The Role of Mortgage Interest Fixation Periods for Macro-Prudential & Monetary Policies

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Motivation

- The **housing** and **mortgage markets** have been at the center of the discussion of both **monetary** and **macro-prudential** policies, especially after the GFC
  * Housing collateral channel $\Longrightarrow$ LTV constraints
  * Cash flow (mortgage payments) channel $\Longrightarrow$ PTI constraints

- The **interest fixation period** is a crucial element in this discussion as it affects the **pass-through** from the nominal policy rate to mortgage rates
  * This is particularly relevant today as Central Banks (CBs) have increased their interest rates substantially to cope with inflationary preassures

- *How does the strength of monetary policy depend on the mortgage interest fixation period? And how it is affected by credit conditions?*

▷ Bank & Mortgage Rates

What we do

1. We provide **evidence on interest fixation periods** of mortgage contracts

2. We extend a standard **general equilibrium model with long-term mortgage debt** and allow mortgage contracts to have different interest fixation periods
   * Three different economies: *(i)* adjustable rate mortgage, *(ii)* fixed rate mortgage, *(iii)* **hybrid rate mortgage** with T periods on the fix part of the contract
   * Two limits: LTV & PTI $\implies$ not all borrowers are constrained by the same limit (Greenwald, 2018)

3. Calibrate the model to the UK and use it to study the **transmission of monetary policy** and its **interaction with credit constraints**
   * Temporary vs. persistent monetary policy shocks
   * Evaluate the effects for different LTV and PTI calibrations (loose vs tight credit conditions)
   * Look at these effects under a different set of credit limits (e.g. only LTV, only PTI, both)

What we find

- *Empirical Fact*: the most predominant mortgage contract has a variable interest fixation period between two to ten years (BIS, 2023)

- *Main Model Findings*:

  * The interest fixation period and the tightness of credit conditions **do not matter** when the monetary policy shock is **transitory**

  * **Looser** credit conditions and **shorter** interest fixation periods **amplify** the redistributive effects of an inflation target shock that moves **persistently** the nominal rates

  * **LTV limits act as a backstop to the high sensitivity of PTI limits** to monetary policy, specially when the interest fixation period is short

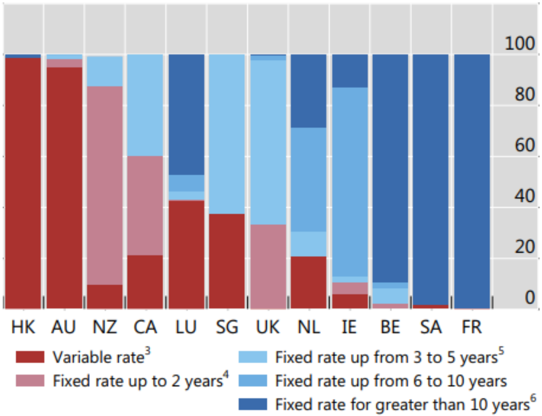
Mortgage Market Structure across the Globe

Interest fixation period across countries

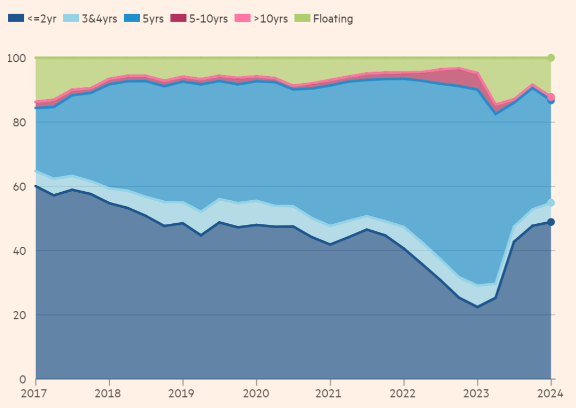
- Fixed and adjustable rate mortgages are known to be the most common and hence the most theoretically studied

- Cross-country evidence seems to tell a different story (BIS, 2023)

