# Structuring Mortgages for Macroeconomic Stability

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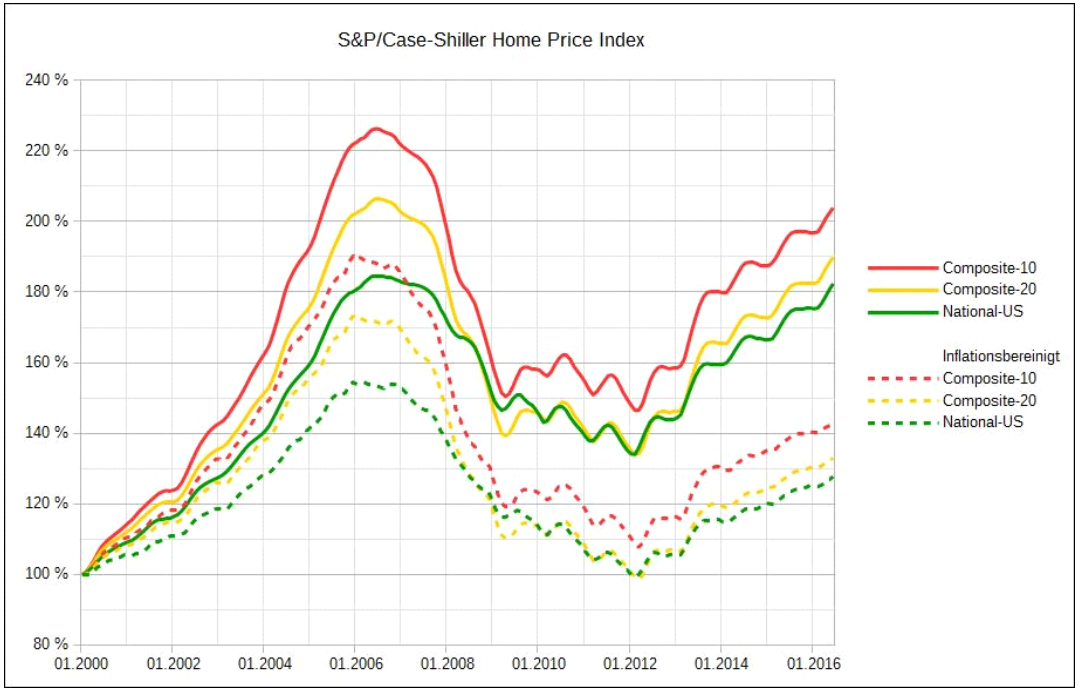
# Mortgages and the Macroeconomy

- Ten years ago, declining house prices and rising mortgage defaults had triggered the Global Financial Crisis and the Great Recession.
- What are the main lessons from that experience with regard to mortgages and the macroeconomy?



# Lessons of the Crisis

- Even with negative home equity, people are quite reluctant to default and do so primarily when income declines.
  - "Dual-trigger" model of default rather than pure strategic default (Guiso, Sapienza, and Zingales 2013, Campbell and Cocco 2015, Bhutta, Dokko, and Shan 2017).
- Foreclosures have negative spillover effects on house prices (Campbell, Giglio, and Pathak 2011, Guren and McQuade 2015) and the macroeconomy (Mian, Sufi, and Trebbi 2015).
- Declining interest rates can stimulate the economy through mortgage effects on household budgets, but there are several frictions in this **mortgage channel** of monetary policy.
  - How can we understand these frictions, and what can we do to mitigate them?

