Bank Heterogeneity, Deposits, and the Pass-through of Interest Rates

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Motivation

- Fed, Bank of England, and ECB all increased policy rates sharply in 2022
- However, interest rates on deposit and savings accounts have been slow to follow


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Banks accused of 'measly' interest rates on savings

8 June · Comments

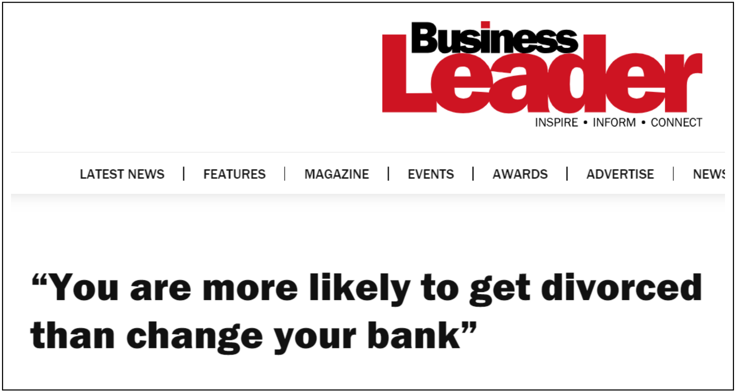
- In the UK, bank regulators have pointed the finger at banks exploiting "loyal" customers

The Guardian
https://www.theguardian.com › money › apr › regulat...

Regulator warns UK banks over miserly savings rates for ...

21 Apr 2023 — Regulator warns UK banks over miserly savings **rates** for **loyal customers**. The "harm" caused to millions of **loyal customers** of high street banks ...

- It is well documented that customers switch current accounts infrequently (4-6% per year in the UK)
  reason for this . . . inertia or preference for the status quo. The longer a customer has been with their bank the stronger their 'mooring' to it (Hartfree et al., 2016)



Note: Shadow chancellor Ed Balls, Sunday 8 July 2012

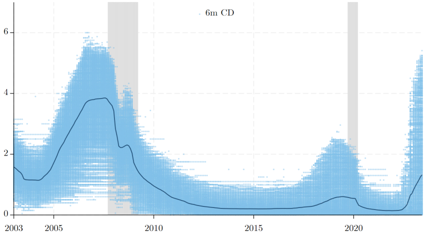
Our paper in a nut-shell...

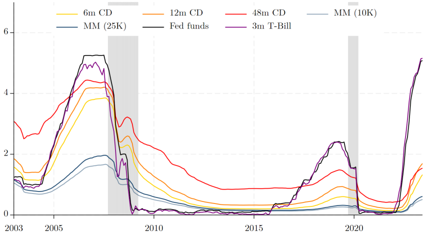
- ...is to study deposit rate dynamics
- What is already known?
  - Fed raises rates→ banks exploit their market power→ deposit rates rise less→ fed funds-deposit spread widens
  - "Deposit channel of monetary policy", (Drechsler et al., 2017)
- What is new?
  - Heterogeneity in the dynamics of relative deposits rates across banks & time
- We identify two new stylized facts using US data
  - (1) More leveraged banks & (2) banks with a large deposit base lower their relative deposit rates during periods of financial stress
- We build a continuous-time heterogeneous bank model to explain these stylized facts
  - Model features (1) customer capital ("deep habits") & (2) occasionally binding leverage constraints

Empirics

US bank-level data

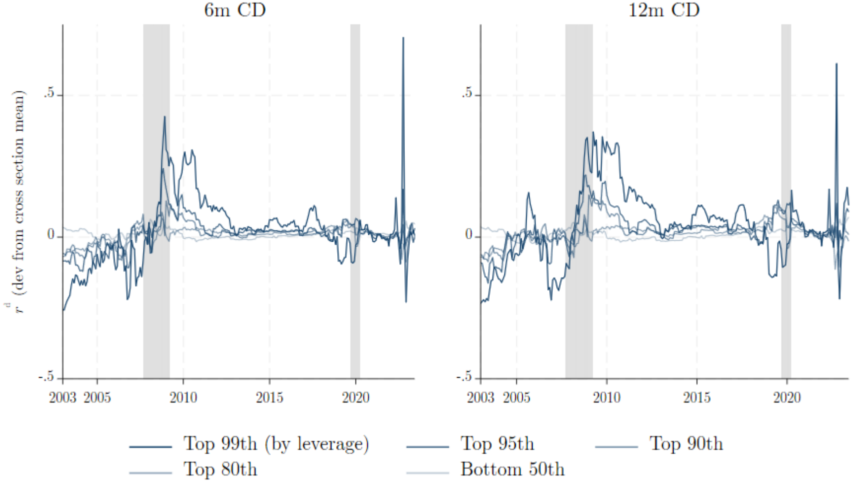
- Focus on interest rates on new deposit accounts from RateWatch (weekly, aggregated to monthly, 2000-2023)
- Also have "average" interest rates on deposits (based on interest rate expenditure) from Call Reports (quarterly, 1998-2023)