- Most countries have interest fixation periods that vary between 2 and 10 years



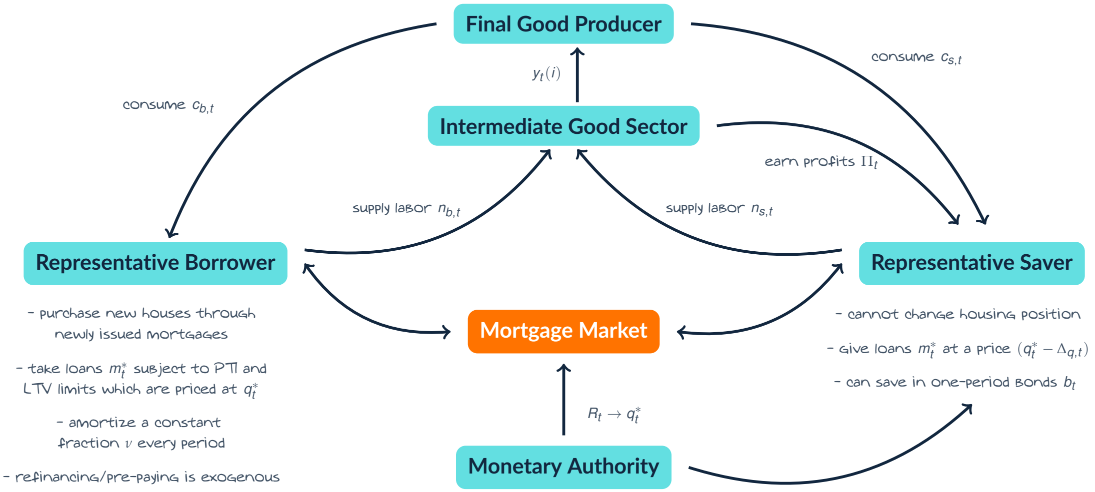
The typical interest fixation period in the UK



- There has been some time variation in the share of mortgages with different interest fixation periods
- Nonetheless, 2-year and 5-year interest fixation periods are the most common in the UK

The Model Economy

Model sketch



▷ Details

Borrower's Problem

- Chooses *consumption* $c_{b,t}$, *labor* supply $n_{b,t}$, the size of newly purchased *houses* $h^*_{b,t}$, and the face value of newly issued *mortgages* m^*_t
- to maximize lifetime expected discounted utility using the aggregate utility function

$$u(c_{b,t}, h_{b,t-1}, n_{b,t}) = \log(c_{b,t}/\chi_b) + \xi \log(h_{b,t-1}/\chi_b) - \eta_b \frac{(n_{b,t}/\chi_b)^{1+\varphi}}{1+\varphi} \tag{1}$$

- subject to the **budget constraint**

$$\begin{aligned} c_{b,t} \leq & (1-\tau_y) w_t n_{b,t} - \pi_t^{-1} \left((1-\tau_y) x_{b,t-1} + \nu m_{t-1}\right) + \rho \left(m^*_t - (1-\nu)\pi_t^{-1} m_{t-1}\right) \\ & - \delta p^h_t h_{b,t-1} - \rho p^h_t \left(h^*_{b,t} - h_{b,t-1}\right) + T_{b,t} \end{aligned} \tag{2}$$

- the **debt constraint**

$$m^*_t \leq \bar{m}_t = \underbrace{\left(\theta^{PTI} w_t n_{t,i} e_{t,i}\right) / q^*_t}_{=\bar{m}^{PTI}_t} \int^{\bar{e}_t} e_i d\Gamma_e(e_i) + \underbrace{\theta^{LTV} p^h_t h^*_{i,t}}_{=\bar{m}^{LTV}_t} (1 - \Gamma_e(\bar{e}_t)) \tag{3}$$

- and **laws of motion** for total start-of-period debt balances m_{t-1}, total promised payments on existing debt $x_{t-1} \equiv q_{t-1} m_{t-1}$ and total start-of-period borrower housing $h_{b,t-1}$