# How Does the Mortgage Channel Work?

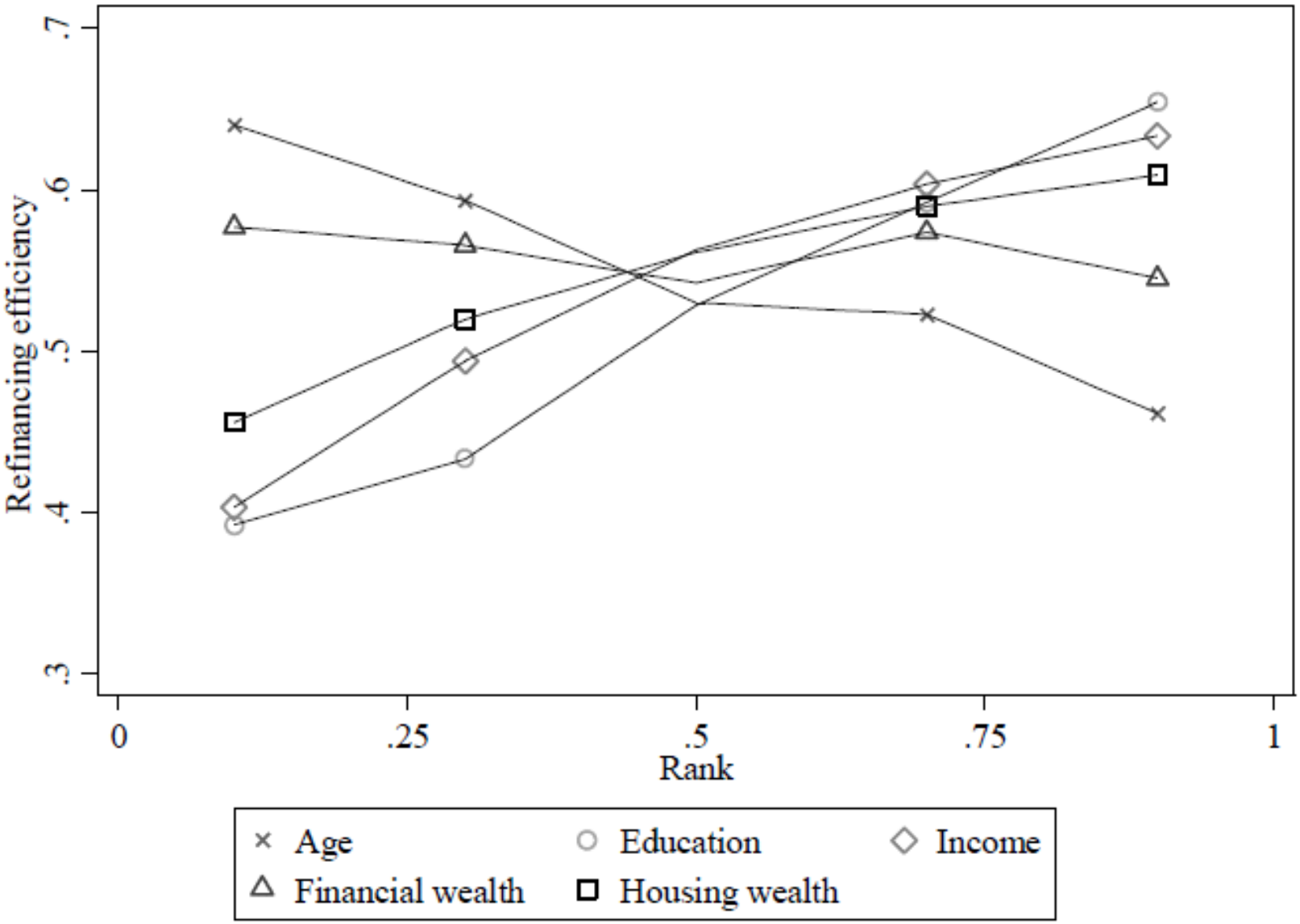
- By contrast with the familiar intertemporal substitution channel that is emphasized in standard macro models, the mortgage channel is about **redistribution** across agents (Auclert 2015).
- Mortgage rate reduction lowers monthly payments by borrowers but also lowers payments received by lenders. There is an aggregate effect if borrowers increase their spending more than lenders cut theirs.
- How is this possible?
  - Borrowers are domestic residents, while some lenders are foreigners with a higher propensity to spend on foreign rather than domestic goods.
  - Borrowers have a high marginal propensity to consume (MPC) because they are borrowing-constrained, while lenders have a low MPC because they are unconstrained permanent income consumers.
- The second argument works only if mortgage payment reductions are **temporary**. If they are permanent, lenders cut their consumption one-for-one, perfectly offsetting the effect on borrowers.

# The Mortgage Channel Is Stronger for ARMs than FRMs

The mortgage channel is stronger for adjustable-rate mortgages (ARMs) than for fixed-rate mortgages (FRMs) (Di Maggio et al. *AER* 2017). Why?

- ARM payments are linked to the short rate but FRM payments are linked to the long-term mortgage rate – which typically falls less than the short rate.
- Mortgage payments decline for all ARM borrowers when the central bank cuts the short rate, but FRM borrowers have to refinance.
  - Borrowers with negative home equity or a low credit score may be unable to refinance even though they need budget relief the most.
  - Less sophisticated borrowers may not refinance even though they could do so (Campbell 2006, Keys, Pope, and Pope 2016, Andersen, Campbell, Nielsen, and Ramadorai 2018).

# Who Fails to Refinance? Evidence from Denmark



# The Mortgage Channel Is Stronger for ARMs than FRMs

The mortgage channel is stronger for adjustable-rate mortgages (ARMs) than for fixed-rate mortgages (FRMs) (Di Maggio et al. *AER* 2017). Why?

- The decline in ARM payments is temporary while the decline in FRM payments is long-lasting, so FRM lenders will cut consumption more, offsetting the stimulative effect on borrowers.
  - For the mortgage channel to be effective in a FRM system, borrowers must **cash out**: extract home equity. Then resources flow from lenders to borrowers today, and in the opposite direction in the future.
  - Cash-out may occur even when interest rates do not decline, but lower rates can stimulate cash-out (Khandani, Lo, and Merton 2013, Beraja, Fuster, Hurst, and Vavra 2017).
  - Cash-out is not possible for borrowers with negative home equity or a low credit score, who need budget relief the most.