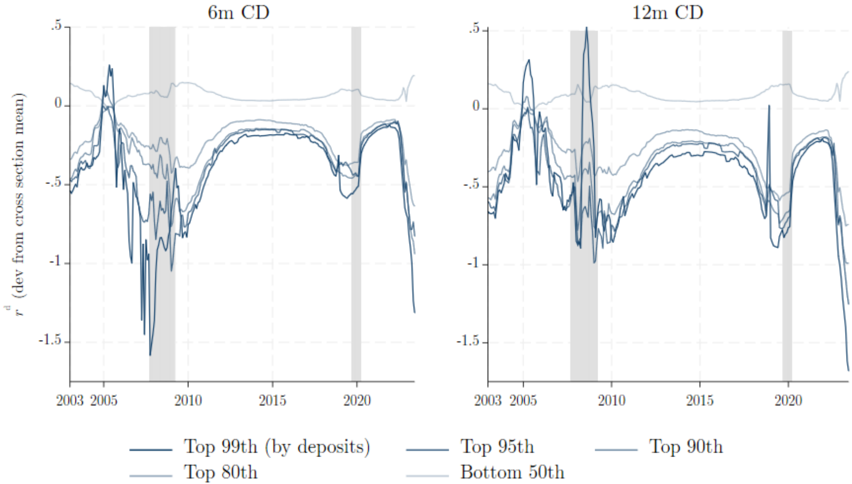
Heterogeneity in deposit rates (by leverage)

Deviation from cross-sectional mean (RateWatch)



Heterogeneity in deposit rates (by deposit base)

Deviation from cross-sectional mean (RateWatch)



Empirical setup

- Local projections (Jorda, 2005):

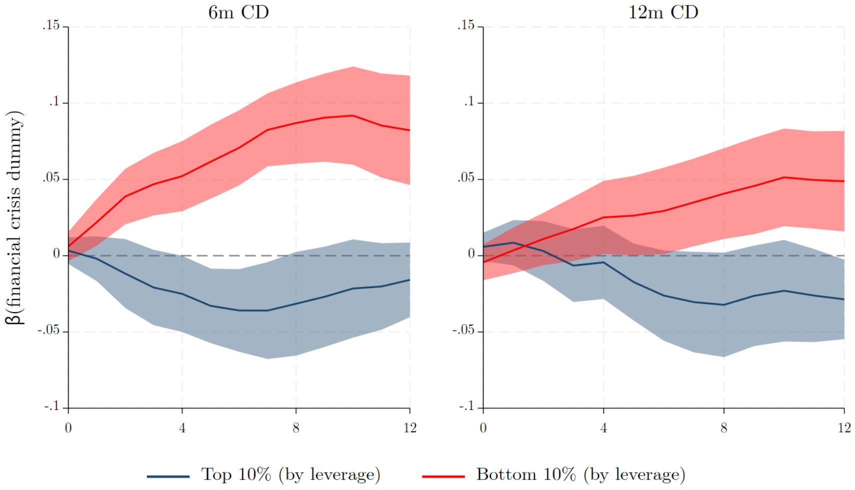
$$\tilde{r}^d_{i,t+h} = \alpha_i + \beta_h x_t + \gamma_{\mathbf{h}} \mathbf{X_{i,t}} + \delta_{\mathbf{h}} \mathbf{X_t} + \epsilon_{i,t+h}$$