LOM: Housing, Mortgage Debt & Promised Payments

- Independently from the interest fixation period T, *housing* and *mortgage debt* evolve

$$h_{b,t} = \rho h^*_{b,t} + (1-\rho) h_{b,t-1} \tag{4}$$

$$m_t = \rho m^*_t + (1-\rho)(1-\nu)\pi_t^{-1} m_{t-1} \tag{5}$$

- **Fixed, Adjustable and Hybrid Rate Mortgage** economies **only differ** in the evolution of *mortgage promised payments*

$$x^{HRM}_{b,t} = \sum_{\tau=0}^{T-1} \left[\rho \left((1-\rho)(1-\nu) \right)^{\tau} \left(\prod_{i=0}^{\tau-1} \pi^{-1}_{t-i} \right) q^*_{t-\tau} m^*_{t-\tau} \right] + \left((1-\rho)(1-\nu) \right)^{T} \left(\prod_{i=0}^{T-1} \pi^{-1}_{t-i} \right) q^*_{t-T} m_{t-T}$$

  * $T = 0 \implies x^{ARM}_{b,t} = q^*_t m_t$
  * $T \to \infty \implies x^{FRM}_{b,t} = \rho q^*_t m^*_t + (1-\rho)(1-\nu)\pi_t^{-1} x_{b,t-1}$
  * Same logic applies in the saver's promised payments law of motion