# Can We Do Better than ARMs?

- Plain-vanilla ARMs have problems too.
- ARMs expose borrowers to the risk of sudden payment increases when rates go up.
- ARMs are ineffective in an environment where the central bank cannot cut the short rate in a recession.
  - Ineffective in a country with a managed exchange rate.
  - Ineffective in a country where interest rate is already low (close to the zero lower bound).
- Are there ways to design even better mortgage contracts?

# Mortgage Design Proposals

- Eberly and Krishnamurthy (2014) propose a system in which borrowers can costlessly refinance from FRM to ARM, with unchanged principal, even when underwater.
  - Similar to the Danish FRM system, and to ARM systems in the UK and southern Europe.
  - But eliminates fixed refi costs, which simplifies the refinancing decision.
- Piskorski and Tchistyi (2010) argue for an option ARM that allows borrowers to defer principal repayment (or even negatively amortize) during a recession.
- A full evaluation of these mortgage systems requires some consideration of default.
  - High-LTV lending or negative amortization can worsen default later in a recession, with possible damage from default externalities.
- We undertake this analysis using a calibrated life-cycle model.

# Features of the Model

- Overlapping generations structure with agents entering and exiting the economy every period.
- Two macro states (recession and expansion) and two interest rate states (high and low).
- Random house prices correlated with the business cycle.
- Real income process of Guvenen, Ozkan, and Song (2014) capturing non-normality and business cycle variation of income growth.
- Constant inflation (or real mortgages).
- Competitive mortgage supply with risk-averse lenders subject to loan-to-value (LTV) constraints.
- Stochastic equilibrium where agents anticipate the occurrence of individual and macro shocks.

