Rigid Mortgage Rates and Monetary Policy Transmission

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1. Motivation

- Since 2019, China has been cutting interest rates to counter its economic slowdown.

  ➢ The 5-year Loan Prime Rate (LPR) was lowered from 4.85% in 2019/10 to 3.95% in 2024/05.

- Alongside this monetary easing, households rushed to prepay their mortgages.

  ➢ Mortgage prepayments in 2023 were estimated at 5.4 trillion RMB, or 14% of total outstanding mortgage loans.

  ➢ Our data shows the monthly percentage of prepayment increased from 3.8% in 2019 to around 9.5% in 2024.

  ➢ This is surprising as mortgage refinancing was prohibited in China. Anecdotal evidence suggests that Chinese households typically used their savings to prepay mortgages without refinancing.
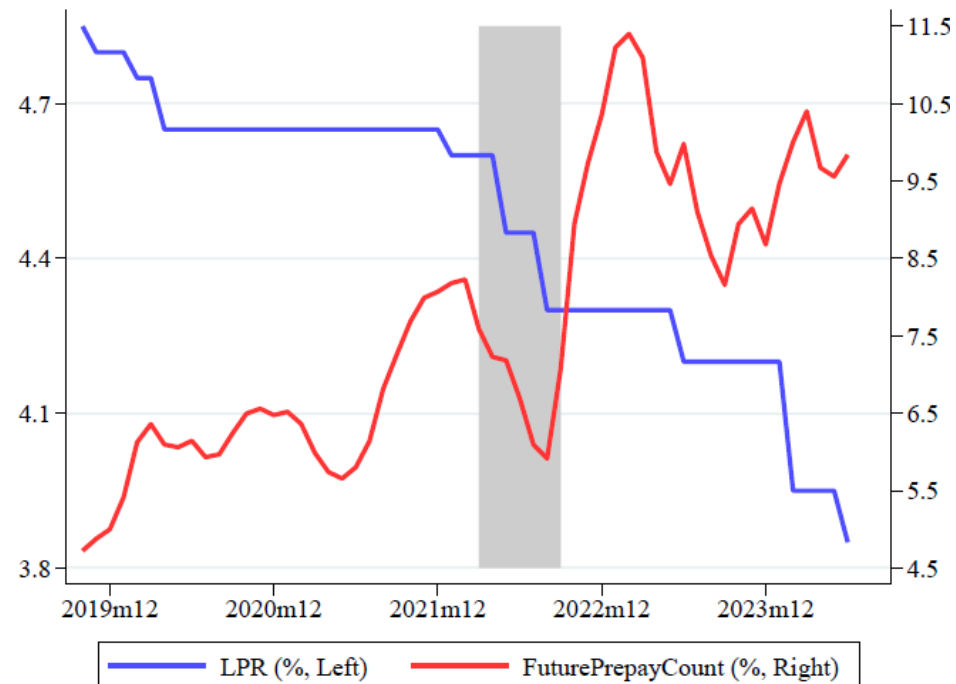
1. Motivation

- The unprecedented mortgage prepayments have raised important questions regarding their causes and impacts.

  ➢ Without refinancing, why did households rush to prepay their mortgages? What are the economic impacts?

China's mortgage rate cuts spur prepayment rush, threaten bank earnings

By Ziyi Tang, Liangping Gao and Ryan Woo

February 20, 2023 8:39 AM GMT+8 · Updated 2 years ago

Workers install windows for residential buildings under construction, following the coronavirus disease (COVID-19) outbreak, in Shanghai, China, October 10, 2022. REUTERS/Aly Song Purchase Licensing Rights

BEIJING, Feb 17 (Reuters) - China has been cutting mortgage rates since last year to boost sales in its moribund property market, but the main result so far has simply been a rush by households to pay off existing mortgages early, potentially squeezing banks' profits.

Banking & finance   Business / China Business

Chinese commercial banks fear stimulus measures will do little to stem tide of mortgage prepayments, squeezing margins

Chinese commercial banks could see an earnings decline of up to 5 per cent this year if a surge in prepayments persists, according to analysts

Lowering outstanding mortgage rates may help but is not 'a panacea' for reviving property sales, an analyst says

Reading Time: 3 minutes   Why you can trust SCMP

Chinese borrowers pile pressure on banks with early mortgage payments

Affluent property owners cut leverage as liquidity crisis hammers property sector and economy sputters

更新于2022年8月30日 20:47 Cheng Leng in Hong Kong

1. Motivation

- In particular, these prepayments have raised concern over the effectiveness of monetary policy transmission, given China's distinctive mortgage system.

- In the United States, mortgage refinancing/prepayment is an important channel for the transmission of monetary policy.

  ➤ When interest rates fall, households can refinance their mortgages to lower the interest costs and boost consumption (e.g., Berger et al., 2021; Agarwal et al., 2023).

- However, mortgage prepayment in China is vastly different.

  ➤ Refinancing a mortgage is prohibited by regulation in China.

  ➤ Households typically use their savings to prepay their mortgages.

  ➤ This can lead to *deleveraging and reduced consumption*, which is contrary to the goals of monetary easing.

2. This Paper

Using loan-level data from a major bank, we examine the following questions:

- At the household level, what motivates mortgage prepayment when interest rates fall?
  - ➢ We propose that asymmetric interest rate pass-through on household balance sheet is a key driver.
  - ➢ When interest rates fall: (i) on the liability side, mortgage rates remain rigid; (ii) on the asset side, savings returns fall rapidly ➔ a widened gap between the cost of debt and the return on assets.
  - ➢ It thus becomes optimal to use savings to prepay mortgages.
  - ➢ This need to tap into liquid savings may further discourage consumption.