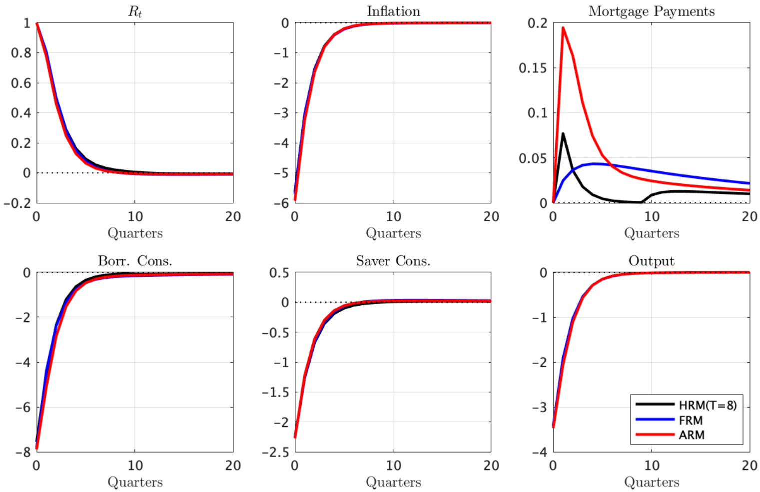
▷ Mortgage Pricing

Model Results

▷ Calibration

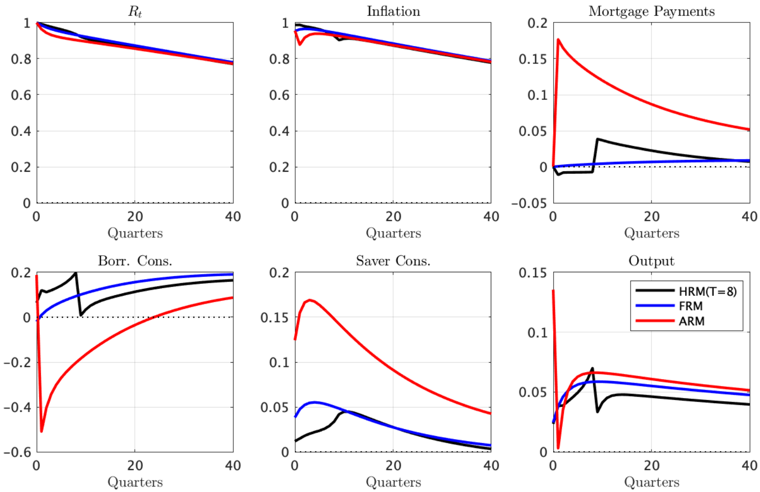
Temporary Monetary Policy Shock

The interest fixation period does not matter

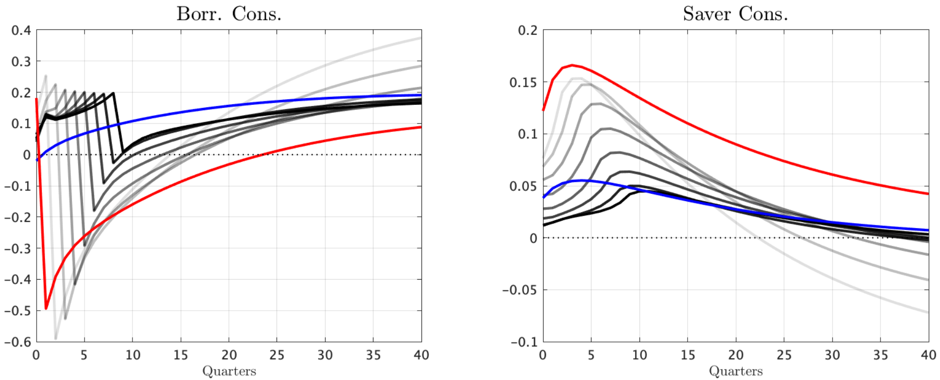


Persistent Inflation Target Shock

No aggregate effects, but redistribution of consumption

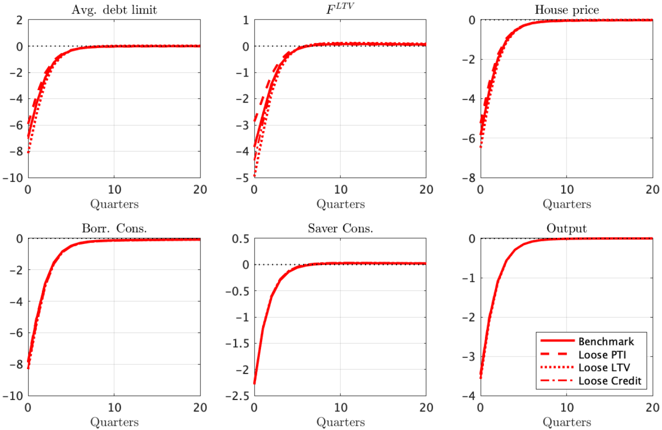


Interest fixation period and its effect on consumption



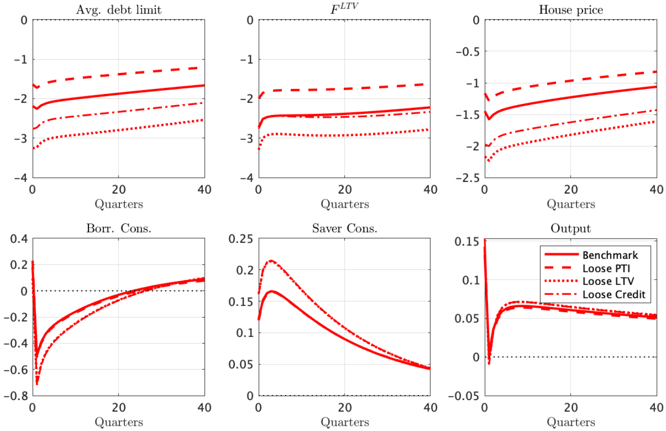
Interaction with Credit Limits

Credit conditions do not matter if shock is transitory



- Here: temporary monetary policy shock
- Loose PTI or LTV economies have a 20% lower PTI and LTV relative to the benchmark
- ARM & FRM economies have similar implications

Looser LTVs amplify effects on house price & redistribution



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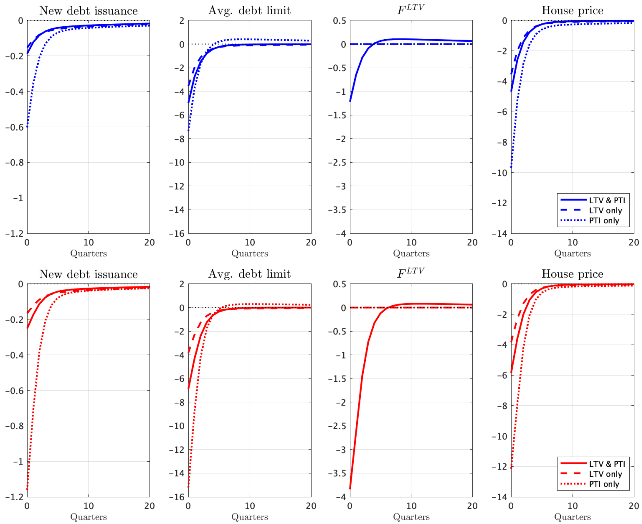
The complementarity between LTV and PTI limits



Three ss dist. of constrained borr.:

1. *PTI only*: stronger reaction of debt & house prices in the ARM economy
2. *LTV only*: no differences
3. *Both LTV & PTI*: strong reaction of F^{LTV} in ARM economy, but only small differences in avg. debt limit and house prices

$\Longrightarrow$ **LTV acts as a backstop**

Concluding Remarks

Main Takeaways

- **The UK mortgage market is not that different after all.** Two and five year interest fixation periods are the most common in many countries.

