RateGap_Mkt* is the difference between average mortgage rate of the whole market and *LPR*. Control variables include CPI Change, GDP Growth and PMI. The t-statistics in parentheses are corrected for autocorrelation using the Newey and West (1987) standard errors with 12 lags. ***, ** and * denote significance at the 1%, 5% and 10% levels.

Panel A: Interest rate gaps and average mortgage prepayments

	$PrepayCount_{t+1,t+6}$		$PrepayValue_{t+1,t+6}$	
LPR_t	-1.1893***		-0.7288**	
	(-3.55)		(-2.49)	
INTRT	-0.6580		-0.3921	
	(-1.12)		(-0.76)	
RateGap_Mkt		1.0956***		0.6793**
		(3.60)		(2.48)
CPI	-0.0289	-0.0057	-0.0414*	-0.0258
	(-1.45)	(-0.24)	(-1.77)	(-1.27)
GDP Growth	0.0076	0.0169	0.0051	0.0111
	(1.20)	(1.65)	(0.77)	(1.41)
PMI	-0.0369***	-0.0389***	-0.0451***	-0.0463***
	(-3.36)	(-3.14)	(-4.39)	(-4.17)
Intercept	7.0226***	-2.5589	1.4754	0.0322
	(4.32)	(-1.50)	(0.82)	(0.02)
Observations	43	43	43	43
R2	72.16%	60.85%	47.38%	67.01%

Panel B1: Dynamic effect: The prepayment volume

	$PrepayCount_{t+1}$		$PrepayCount_{t+2}$		$PrepayCount_{t+3}$		$PrepayCount_{t+4}$		$PrepayCount_{t+5}$		$PrepayCount_{t+6}$	
LPR_t	-0.9678***		-1.2322***		-1.6822***		-2.9504***		-3.9963***		-1.1892	
	(-2.55)		(-2.53)		(-3.08)		(-3.24)		(-3.03)		(-0.97)	
$INTRT_t$	-0.3082		0.7366		1.3673**		3.0373***		3.8953***		0.3029	
	(-0.19)		(1.24)		(2.16)		(3.34)		(2.76)		(0.23)	
RateGap_Mkt		0.8309***		0.8858***		0.9094***		1.0600***		1.0746***		0.8032***
		(2.81)		(2.84)		(3.85)		(4.31)		(6.40)		(3.96)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
R2	52.37%	44.98%	44.10%	44.04%	36.78%	44.01%	16.27%	47.24%	10.85%	47.45%	16.66%	37.62%
N	47	47	46	46	45	45	44	44	43	43	42	42

Panel B2: Dynamic effect: The prepayment value

	$PrepayValue_{t+1}$		$PrepayValue_{t+2}$		$PrepayValue_{t+3}$		$PrepayValue_{t+4}$		$PrepayValue_{t+5}$		$PrepayValue_{t+6}$	
LPR_t	-1.0564***		-0.9745*		-1.3199**		-2.7265***		-4.2855***		-2.6630	
	(-2.72)		(-1.89)		(-2.39)		(-3.04)		(-2.93)		(-1.25)	
$INTRT_t$	0.3878		-0.2273		0.3376		2.2125**		3.7113**		1.4768	
	(0.75)		(-0.32)		(0.43)		(2.48)		(2.43)		(0.63)	
RateGap_Mkt		0.9223**		0.7610**		0.9403***		1.2429***		1.4245***		1.2604***
		(2.40)		(2.22)		(3.16)		(3.97)		(6.20)		(5.19)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
R2	47.38%	45.41%	49.36%	42.49%	45.27%	43.97%	27.65%	48.71%	2.24%	54.09%	22.87%	46.10%
N	47	47	46	46	45	45	44	44	43	43	42	42