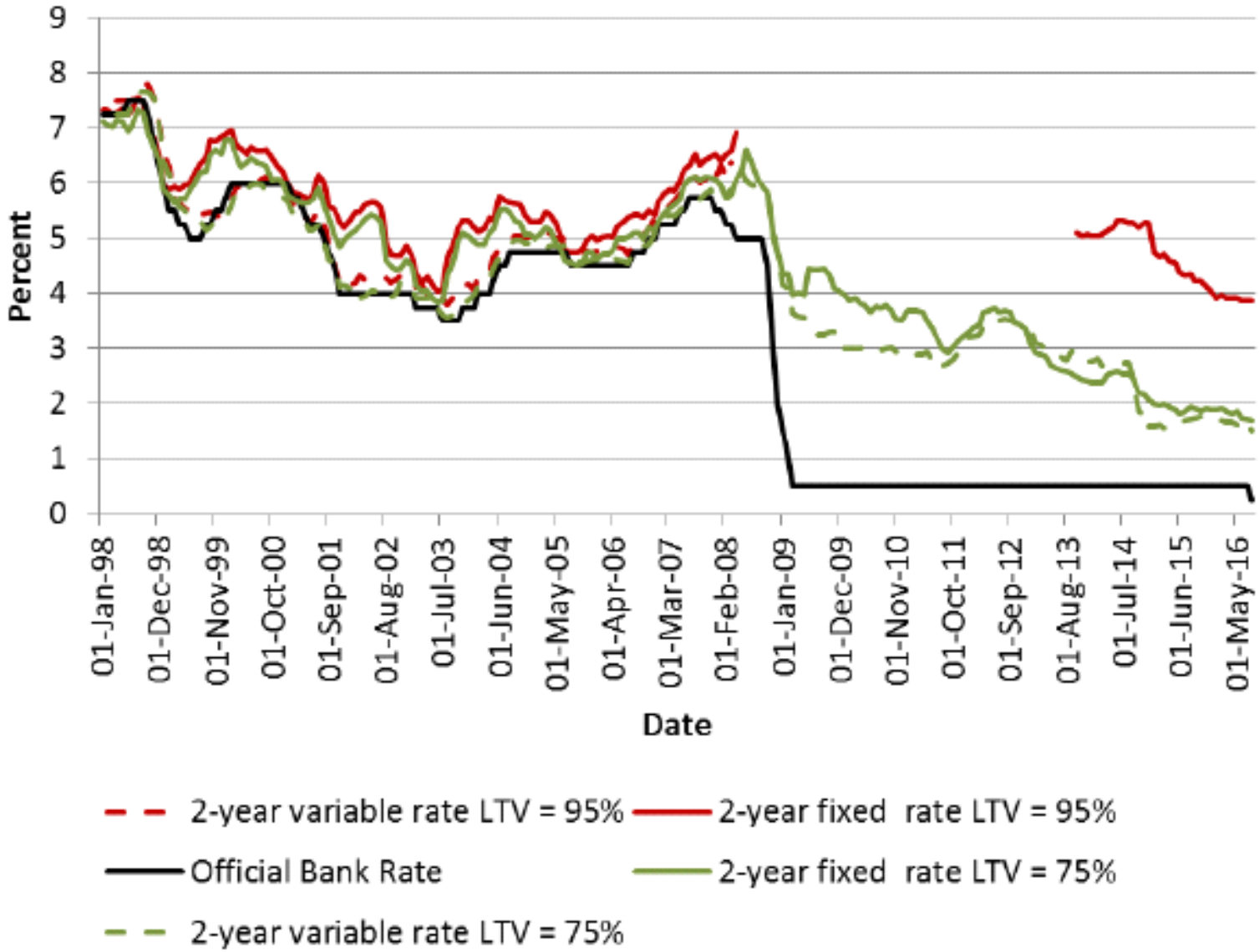
# Household Decisions

- Initial loan size is a constant fraction of income (housing choice adjusts to prices to accommodate this). After the initial date house size remains fixed.
- Power utility function, separable in housing and non-housing consumption.
- After the initial period, borrowers have the options to:
  - **Refinance** to a new mortgage, paying fixed cost, and cash out if LTV constraint permits.
  - **Default** if home equity is negative, paying stigma cost, and move to rental housing.
  - **Sell** the house if home equity is positive, prepaying the loan, and move to rental housing.

# Mortgage Pricing

- We assume that mortgage lenders are agents like those in our model, but without mortgages and with substantial financial assets.
- We derive a pricing kernel from the consumption of such agents.
- Mortgage premia are conditioned on the initial state (recession or expansion) but not other state variables, and are fixed for the life of the mortgage.
- Mortgage premia deliver zero risk-adjusted profits to lenders, given the default and prepayment behavior of borrowers.
  - Since default and prepayment decisions depend on mortgage premia, we must solve a fixed point problem.
  - There may be no fixed point for high-LTV loans (Stiglitz and Weiss 1981).
- We find higher mortgage premia in recessions, consistent with data.

# UK Mortgage Rates 1998-2016



# Optimization Problem

The Bellman equation for household optimization:

$$V_{it}(\Omega_{ti}) = \max\{U(C_{it}) + \beta \mathrm{E}_t \max[V_{i,t+1}(\cdot), V_{i,t+1}^{Rental}(\cdot)]\}.$$

- State variables ($\Omega_{ti}$): Time, business cycle, interest rate, house prices; cash-on-hand, permanent income, debt, mortgage loan premium, whether agent has moved to the rental market before. FRM contracts have an additional state variable, the interest rate at mortgage origination.
- Choices: Borrowers decide whether to make the scheduled mortgage payments, refinance (s.t. LTV constraint), default, or prepay the loan. Both borrowers and renters decide how much to consume and save.
- We simulate the model with 400 different paths for the aggregate variables. We have 550 agents per period, distributed across overlapping generations.

# Calibration (Table 1)

| Description | Parameter | Value |
|---|---|---|
| Panel A: Business cycle transition probabilities | | |
| P(recession \| recession) | | 0.37 |
| P(recession \| expansion) | | 0.18 |
| Panel B: Real interest rate | | |
| Mean log real rate | $\mu_r$ | 0.01 |
| St. dev. of real rate | $\sigma_r$ | 0.025 |
| High value log real risk-free | | 0.035 |
| Low value log real risk-free | | -0.015 |
| P(high rate \| recession) | | 0.38 |
| P(high rate \| expansion) | | 0.52 |
| Panel C: House prices | | |
| Mean log house price change | $\mu_H$ | 0 |
| St dev log house price change | $\sigma_e$ | 0.162 |
| High log house price growth | | 0.162 |
| Low log house price growth | | -0.162 |
| P(increase in house prices \| recession) | | 0.39 |
| P(increase in house prices \| expansion) | | 0.52 |

# Calibration (Table 1)

| | | |
|---|---|---|
| **Panel D: Time and preference parameters** | | |
| Subjective discount factor | $\beta$ | 0.98 |
| Risk aversion | $\gamma$ | 2 |
| Number of periods | $T$ | 20 |
| Utility of terminal wealth | $b$ | 10 |
| **Panel E: Labor income process** | | |
| Log permanent income AR(1) coefficient | $\rho$ | 0.979 |
| Prob. aggregate/idiosyncratic shock | $p_1$ | 0.49 |
| Mean log earnings growth expansion (1) | $\mu_{1E}$ | 0.119 |
| Mean log earnings growth expansion (2) | $\mu_{2E}$ | -0.026 |
| Mean log earnings growth recession (1) | $\mu_{1R}$ | -0.102 |
| Mean log earnings growth recession (2) | $\mu_{2R}$ | 0.094 |
| St. dev permanent income shock (1) | $\sigma_1$ | 0.325 |
| St. dev permanent income shock (2) | $\sigma_2$ | 0.001 |
| St. dev. temporary shock | $\sigma_\epsilon$ | 0.186 |
| Tax rate | $\phi$ | 20% |