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- We find that:

  1. Credit limits and interest fixation periods do not matter when the shock is transitory
  2. Looser credit limits and shorter fixation periods amplify the redistributive effects of persistent movements in mortgage rates
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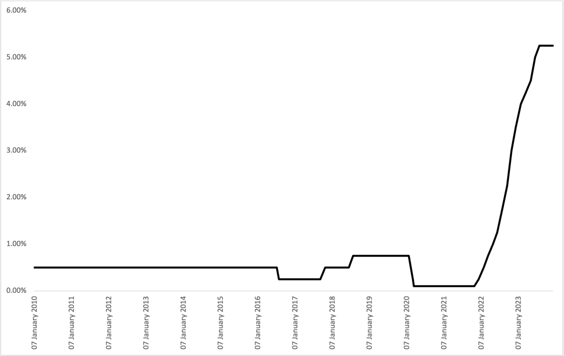
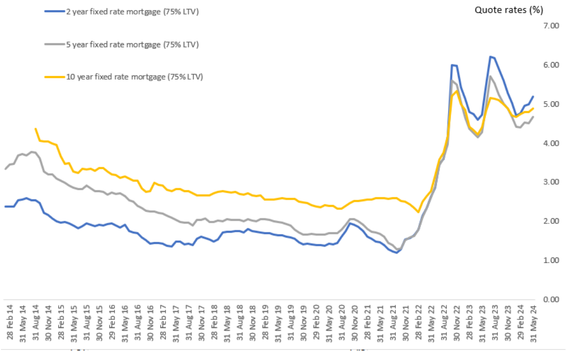
THANK YOU!

Appendix

Bank Rate



(a) Bank Rate



(b) Mortgage Rates

▷ Back

Model Details

Understanding the new law of motion: $x_{b,t}^{HRM}$

- The law of motion of promised payments (8) in a HRM economy when T=1 is given by

$$x_{b,t}^{HRM(T1)} = \rho q_t^* m_t^* + (1-\rho)(1-\nu) \underbrace{q_{t-1}^* m_{t-1}}_{x_{t-1}}$$

- Note that this is just a combination of the law of motion of promised payments in the FRM and ARM economies
- In fact, the law of motion for the ARM economy can be obtained after setting $T = 0$ in eq. (8)
- And the law of motion for the FRM economy can be recovered after setting $T = \infty$ in eq. (8) and convert the infinitive sum into a recursion
  * Alternatively you can also expand the recursion in eq. (6) to see it

▷ Back

Saver's Problem

- Chooses *consumption* $c_{s,t}$, *labor* supply $n_{s,t}$, one period bonds b_t, and the face value of newly issued *mortgages* m_t^*
- to maximize lifetime expected discounted utility using the aggregate utility function

$$u(c_{s,t}, n_{s,t}) = \log(c_{s,t}/\chi_s) + \xi \log(\tilde{H}_{s,t-1}/\chi_s) - \eta_s \frac{(n_{s,t}/\chi_s)^{1+\varphi}}{1+\varphi} \tag{6}$$

- subject to the **budget constraint**

$$\begin{aligned} c_{s,t} \leq (1-\tau_y)\, w_t n_{s,t} + \pi_t^{-1} x_{s,t-1} - \rho \left(m_t^* - (1-\nu)\pi_t^{-1} m_{t-1} \right) \\ - \delta p_t^h \tilde{H}_s - \left(R_t^{-1} b_t - \pi_t^{-1} b_{t-1} \right) + \Pi_t + T_{s,t} \end{aligned} \tag{7}$$

- and **laws of motion** for total start-of-period debt balances m_{t-1}, and total promised payments on existing debts, which again differ across the three economies
- In addition, there is a proportional tax on all future mortgage payments $\Delta_{q,t}$ that follows a stochastic process (term premium shock = innovation of this process)