- At the city-level, what are the implications to the effectiveness of monetary policy?
  - ➢ We examine the impacts on city-level aggregate consumption.
  - ➢ We also use an instrument variable following Berger et al. (2021) to provide causal evidence.

2. This Paper

Consistent with the proposed mechanism, we have the following main findings:

- Prepayment has a (non-linear) positive relationship with the gap between mortgage rates and savings returns.

  ➢ Prepayment increases with the rate gap only when the gap is positive.

  ➢ Savings and consumption decline following prepayments, contradicting to the U.S. evidence.

- A policy intervention that alleviates mortgage rate rigidity reduces prepayments and increases consumption.

  ➢ The results provide: (1) causal evidence for our proposed mechanism; (2) policy insights on how to improve interest rate pass-through.

- Consistent results on city-level aggregate prepayments and consumption.

  ➢ Prepayments indeed impacts the effectiveness of monetary policy at the macro level.

3. Institutional Background

- **In China, institutional frictions make mortgage rates downwardly rigid in response to monetary easing.**

- Mortgage interest rate ($M_{i,t}$) can be generally written as

$$M_{i,t} = LPR_{t-\tau} + Local\_Margin_{i,0}$$

- Friction 1: $LPR_{t-\tau}$ is floating but subject to a delay τ_i

  ➤ $M_{i,t}$ is adjusted only once a year based on the most recent LPR.

- Friction 2: $Local\_Margin_{i,0}$ is the fixed component and set at the issuance of the mortgage.

  ➤ Depends on a city's home price control policies, borrower i's home portfolio (first home or not).

  ➤ Varies across cities, over time, and across households. Unaffected by current market conditions.

- Friction 3: Mortgage refinancing was prohibited by regulation in China.

  ➤ An internal bank report indicates that fewer than 1% of clients may have illicitly used other types of loans to finance their mortgage prepayments.

- **Due these frictions, interest rate cuts are not effectively reflected in mortgage rates.**

3. Institutional Background

- **On the asset side, interest rate cuts are promptly reflected and amplified in household asset returns.**

- Chinese households hold substantial wealth management products (WMPs) as savings, whose returns adjust quickly—and often amplify—in response to benchmark rate cuts.
  - ➢ Chinese households tend to view WMPs as low-risk savings instruments (Acharya et al., 2024).
  - ➢ These products mostly invest in short-term bonds and money market instruments.
  - ➢ The returns of WMPs: $r_t = a \times Benchmark\_Rate_t + b$, a≥1

- **These institutions cause an asymmetric interest rate pass-through on household balance sheets.**
  - ➢ Interest rate cuts are not effectively transmitted to household liabilities but are swiftly reflected and amplified in household asset returns.

3. Institutional Background

- **The asymmetric interest rate pass-through on household balance sheets.**

  ➢ As $LPR_t\downarrow$, the gap between $M_{i,t}$ and $r_{i,t}$ widen significantly.
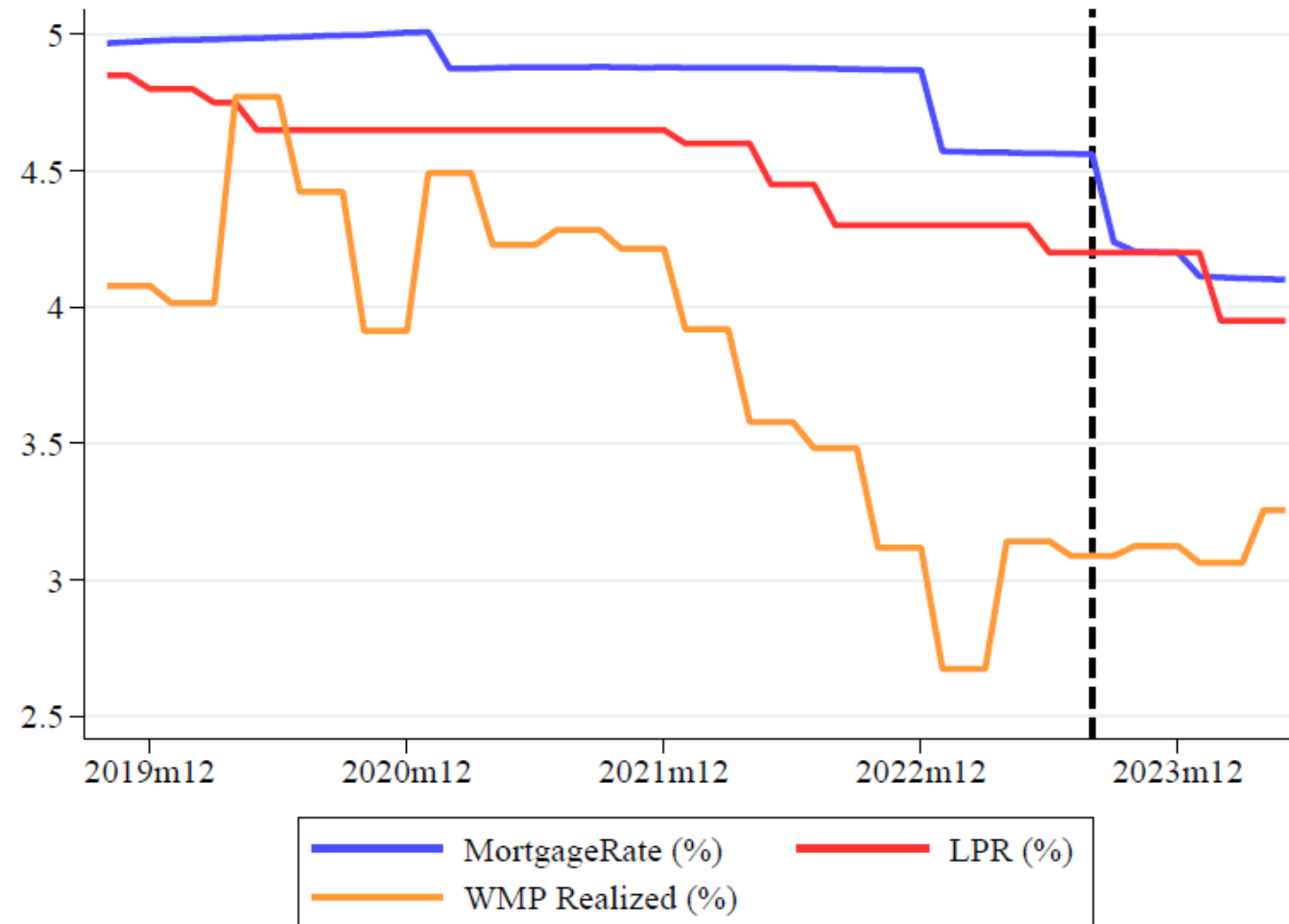
4. Hypothesis Development