Table 5. Interest rate gaps and mortgage prepayments: Robustness tests

This table shows the effect of interest rate levels and gaps on mortgage prepayments at the city level, using alternative measures. The dependent variable is the natural logarithm of average *PrepayCount* from t+1 to t+6 for a city. *PrepayCount* is the number of prepayments normalized to total number of mortgage payments. In Panel A, *NewRate* is the average new mortgage rate in a city. *INTRT* is the average existing mortgage rate. *RateGap_City* is the difference between average mortgage rate and *NewRate* for a city. In Panel B, we follow Berger et al., (2021) and calculate the fraction of existing mortgage repayments having interest rate higher than the LPR. The independent variable is the nature logarithm of this fraction. Control variables include *CPI* YoY change, *PMI*, city-level GDP Growth and GDP per capita of the city. We also include City Fixed Effect and Year-Month Fixed Effect to control for time-invariant characteristics for a city and time-varying characteristics. The sample covers 267 cities. The sample is from October 2019 to June 2023. The t-statistics are shown in parentheses, calculated from standard errors clustered by time. ∗∗∗, ∗∗ and ∗ denote significance at the 1%, 5% and 10% levels.

Panel A: Use the average new mortgage rate as the benchmark rate

	$PrepayCount_{t+1,t+6}$	
NewRate	-0.1743***	
	(-2.48)	
INTRT	0.0668	
	(0.34)	
RateGap_City		0.0631***
		(2.84)
CPI	-0.1086***	
	(-4.87)	
PMI	-0.0290**	
	(-2.37)	
GDP Growth	-0.9423	-0.1185*
	(-1.44)	(-1.83)
GDP Percap	0.7065***	-0.1559***
	(4.10)	(-4.09)
CITY FE	YES	YES
Year_Month FE	NO	YES
R2	87.28%	93.34%
N	10277	10277

Panel B: Use frac>0 as the measure of interest rate gap

	$PrepayCount_{(t+1,t+6)}$
$Frac>0_{t-1}$	0.4381***
	(5.43)
Controls	YES
Time FE	YES
R2	92.83%
N	9060

Table 6. Mortgage prepayments and net lending

This table shows the effect of prepayment on net lending at the city level. The dependent variable is the average lending growth from t+1 to t+6 for a city. *PrepayCount* is the natural logarithm of the ratio of the number of mortgage repayments to the number of mortgage repayments of a city in a given month. *Frac>0* is the natural logarithm of the fraction of existing mortgage having a mortgage rate higher than the LPR. In Panel A, we report the result of the OLS and IV regression of net lending on the mortgage prepayments and a set of control variables. We use *Frac>0* as the instrument variable for *PrepayCount.* Panel B reports the first stage regression of mortgage prepayments on *Frac>0*. Control variables include CPI (YoY change), PMI, city-level GDP Growth and GDP per capita of the city. We also include City Fixed Effect and Year-Month Fixed Effect to control for time-invariant characteristics for a city and time-varying characteristics. The t-statistics are shown in parentheses, calculated from standard errors clustered by time. ***, ** and * denote significance at the 1%, 5% and 10% levels.

Panel A: Mortgage prepayments and net lending

	$LendingGrowth_{t,t+6}$	
	OLS	*IV*
$PrepayCount_{t,t+6}$	-0.0010**	-0.0454***
	(-2.43)	(-4.55)
GDP growth	0.0018	0.0011
	(0.56)	(0.35)
GDP per cap	0.0025*	-0.0159***
	(1.94)	(-3.98)
Time FE	YES	YES
City FE	YES	YES
R2	40.32%	39.18%
N	5760	5760

Panel B: The first stage regression of the IV

	$PrepayCount_{t,\ t+6}$
$Frac>0_{t-1}$	0.2511***
	(3.61)
GDP growth	-0.0233
	(-0.19)
GDP per cap	-0.4035***
	(-5.86)
F statistics	13.05
Time FE	YES
City FE	YES
R2	92.50%
N	5760

Table 7. Mortgage prepayments and household consumptions

This table shows the effect of mortgage prepayments on consumption at the city level. The dependent variable is the average consumption growth from t+1 to t+6 for a city. We compute consumption growth made through UnionPay cards for each city in each month. *PrepayCount* is the natural logarithm of the ratio of the number of mortgage repayments to the number of mortgage repayments of a city in a given month. *Frac>0* is the natural logarithm of the fraction of existing mortgage having a mortgage rate higher than the LPR. In Panel A, we report the result of the OLS and IV regression of consumptions on the mortgage prepayments and a set of control variables. We use *Frac>0* as the instrument variable for *PrepayCount.* Panel B reports the first stage regression of mortgage prepayments on *Frac>0*. Control variables include *CPI* (YoY change), *PMI*, city-level GDP Growth and GDP per capita of the city. We also include City Fixed Effect and Year-Month Fixed Effect to control for time-invariant characteristics for a city and time-varying characteristics. The sample covers 197 cities. The sample is from October 2019 to June 2023. The t-statistics are shown in parentheses, calculated from standard errors clustered by time. ***, ** and * denote significance at the 1%, 5% and 10% levels.