# Calibration (Table 1)

| Panel F: Loan and rental market parameters | | |
|---|---|---|
| Initial loan to income | $lti$ | 3.5 |
| Initial loan to value expansion (recession) | $ltv$ | 0.9 (0.8) |
| Loan premium (ARM, recession) | $\psi^{ARM}$ | 0.03 |
| Servicing costs (as % of loan outstanding) | | 0.0025 |
| Loan maturity | $\tau$ | 20 years |
| Default utility penalty | $\lambda$ | 0.1 |
| Prepayment cost | $\theta_P$ | 0 |
| Refinancing cost | $\theta_R$ | \$1000 |
| House sale commission | $\theta_c$ | 0.06 |
| Property taxes | $\tau_p$ | 0.015 |
| Maintenance expenses | $m_p$ | 0.025 |
| Rental premium | $\varepsilon$ | 0.01 |

# Mortgage Designs Considered

1. Standard ARM (benchmark case).
2. Option ARM with a free option to extend maturity in a recession.
3. Standard FRM.
4. Option FRM with a free option to switch to an ARM in a recession with no home equity constraint (Eberly-Krishnamurthy proposal).

# Real Interest Rate Regimes

1. Benchmark (post-1985): Mean real rate of 1.0%, standard deviation of 2.5%, procyclical real rate.
2. Low real rate (post-2000): mean real rate of -1.0%, standard deviation of 2%, acyclical real rate.

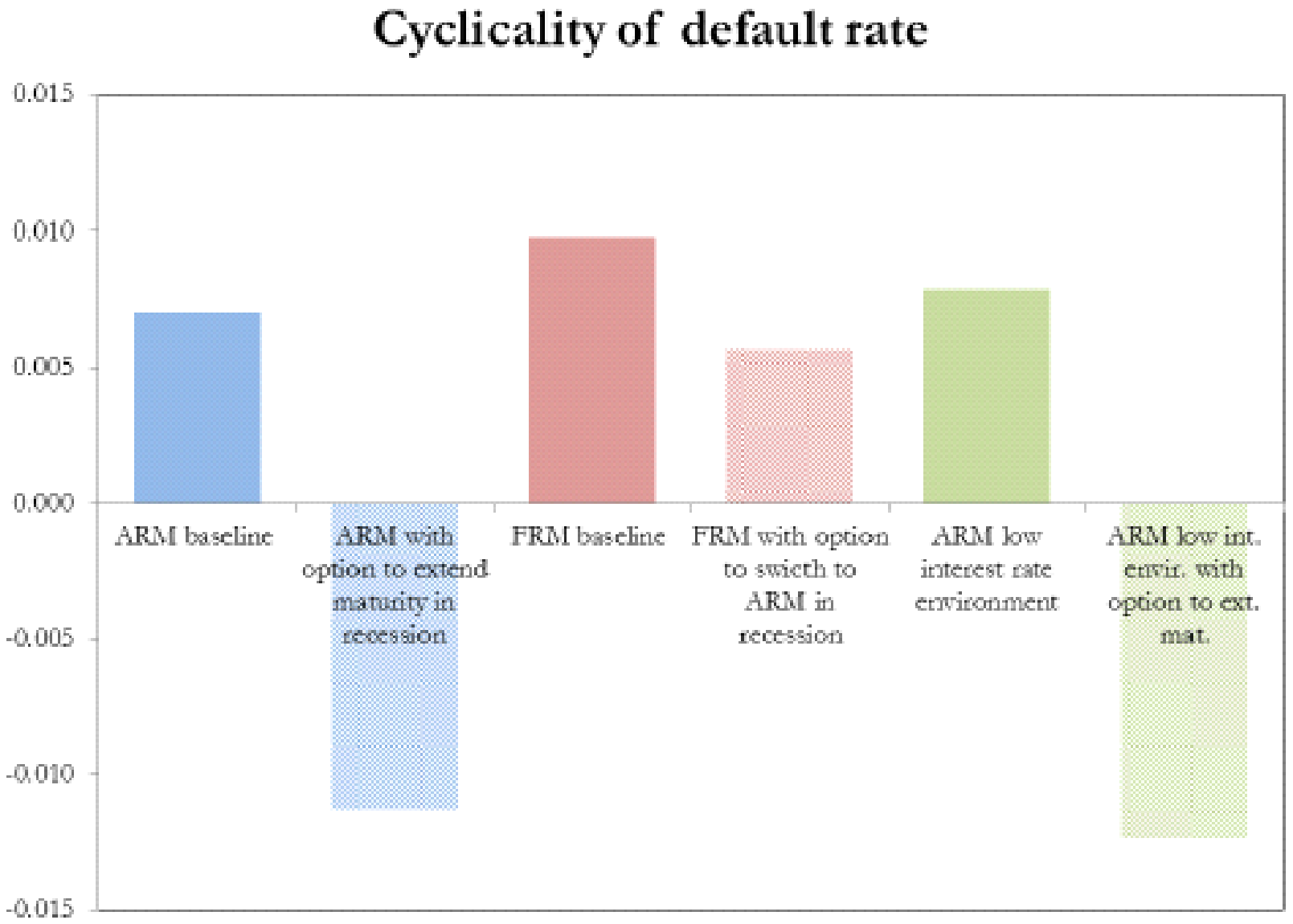
- A stable and acyclical real rate reflects the impact of the zero lower bound on the nominal rate.
- A plain-vanilla ARM is less satisfactory in this environment.