- **We hypothesize that the asymmetric interest rate pass-through is the key driver of mortgage prepayments when interest rates fall.**

- When deciding whether to save or prepay their mortgages, households weigh the expected returns on their assets ($r_{i,t}$) against the costs of their liabilities (M_t).

  - ➢ When $r_{i,t} > M_{i,t}$, households choose to save.

  - ➢ When $r_{i,t} < M_{i,t}$, households choose to prepay.

- As benchmark interest rate↓, the gap between $M_{i,t}$ and $r_{i,t}$ ↑, leading to prepayments.

  - ➢ This relationship should be *nonlinear*, as households would not prepay when the gap is negative.

- **Hypothesis 1:** *Mortgage prepayment has a nonlinear relationship with the gap between the mortgage rate and the household's savings return. When the gap is negative, households will not choose to prepay. When the gap is positive, prepayment will increase as the gap widens.*

4. Hypothesis Development

- Moreover, without refinancing, households likely rely on their savings to prepay mortgages.

  ➢ Prediction 1: Those with greater savings are more likely to engage in prepayment.

  ➢ Prediction 2: This diversion of funds away from savings may force households to reduce their consumption.

  ➢ Both predictions are contradicting to the U.S. evidence where refinancing is available.

- **Hypothesis 2:** *If the gap between the mortgage rate and savings return is positive, households with higher income and AUM will prepay their mortgages to a greater extent.*

- **Hypothesis 3:** *After the interest rate cuts, in order to prepay their mortgages, households with a positive gap between the mortgage rate and savings return will deleverage by reducing their deposits and may decrease their consumption.*

5. Related Literature

- Interest Rate and Mortgage Prepayment

  ➢ Dunn and McConnell 1981, Green and Shoven 1986, Schwartz and Torous 1989, and Deng, Quigley, and Van Order 2000, Agarwal, Rosen, and Yao 2016; Bhutta and Keys 2016; Keys, D. G. Pope, and J. C. Pope 2016; Andersen et al. 2020

- Monetary Policy Transmission through mortgage market

  ➢ Di Maggio et al. 2017, Auclert 2019, Beraja et al. 2019 and Cloyne, Ferreira, and Surico 2020, State-Dependence: Berger et al. 2021 and Eichenbaum, Rebelo, and Wong 2022.

- Monetary Policy in China.

  ➢ Monetary stimulus via banking system: K. Chen, Ren, and Zha 2018, Z. Chen, He, and Liu 2020 and K. Chen, Gao, et al. 2023

  ➢ via mortgage market: Agarwal, Deng, et al. 2022

- Household leverage, savings and consumption

  ➢ Mian, Rao, and Sufi 2013, H. Chen, Michaux, and Roussanov 2020, Caballero 1990, Gourinchas and Parker 2001, Parker and Preston 2005 and Christelis et al. 2020

6. Sample and Data

- **Loan-level data from a major commercial bank in China**

  ➢ Mortgage information: location, issuance date, maturity, interest rate, balance, monthly repayments, and a prepayment indicator.

  ➢ Borrower information: demographic details (age, gender, education) and monthly financial variables (e.g., deposits, AUM, credit score, and consumption).

  ➢ October 2019 to May 2024 at the monthly frequency.

  ➢ We randomly select 100,000 mortgage loans outstanding at October 2019.

  ➢ 37.5% borrowers have made at least one prepayment in the sample period.

- **City-level data**

  ➢ Mortgage data aggregated at the city-month level.

  ➢ City-level consumption data based on UnionPay bank card transactions.

  ➢ Other city-level macroeconomic indicators, including GDP per capita, PMI, CPI, etc.

7.1 Prepayment and RateGap: Baseline

- **H1:** There is a nonlinear relation between prepayment and interest rate gap.