Panel A: Mortgage prepayments and consumption

	$ConsumeGrowth_{t,\ t+6}$	
	OLS	IV
$PrepayCount_t$	-0.14579***	-0.5917**
	(-4.04)	(-2.05)
GDP growth	-0.0655	-0.0862
	(-0.37)	(-0.46)
GDP per cap	0.02842	-0.0269
	(0.36)	(-0.30)
Time FE	YES	YES
City FE	YES	YES
R2	56.2%	53.72%
N	4938	4938

Panel B: The first stage regression of the IV

	$PrepayCount_{t,\ t+6}$
$Frac>0_{t-1}$	0.3834***
	(3.51)
GDP growth	0.0073
	(0.03)
GDP per cap	-0.1204
	(-0.88)
F statistics	12.33
Time FE	YES
City FE	YES
R2	82.6%
N	6529

Table 8. Interest rate gaps, mortgage prepayments, and household consumptions

This table shows the relations between interest rate gaps, mortgage prepayments, and consumptions at the city level. The dependent variable is the average consumption growth from t+1 to t+6 for a city. We compute consumption growth made through UnionPay cards for each city in each month. *Frac>0* is the natural logarithm of the fraction of existing mortgage having a mortgage rate higher than the LPR. *High Frac* is a dummy that takes the value one if *Frac>0* of the city is above the sample's 70th percentile and zero otherwise. ΔLPR is the change in LPR from month t to month t-1 for the first column, and is the change in LPR from month t to month t-6 for the second column. Control variables include *CPI* (YoY change), *PMI*, city-level GDP Growth and GDP per capita of the city. We also include City Fixed Effect and Year-Month Fixed Effect to control for time-invariant characteristics for a city and time-varying characteristics. The t-statistics are shown in parentheses, calculated from standard errors clustered by time. ∗∗∗, ∗∗ and ∗ denote significance at the 1%, 5% and 10% levels.

	$ConsumeGrowth_{t,\ t+6}$	
*High Frac**ΔLPR_t*	0.2639*	0.1665*
	(1.85)	(1.84)
High Frac	-0.0222	-0.0101
	(-0.98)	(-0.39)
GDP Growth	-0.2096	-0.1972
	(-1.02)	(-0.96)
GDP Per cap	0.1391	0.1206
	(1.40)	(1.29)
Time FE	YES	YES
City FE	YES	YES
R2	0.5759	0.5736
N	6298	6485

Appendix

Table A1. Variable definitions

PrepayCount	The number of prepayments scaled by the total number of loan payments of city *j* in month *t.*
PrepayValue	The value of prepayments scaled by the total value of loan payments of city *j* in month *t.*
INTRT	The average existing mortgage interest rate of city *j* in month *t.*
LPR	The LPR rate in month *t.*
NewRate	The average new mortgage rate of city *j* in month *t.*
RateGap	*INTRT-LPR*
RateGap_Mkt	The difference between average existing mortgage rate of the whole market, and *LPR*.
RateGap_City	*INTRT - NewRate*
AvgPrepayValue	The market average prepayment value ratios across cities in month t.
AvgPrepayCount	The market average prepayment volume ratios across cities in month t.
Frac>0	The fraction of existing mortgage rate higher than *LPR* of city *j* in month *t.*
Consumption	The consumption of city i in month t. The data is from China UnionPay.
GDP Growth	Quarterly GDP Growth Rate of city *j* in the prior quarter of month *t.*
GDP Per Capita	The natural logarithm of GDP per capita of city *j* in the prior year of month *t*.
CPI	The Year-On-Year change of Consumer Price Index in the prior month.
PMI	The Purchasing Managers' Index for the prior month.