# Comparison of Plain and Option ARMs (Tables 3 and 4)

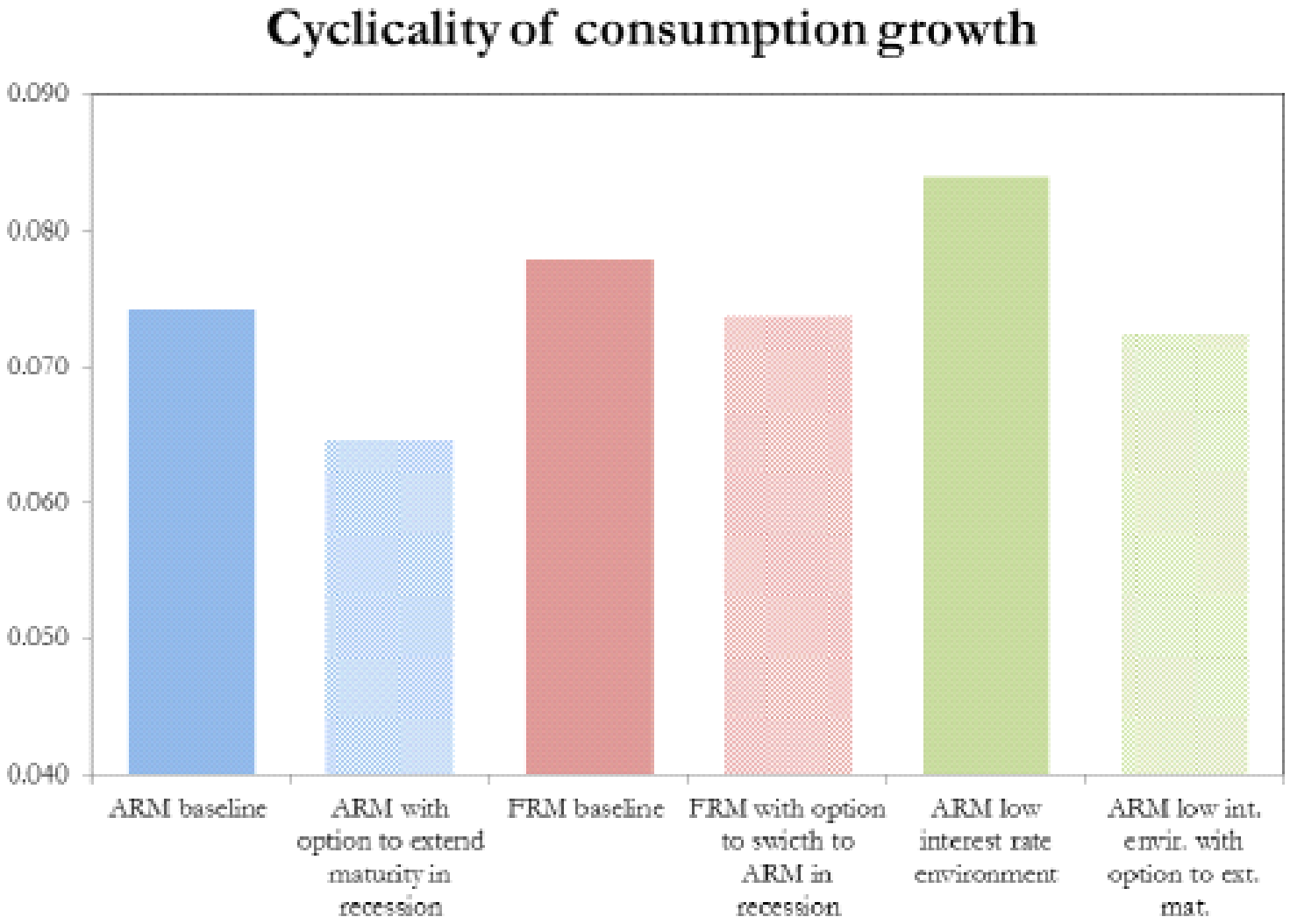
| **Plain ARM** | Unconditional | Recession | Expansion |
|---|---|---|---|
| Loan premia | 0.016 | 0.030 | 0.012 |
| Average log cons. growth | 0.042 | -0.016 | 0.059 |
| Log change in income | 0.027 | -0.009 | 0.038 |
| Incidence | | | |
| Default | 0.013 | 0.019 | 0.012 |
| Refinance | 0.093 | 0.014 | 0.115 |
| Pay | 0.883 | 0.953 | 0.863 |

| **Option ARM** | Unconditional | Recession | Expansion |
|---|---|---|---|
| Loan premia | 0.015 | 0.026 | 0.012 |
| Average log cons. growth | 0.040 | -0.010 | 0.055 |
| Log change in income | 0.027 | -0.009 | 0.038 |
| Incidence | | | |
| Default | 0.013 | 0.005 | 0.016 |
| Refinance | 0.085 | 0.006 | 0.108 |
| Pay | 0.748 | 0.340 | 0.865 |
| Extend | 0.142 | 0.639 | n/a |