- We estimate the following regression:

$$Prepay_{i,t+1->t+6} = \alpha + \beta\, Max(RateGap_{i,t}, 0) + Controls + \mu_c + \gamma_t + \varepsilon_{i,t}$$

- $RateGap_{i,t} = M_{i,t} - LPR_t$

- $Prepay_{i,t+1->t+6} = 1$ if borrower i makes a prepayment between month $t+1$ and $t+6$

- Identification exploits household level variations in $M_{i,t}$, which depends on

  ➢ The local home-purchase policy, the borrowers' home portfolio at the issuance of the mortgage (t=0).

  ➢ The days to borrower i's adjustment date to use the most recent LPR_t

- Control for various borrower characteristics and local housing prices.

- Control for city×time fixed effects.

  ➢ To separate from an expectation channel: due to the pessimism, PBOC cut rate and households prepay.
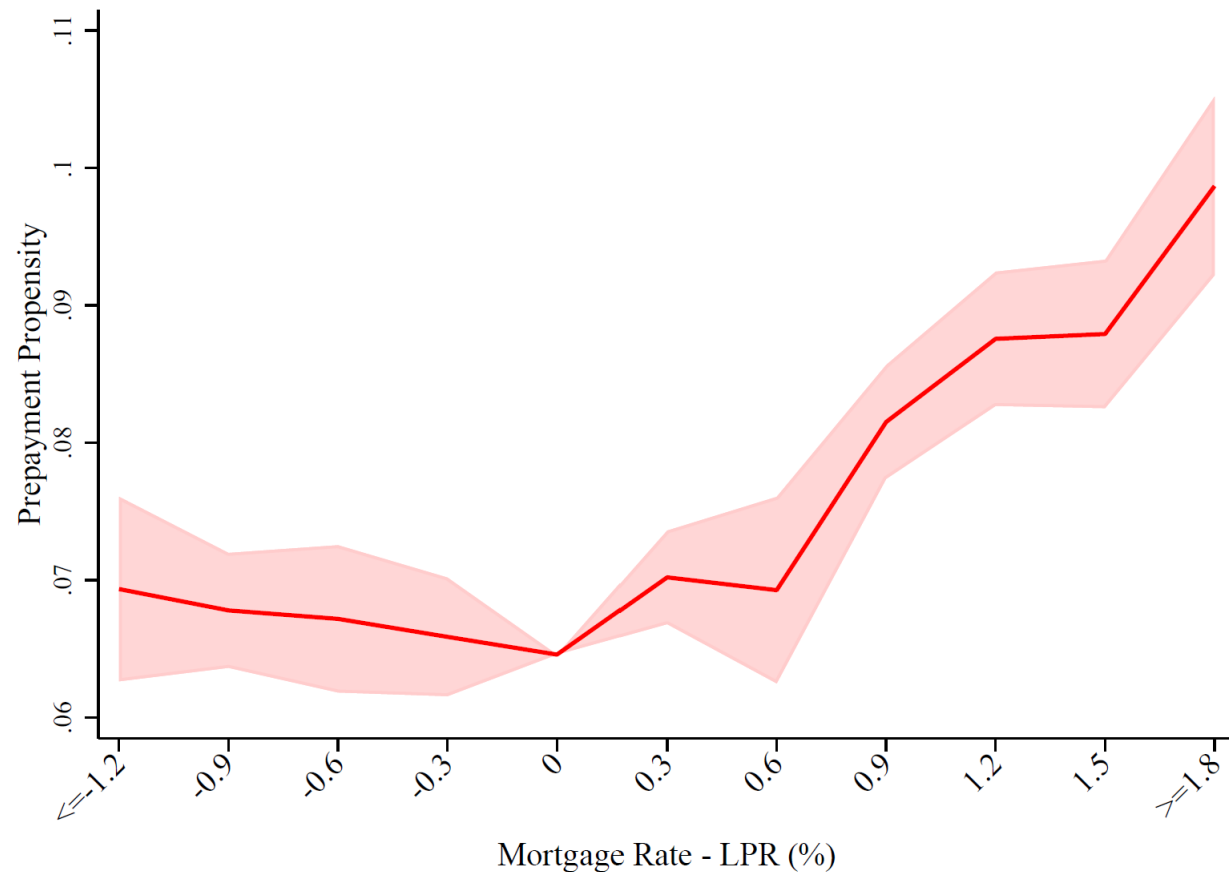
7.1 Prepayment and RateGap: Baseline

$$Prepay_{i,t+1->t+6} = \alpha + \beta\ Max(RateGap_{i,t}, 0) + Controls + \mu_c + \gamma_t + \varepsilon_{i,t}$$

	(1)	(2)	(3)
		$Prepay_{t+1 \rightarrow t+6}$	
$Max(RateGap, 0)$	0.0203***	0.0239***	0.0172***
	(8.99)	(15.71)	(18.33)
Controls	NO	YES	YES
City FE	YES	YES	-
Time FE	YES	YES	-
City-Time FE	NO	NO	YES
Within R^2	0.12%	0.92%	0.60%
N	4142307	4142307	4142307

- A one-SD increase in Max(*RateGap,0*) is associated with a 12.0% increase in the prepayment indicator relative to its sample mean.

- The results remain robust to both partial and full mortgage prepayments.