  - $\tilde{r}^d_{i,t+h} = r^d_{i,t+h} - \bar{r}^d_{t+h}$ deposit rate of bank i in month $t+h$, in deviation from the cross-section mean
  - x_t is either
    - $D_t^{\text{fincrisis}}$, a financial stress dummy (based on Ludvigson, 2021, financial uncertainty index),
    - ε_t^{mp}, exogenous monetary policy surprise (Jarociński, 2024)

- Testing for heterogeneous effects
  - Rank banks by leverage (or size of deposit base)
  - Define dummy $D^d_{it} = 1$ for bank i in decile d in year t
  - Interact dummy with all explanatory variables
  - Gives decile-specific coefficient estimates of β^d_h

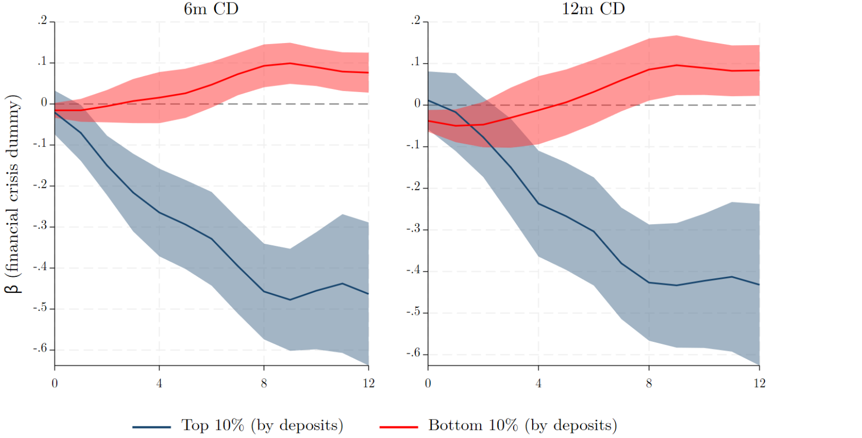
Response to financial stress (by leverage)

Highly leveraged banks lower their relative deposit rates



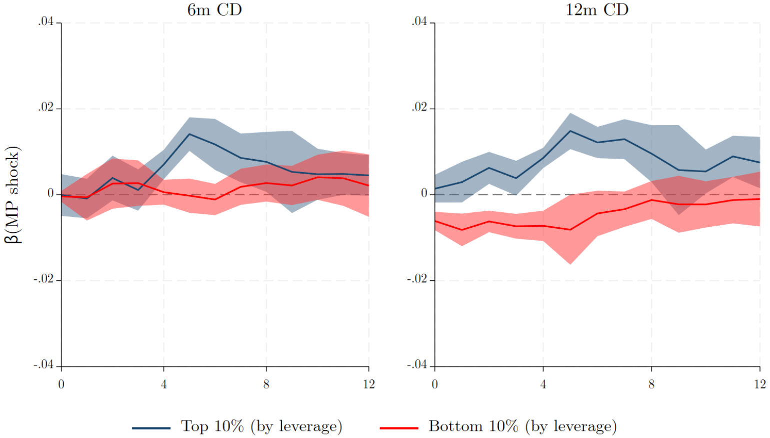
Response to financial stress (by deposit base)

Banks with a large deposit base lower their relative deposit rates
(Note: unconditional cross-sectional correlation between leverage and deposit base is low ≈ 0.07)



Response to MP shock (by leverage)

Highly leveraged banks raise their relative deposit rates in response to a monetary tightening



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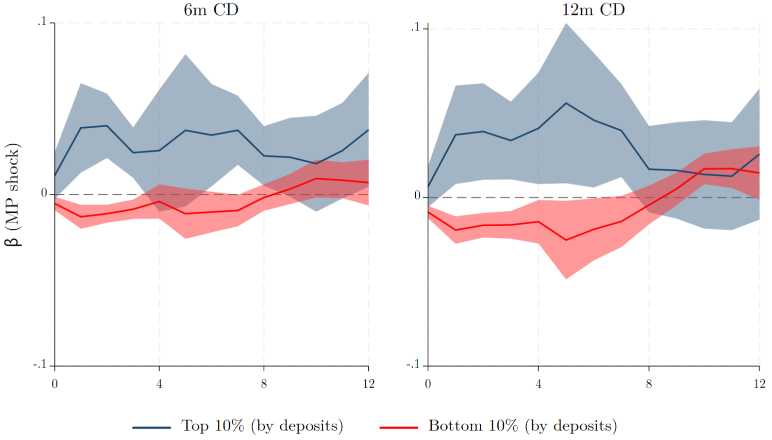