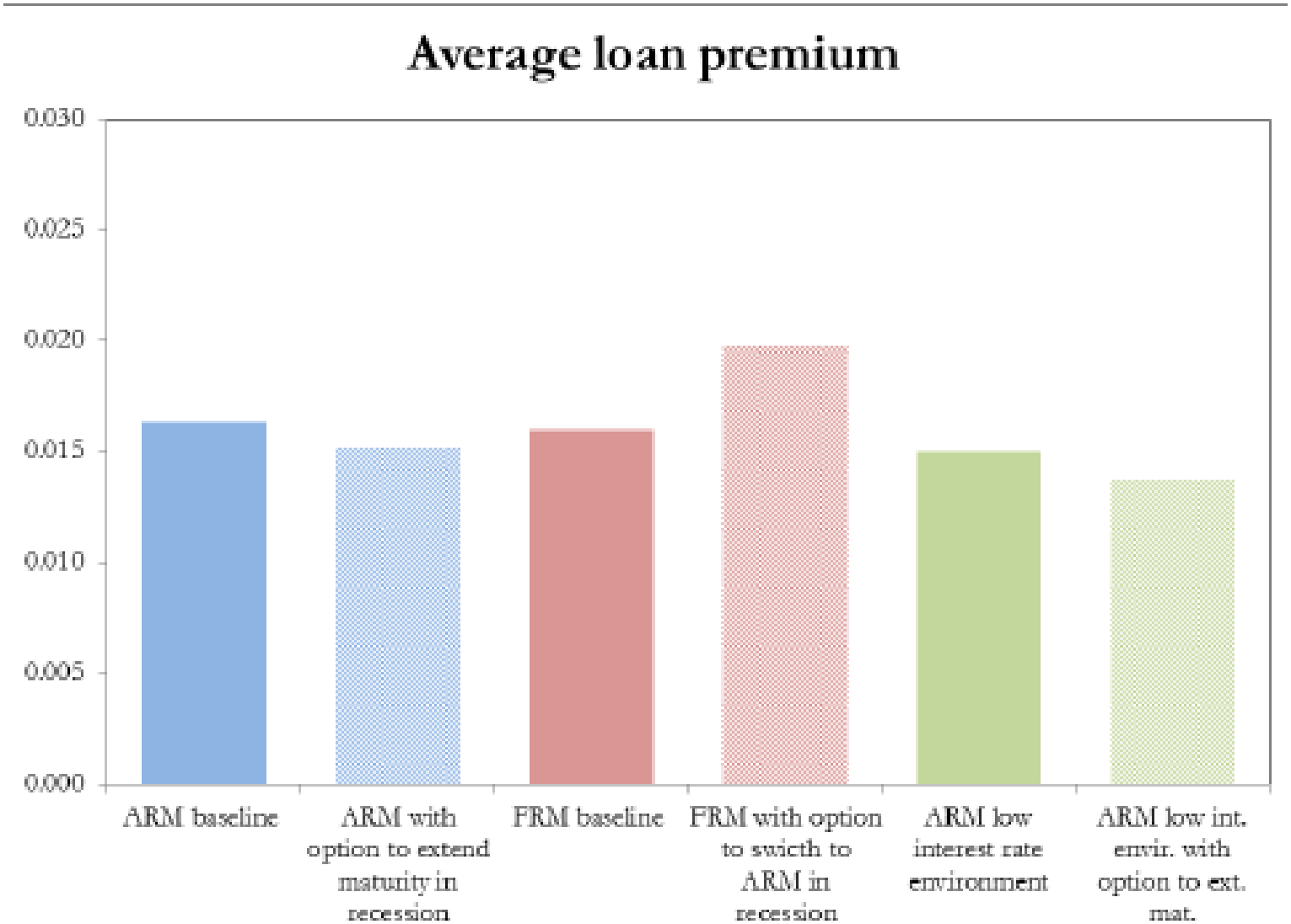
# Option ARM Reduces Defaults During Recessions