7.1 Prepayment and RateGap: Baseline

Nonlinear relationship: only significant when RateGap > 0, and insignificant when RateGap < 0

7.2 Prepayment and RateGap: Alternative Savings Returns

- The true savings returns are unobservable. For robustness, we use returns on wealth management products (WMPs) as alternative proxies for savings returns.

$$RateGap\_WMP_{i,t} = M_{i,t} - R\_WMP_t$$

$$Max(RateGap\_WMP_{i,t}, X)$$

	(1)	(2)	(3)	(4)	(5)
			$Prepay_{t+1 \to t+6}$		
$X =$	0.4%	0.7%	1%	1.3%	1.6%
$Max(RateGap\_MaturingWMP, X)$	0.0124***	0.0112***	0.0097***	0.0084***	0.0078***
	(16.89)	(17.42)	(18.84)	(16.71)	(13.58)
Controls	YES	YES	YES	YES	YES
City-Time FE	YES	YES	YES	YES	YES
Within R^2	0.5895%	0.5913%	0.5909%	0.5858%	0.5787%
Obs.	4142307	4142307	4142307	4142307	4142307

7.3 Prepayment and RateGap: Cross-sectional Analysis

- **H2:** More affluent households are more likely to prepay in response to a decline in interest rates.

| Characteristic =	(1) AUM	(2) Education	(3) CreditScore
$Max(RateGap,\ 0) \times HighChar$	0.0165***	0.0183***	0.0138***
	(9.75)	(9.62)	(7.91)
$HighChar$	0.0224***	0.0190***	0.0170***
	(17.17)	(10.25)	(15.89)
$Max(RateGap,\ 0)$	0.0119***	0.0128***	0.0125***
	(16.06)	(17.91)	(15.91)
Controls	YES	YES	YES
City-Time FE	YES	YES	YES
Within R^2	0.63%	0.62%	0.59%
Obs.	4142307	4142307	4142307

7.3 Prepayment and RateGap: Cross-sectional Analysis

- **H2:** More affluent households are more likely to prepay in response to a decline in interest rates.
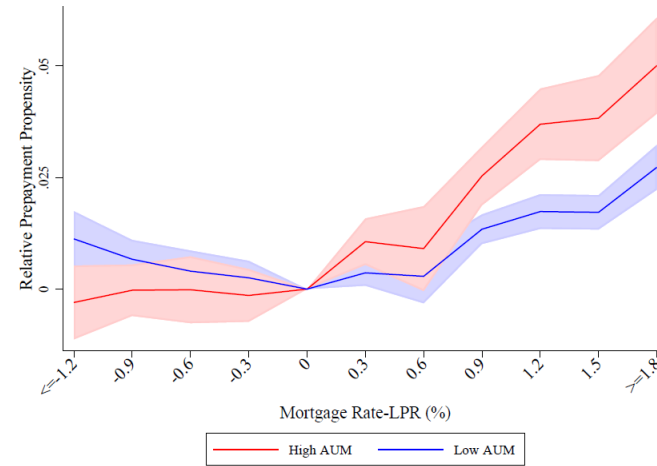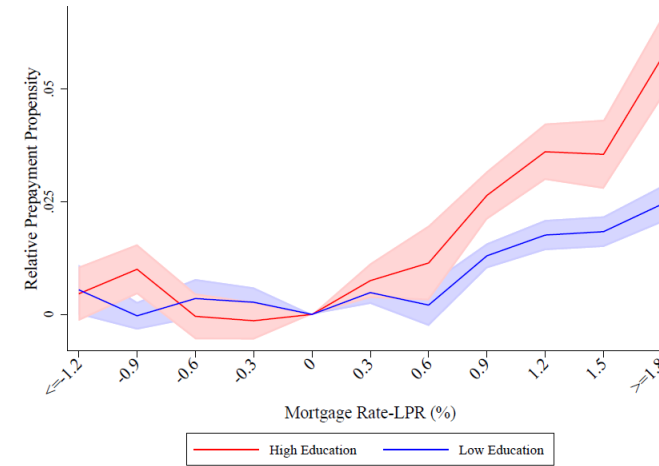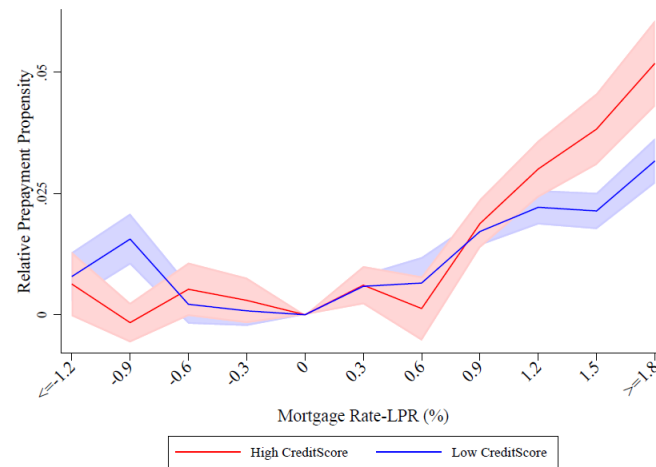

(a) Panel A: By AUM

(b) Panel B: By Education

(c) Panel C: By CreditScore

7.4 Savings and Consumption after Prepayments

- **H3:** Household savings and consumption decline after prepaying mortgages without refinancing.

	(1) $Log(Deposit)$	(2) $Log(AUM)$	(3) $Log(Consumption)$
$AfterPrepay$	-0.7793***	-0.7214***	-0.0206***
	(-116.49)	(-108.35)	(-2.65)
Controls	YES	YES	YES
Individual FE	YES	YES	YES
City-Time FE	YES	YES	YES
Within R^2	0.69%	0.60%	0.17%
Obs.	5344676	5344676	1026503

- $AfterPrepay_{i,t}$=1 if borrower i has made a prepayment by month t.
- Deposits, AUM, and Consumption decline significantly after mortgage prepayments.