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The rest of the economy: the New Keynesian block

- **Production**
  * A competitive *final good producer*: $\max_{y_t(i)} P_t \left[\int_0^1 y_t(i)^{\frac{\lambda-1}{\lambda}} di\right]^{\frac{\lambda}{\lambda-1}} - \int_0^1 P_t(i) y_t(i) di$
  * A continuum of *intermediate good producers* that choose price $P_t(i)$ and operates a linear technology $y_t(i) = a_t n_t(i)$ to meet the final's good producer demand.
  * Intermediate good producers are subject to *price stickiness* – Calvo pricing with indexation.
- **Monetary authority**: it follows a *Taylor rule* of the form

$$\begin{aligned} \log R_t = \log \bar{\pi}_t + \phi_r \left(\log R_{t-1} - \log \bar{\pi}_{t-1}\right) \\ + (1-\phi_r)\left[\left(\log R_{ss} - \log \pi_{ss}\right) + \psi_\pi \left(\log \pi_t - \log \bar{\pi}_t\right)\right] + \log \eta_t \end{aligned} \tag{8}$$

where $\log \eta_t$ is a temporary monetary policy shock and $\bar{\pi}_t$ is a time-varying inflation target that follows an AR(1) in logs (innovation = infl. target shock)

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Equilibrium Conditions

Mortgage Pricing

- The optimality of new debt, m_t^*, determines the mortgage coupon rate, q_t^*
- **Borrower optimality**:

$$1 = \Omega_{b,t}^m + \Omega_{b,t}^x q_t^* + \mu_t \tag{9}$$

where μ_t is the multiplier on the aggregate credit limit, and $\Omega_{b,t}^m$ and $\Omega_{b,t}^x$ are the marginal continuation <u>*costs*</u> to the the borrower of taking an additional dollar of face value debt and of promising an additional dollar of initial payments

- **Saver optimality**:

$$1 = \Omega_{s,t}^m + \Omega_{s,t}^x \left(q_t^* - \Delta_{q,t}\right) \tag{10}$$

where $\Omega_{s,t}^m$ and $\Omega_{s,t}^x$ are the marginal continuation <u>*benefits*</u> of an additional unit of face value debt and an additional dollar of promised initial payments

- **Borrower (saver) marginal continuation costs (benefits) differ depending on the contract type: (a) ARM, (b) FRM, (c) HRM**

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Mortgage Pricing II – borrower's continuation costs

- **FRM & HRM economies** have the same marginal continuation cost of *face value debt* $\Omega^m_{b,t}$, but different marginal continuation cost of an additional *dollar of promised payments*:

$$\Omega^m_{b,t} = \mathbb{E}_t \left[\Lambda^b_{t,t+1} \pi^{-1}_{t+1} \left(\nu + (1-\nu)\rho + (1-\nu)(1-\rho)\Omega^m_{b,t+1}\right)\right] \tag{11}$$

$$\Omega^{x,FRM}_{b,t} = \mathbb{E}_t \left[\Lambda^b_{t,t+1} \pi^{-1}_{t+1} \left((1-\tau_y) + (1-\nu)(1-\rho)\Omega^x_{b,t+1}\right)\right] \tag{12}$$

$$\Omega^{x,HRM}_{b,t} = \sum_{\tau=1}^{T} (1-\rho)^{\tau-1} (1-\nu)^{\tau-1} \mathbb{E}_t \left[\left(\prod_{j=0}^{\tau-1} \Lambda^b_{t+j,t+j+1} \pi^{-1}_{t+j+1}\right)(1-\tau_y)\right] \tag{13}$$

- As *mortgage payments* is not a state variable in the **ARM economy**, its marginal continuation cost is zero: $\Omega^{x,ARM}_{b,t} = 0$. And the marginal cost of an *additional unit of debt* also includes a term that capture the cost of current mortgage payments:

$$\Omega^{m,ARM}_{b,t} = \mathbb{E}_t \left[\Lambda^b_{t,t+1} \pi^{-1}_{t+1} \left((1-\tau_y)\, q^*_t + \nu + (1-\nu)\,\rho + (1-\nu)\,(1-\rho)\,\Omega^{m,ARM}_{b,t+1}\right)\right] \tag{14}$$