# Option ARM Stabilizes Consumption



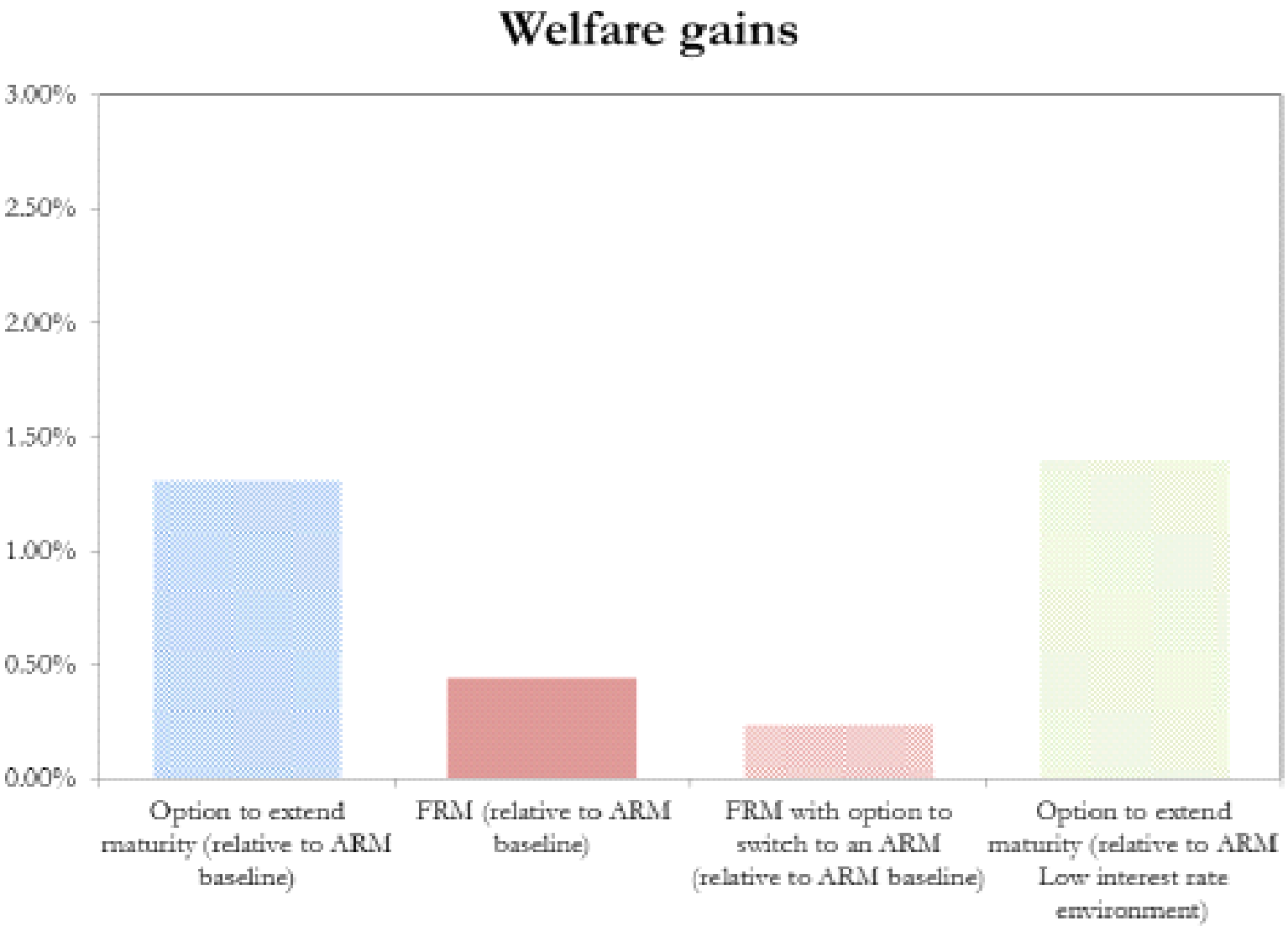
# Option ARM is Not That Expensive



# Summary of Cyclicality and Pricing Results

- Relative to a standard ARM, an option ARM
  - stabilizes consumption growth over the business cycle,
  - shifts defaults to expansions,
  - and has a lower premium because cash flows to lenders are more stable and less cyclical.
- Relative to a standard FRM, an option FRM
  - modestly stabilizes consumption growth over the business cycle,
  - modestly reduces defaults in recessions,
  - but has a higher premium because lenders lose payments in recessions.

# Welfare Gains from an Option ARM



# Summary of Welfare Results

- In our model, borrowers prefer FRMs to ARMs despite the good macroeconomic properties of ARMs:
  - they dislike the risk of interest rate increases.
- But an option ARM is even more strongly preferred:
  - it is attractively priced and reduces risk during recessions,
  - and in a low interest rate environment, it does even better.
- These results hold while lenders make equal risk-adjusted profits.

# Conclusion

- The option ARM has many advantages in our analysis.
- And all the more so in a low and stable real interest rate environment where the standard ARM delivers less budget relief in a recession.
- Like the option FRM, the system depends on a disinterested party declaring a recession in a timely and credible manner.
- We ignore household inertia, but this may be less of an issue in this context since the option is exercised by distressed borrowers.
- We plan to extend our analysis to consider other mortgage designs and factors not considered yet such as inflation risk.