7.5 Policy Experiment

- We examine a policy intervention that alleviates mortgage rigidity to build causality and provide policy implications.

- In August 2023, the PBOC issued a policy to cut rate of some existing mortgages.

  ➢ This policy reduces the local margins for properties previously classified as "non-first homes" that can now be reclassified as "first homes" under the new criteria.

  ➢ 25% of households were affected in our sample and their mortgage rates were reduced by 50 bps on average.

- We use this policy experiment to perform a Difference-in-Differences analysis:

$$Prepay_{i,t} = \alpha + \beta \, Treat_i \times Post_t + Controls + \mu_i + \gamma_{c,t} + \varepsilon_{i,t}$$

  ➢ Treated: 25% of households benefited from the policy.

  ➢ Control: The remaining unaffected households.

  ➢ Event month: August 2023.

  ➢ Sample period: 10/2022 to 05/2024.

7.5 Policy Experiment

$$Prepay_{i,t} = \alpha + \beta\,Treat_i \times Post_t + Controls + \mu_i + \gamma_{c,t} + \varepsilon_{i,t}$$

	(1)	(2)
	Prepay	
$Treat \times Post$	-0.005***	-0.005***
	(-5.68)	(-5.76)
Controls	NO	YES
Individual FE	YES	YES
City-Time FE	YES	YES
Within R^2	0.01%	1.19%
Obs.	13444263	13444263

- prepayment decreases by 25.51% (0.00518/0.0196) relative to the sample mean.
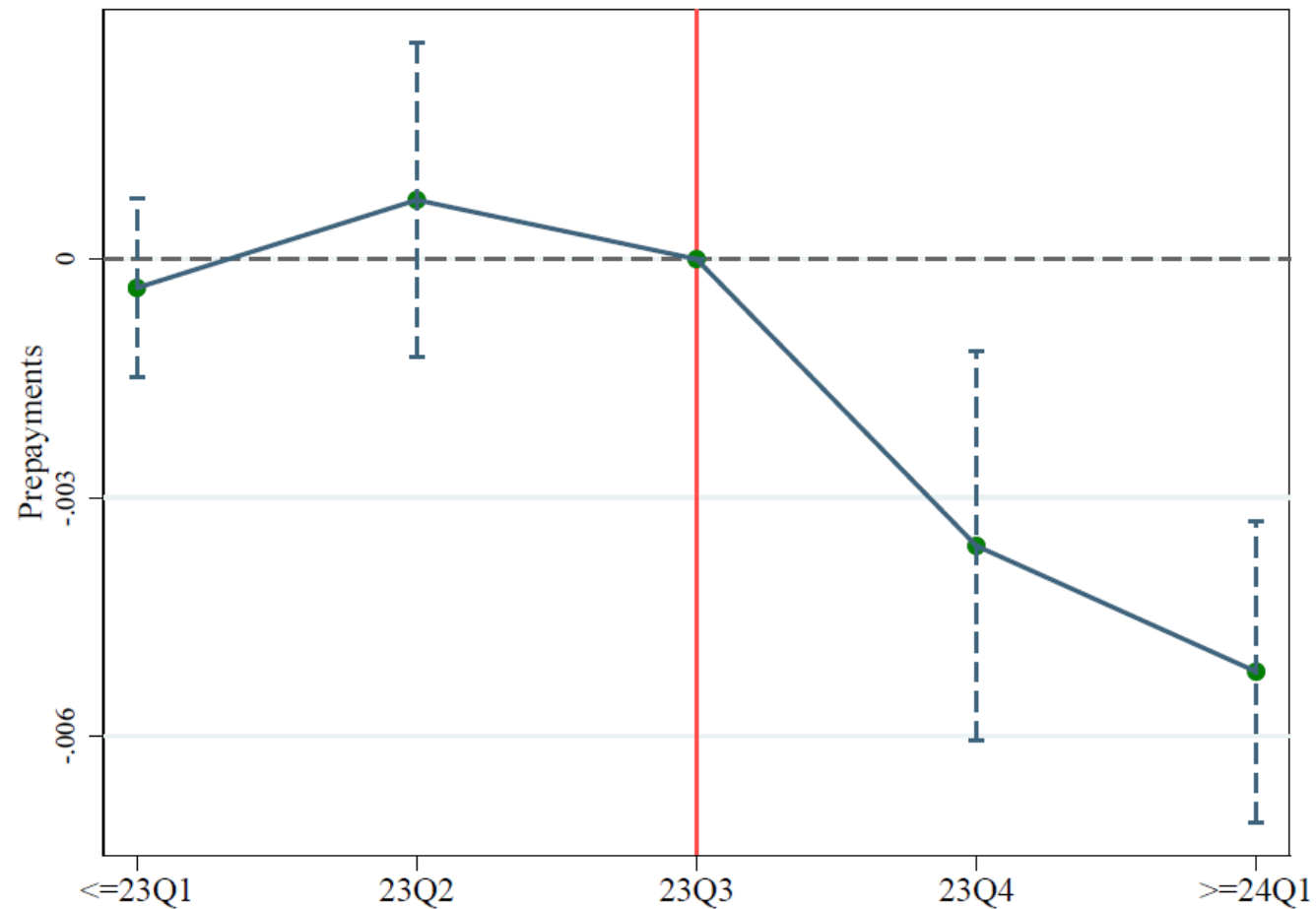
7.5 Policy Experiment

$$Prepay_{i,t} = \alpha + \beta\, Treat_i \times Post_t + Controls + \mu_i + \gamma_{c,t} + \varepsilon_{i,t}$$

(a) Panel A: Prepayments

7.5 Policy Experiment

$$Log(Consumption)_{i,t} = \alpha + \beta \, Treat_i \times Post_t + Controls + \mu_i + \gamma_{c,t} + \varepsilon_{i,t}$$

	(1)	(2)
	Log(Consumption)	
Treat × *Post*	0.0067**	0.0068***
	(2.98)	(2.72)
Controls	NO	YES
Individual FE	YES	YES
City-Time FE	YES	YES
Within R^2	0.00%	3.00%
Obs.	5924701	5924701

- Monthly consumption increases by 0.68%.