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Saver's Continuation Benefits

- Similarly to the borrower's problem, the marginal continuation benefit of an *additional unit of debt* is identical in **FRM & HRM economies**. However, the marginal continuation benefit of an *additional dollar of promised payments* is different

$$\Omega^m_{s,t} = \mathbb{E}_t \left[\Lambda^s_{t,t+1} \pi^{-1}_{t+1} \left(\rho \left(1-\nu\right) + (1-\rho)(1-\nu)\Omega^m_{s,t+1} \right) \right] \tag{15}$$

$$\Omega^{x,FRM}_{s,t} = \mathbb{E}_t \left[\Lambda^s_{t,t+1} \pi^{-1}_{t+1} \left(1 + (1-\rho)\left(1-\nu\right) \Omega^{x,FRM}_{s,t+1} \right) \right] \tag{16}$$

$$\Omega^{x,HRM}_{s,t} = \sum_{\tau=1}^{T} (1-\rho)^{\tau-1} (1-\nu)^{\tau-1} \mathbb{E}_t \left[\left(\prod_{j=0}^{\tau-1} \Lambda^s_{t+j+1,t+j} \pi^{-1}_{t+j+1} \right) \right] . \tag{17}$$

- In the **ARM economy**, as $x^{ARM}_{s,t}$ is not a state variable, the marginal benefit of an *additional dollar of payments* is again zero $\Omega^{x,ARM}_{s,t} = 0$, and the marginal benefit of an *additional unit of debt* includes a term on the current mortgage payment benefit

$$\Omega^{ARM}_{s,t} = \mathbb{E}_t \left[\Lambda^s_{t,t+1} \pi^{-1}_{t+1} \left((q^*_t - \Delta_{q,t}) + \rho \left(1-\nu\right) + (1-\nu)(1-\rho)\Omega^{ARM}_{s,t+1} \right) \right] . \tag{18}$$

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Calibration

Externally calibrated

Household's Parameters		
Parameter	*Interpretation*	*Value*
χ_b	Fraction of borrowers	27.74%
ξ	Housing utility weight	0.25
φ	Inv. Frisch elasticity	1.0
σ_e	Income dispersion	0.53
τ_y	Income tax rate	0.212
θ^{PTI}	Max PTI ratio	0.36
θ^{LTV}	Max LTV ratio	0.85
ν	Mortgage amortization	1.71%
ρ_b	Refinancing rate	0.10
δ_h	Housing depreciation	0.005
ϕ_q	Term premium (pers.)	0.852

New Keynesian Block Parameters		
Parameter	*Interpretation*	*Value*
ϕ_a	Persistence (TFP shock)	0.9
σ_a	Standard deviation (TFP shock)	0.05
λ	Variety elasticity	6.0
ζ	Price stickiness	0.75
ϕ_r	Interest rate smoothing	0.8336
φ_π	Taylor rule weight on inflation	1.497
$\phi_{\bar{\pi}}$	Persistence (infl. target shock)	0.994
ϕ_η	Persistence (interest rate shock)	0.3

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Internally calibrated: steady state and data targets

- The HRM economy with T=8 (2 years) is chosen as the benchmark for calibration.
- **6 parameters** are picked such that we match certain **steady state targets**:

Parameter	*Interpretation*	*Value*	*Steady state target*
β_s	Saver discount factor	0.998	10-year UK gilt = 2.5%
η_b	Borr. labor disutility	7.518	$n_{b,ss} = 1/3$
η_s	Saver labor disutility	5.775	$n_{s,ss} = 1/3$
$\log \bar{H}$	Log housing stock	2.256	$p^h_{ss} = 1$
μ_a	Mean (TFP shock)	1.015	$y_{ss} = 1$
π_{ss}	Steady state inflation	1.005	Inflation rate = 2%

- The remaining **3 parameters** are jointly chosen to match the **borrower's and saver's house value to income** (5.0 and 6.4, respectively) and the **annualized mortgage rate** (3.5%)

Parameter	*Interpretation*	*Value*
β_b	Borr. discount factor	0.957
$\log \bar{H}_s$	Log saver housing stock	1.678
μ_q	Term premium (mean)	0.36%

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