7.5 Policy Experiment
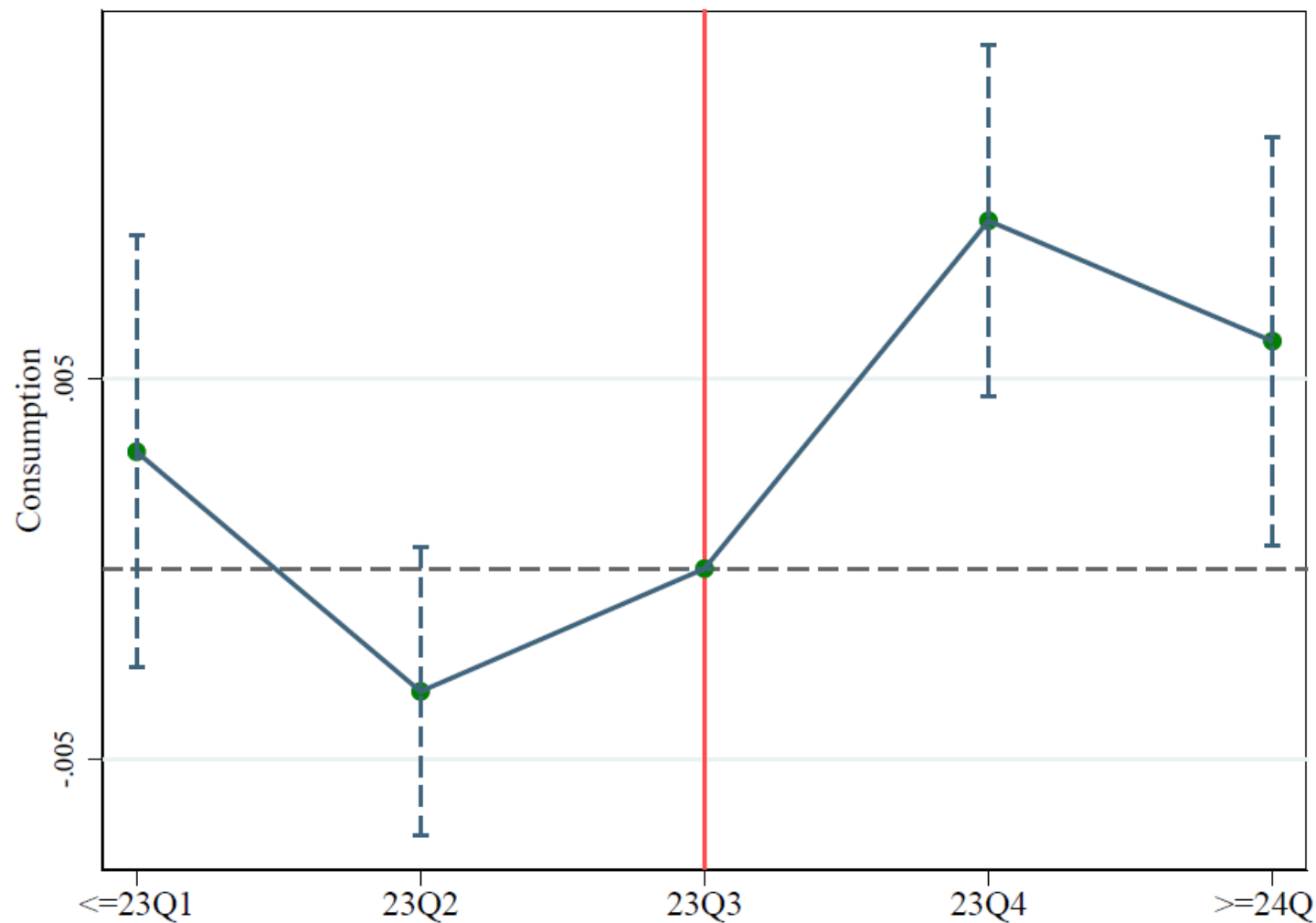
$$Log(Consumption)_{i,t} = \alpha + \beta\, Treat_i \times Post_t + Controls + \mu_i + \gamma_{c,t} + \varepsilon_{i,t}$$

(b) Panel B: Consumption

8.1 Macro-economic Effect: City-level Analysis

- **Due to frictions in refinancing, the transmission through household mortgage market can be counter-productive in China:**

  Interest rate ↓ => rate gap between mortgage and saving ↑

  => household prepay with savings and deleverage

  => aggregate consumption ↓

- **However, U.S. evidence shows the opposite:**

  Interest rate ↓ => household prepay and refinance

  => interest expense ↓ and leverage ↑

  => consumption ↑

8.1 Macro-economic Effect: City-level Analysis

- We estimate the following regression:

$$PrepayCount_{c,t+1->t+6} = \alpha + \beta \, Frac{>}0_{c,t} + Controls + \mu_c + \gamma_t + \varepsilon_{c,t}$$

- **PrepayCount$_{c,t+1->t+6}$** : The number of mortgage prepayments over month $t + 1$ to $t + 6$ scaled by the total number of existing mortgages in city c.

- **Frac$>0_{c,t}$** : The proportion of outstanding mortgages with interest rates exceeding the LPR for each city-month (Berger et al., 2021)

	(1)	(2)	(3)	(4)	(5)
			$PrepayCount_{t+1 \to t+6}$		
X=	0%	-0.6%	-0.3%	0.3%	0.6%
$Frac > X$	0.0468***	0.0665***	0.0414***	0.0122***	0.0036
	(5.78)	(9.49)	(6.69)	(2.86)	(1.28)
Controls	YES	YES	YES	YES	YES
City FE	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES
Within R^2	4.41%	2.73%	3.30%	1.76%	1.39%
Obs.	12950	12950	12950	12950	12950

1 S.D. increase in *Frac>0* is associated with a 14.0% increase in prepayment ratio relative to the sample mean

8.1 Macro-economic Effect: City-level Analysis

- We examine whether *PrepayCount* predicts lower household consumption growth.

- We use *Frac>0* as the instrument variable for *PrepayCount*.

  ➢ **Relevance**: We show that *PrepayCount* is highly correlated with *Frac>0*.

  ➢ **Exclusive restriction**: *Frac > 0* depends on the composition of $M_{i,t}$ in the city, which is path-dependent and does not directly relate to the current expectation of economy.

	(1)	(2)	(3)
		IV	OLS
	$PrepayCount_t$	$\Delta Consumption_{t+1\rightarrow t+6}$	$\Delta Consumption_{t+1\rightarrow t+6}$
$Frac > 0_{t-1}$	0.0137***		
	(5.32)		
$PrepayCount_t$		-8.4770***	-3.6741***
		(-6.49)	(-6.92)
F-Stat	28.30		
Controls	YES	YES	YES
City FE	YES	YES	YES
Time FE	YES	YES	YES
Within R^2	3.37%	1.24%	4.13%
Obs.	6426	6426	6426

1 S.D. increase in *Prepaycount* is associated with a 5.09% decrease in consumption growth

8.2 Discretionary Consumption

- The decline is larger for discretionary consumption and large consumption.

Panel A: Mortgage prepayment and essential vs. discretionary consumption

	(1)	(2)	(3)	(4)
	$\Delta ConsumptionEssn_{t+1\to t+6}$		$\Delta ConsumptionDisc_{t+1\to t+6}$	
	IV	OLS	IV	OLS
$PrepayCount_t$	-0.0324	-1.3782***	-8.4640**	-2.3316***
	(-0.02)	(-3.03)	(-2.40)	(-3.82)
Controls	YES	YES	YES	YES
City FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Within R^2	0.66%	1.09%	0.70%	1.46%
Obs.	6426	6426	6426	6426

Panel B: Mortgage prepayment and small vs. large consumption

	(1)	(2)	(3)	(4)
	$\Delta ConsumptionS_{t+1\to t+6}$		$\Delta ConsumptionL_{t+1\to t+6}$	
	IV	OLS	IV	OLS
$PrepayCount_t$	-0.7749	-1.3479***	-8.5001***	-3.7063***
	(-0.65)	(-3.46)	(-3.40)	(-6.92)
Controls	YES	YES	YES	YES
City FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Within R^2	0.08%	0.63%	1.23%	4.11%
Obs.	6426	6426	6426	6426

8.3 Policy Implications

- From the perspective of policy making, *Frac>0* can be interpreted as the degree to which mortgage rate rigidity can impede the intended outcomes of monetary policy.

  ➢ In cities with high *Frac>0*, rate cuts are unlikely to stimulate household borrowing and consumption effectively.

$$\Delta Consumption_{c,t+1\to t+6} = \alpha + \beta\ HighFrac_{c,t-1} \times \Delta LPR_t + Controls + \mu_c + \gamma_t + \varepsilon_{c,t}$$

	(1) $\Delta Consumption_{t+1,t+6}$
$HighFrac_{t-1} \times \Delta LPR_t$	0.0793** (2.02)
Controls	YES
City FE	YES
Time FE	YES
Within R^2	0.81%
Obs.	6426

9. Conclusion

- We propose a new mechanism through which mortgage rigidity can lead to counterproductive outcomes for expansionary monetary policies.

  ➢ rigid mortgage rate → asymmetric interest rate pass-through → interest rate ↓→ (M-r) ↑→ prepay and reduce savings and consumption.

- We show this mechanism explains the unprecedented wave of mortgage prepayments in China between 2019 and 2024.

  ➢ Prepayments have a non-linear positive relationship with rate gaps.

  ➢ Prepayments reduce savings and consumption.

  ➢ Policy that alleviates mortgage rigidity reduces prepayments and increases consumption.

  ➢ The effect holds for the macro analysis at the city level.

9. Conclusion

- **Policy update:** On September 29, 2024, the PBOC introduced a new mortgage pricing mechanism with two key changes:

  ➢ **Adopt a flexible local margins:** Local margins are now allowed to float based on market conditions.

  ➢ **Increase the adjustment frequency**: The frequency of mortgage rate adjustments has been shortened from once a year to a minimum of three months.

- Our findings align with and support the PBOC's reforms aimed at addressing mortgage rate rigidity.