From empirics to model

- Substantial heterogeneity in deposit rate dynamics across banks → need a model of bank heterogeneity to capture this
- In the model, banks are heterogeneous along two dimensions
  1. (Occassionally binding) financial frictions → bank net worth
  2. Deep habit formation → stock of "customer capital"
- Related literature
  - **Heterogeneous bank models**: Jamilov (2021), Jamilov & Monacelli (2021), Bellifemine et al. (2022)
  - **Deep habit formation**: Ravn et al. (2006), Gilchrist et al. (2017, 2023), Dempsey & Faria-e Castro (2021)

Model

Households

- Infinite horizon, representative household (t- continuous)
- Consumes, C_t, and saves/accesses liquidity service from a continuum of banks (i): d_{it}
- Instantaneous utility

$$u\left(C_t\right) + \vartheta \left(\int_0^1 \left(\frac{d_{it}}{s_{it}^{\theta}} \right)^{\varepsilon} \mathrm{d}i \right)^{\frac{1}{\varepsilon}}$$

  - CES over liquidity services
  - Deep external habit formation: Customer capital s_{it} where $\theta < 0$ and $\dot{s}_{it} = (1-h)\left(d_{it} - s_{it}\right)$
- Wealth accumulation (risk-free rate: r_t, deposit rate: r_{it}^d)

$$\dot{A}_t = r_t A_t - \int_0^1 \left(r_t - r_{it}^d\right) d_{it} \mathrm{d}i + \Pi_t - C_t$$

Household's first-order conditions

- (Standard) Euler equation

$$\dot{C}_t = \frac{1}{\eta}\left(r_t - \rho\right) C_t$$

- Deposit demand curve

$$r^d_{it} = r_t - \frac{\vartheta}{u'(C_t)}\left(\frac{d_{it}}{\tilde{D}_t}\right)^{\varepsilon-1} s_{it}^{-\theta\varepsilon}$$

  - r^d_{it} upward sloping in d_{it} (market power: $\varepsilon < 1$)
  - r^d_{it} bounded above by r_t
  - curve shifts down with s_{it} (effect of habits)

Banks

- Continuum of banks (owned by the households)
  [drop i subscript]
- Banks "exit" at rate ζ (transferring equity to household) and replaced with new banks with initial equity ωN_t
- Balance sheet: $k_t = d_t + n_t \longrightarrow$ leverage: $\phi_t = k_t / n_t$
- A bank maximizes expected present discount value of equity (net worth, n_t) at exit

$$V_0 = \max_{d_t} \mathbb{E}_0 \int_0^\infty \zeta n_t e^{-\left(\int_0^t r_\tau \mathrm{d}\tau + \zeta t\right)} \mathrm{d}t$$

- Faces a potentially binding incentive compatibility constraint ("endogenous leverage constraint")

$$V_t \geq \lambda k_t$$

Banks cont.

- Takes account of household deposit demand function

$$r_t^d = r_t - \frac{\vartheta}{u'(C_t)} \left(\frac{d_t}{\tilde{D}_t} \right)^{\varepsilon - 1} s_t^{-\theta\varepsilon}$$

- Internalizes the effect on customer capital

$$\dot{s}_t = (1 - h)(d_t - s_t)$$

- And is governed by the accumulation of net worth

$$\mathrm{d}n_t = \left(r_t^k k_t - r_t^d d_t - \mathsf{c}(k_t) \right) \mathrm{d}t + n_t \sigma \mathrm{d}Z_t$$

  - $\mathsf{c}(\cdot)$ is convex portfolio cost
  - Z_t is a Wiener process (idiosyncratic net worth shocks)

Banks cont.

- Optimal solution satisfies Hamilton-Jacobi-Bellman (HJB)

  [drop t subscript]

$$(r+\zeta)V = \max_{d_t} \zeta n + \frac{\partial V}{\partial n} S_n + \frac{\partial V}{\partial s} S_s + \frac{(n\phi\sigma)^2}{2}\frac{\partial^2 V}{\partial n^2}$$

  where S_n & S_s are drifts in net worth & customer capital

- First-order condition (of unconstrained banks, $V > \lambda k$)

$$0 = \frac{\partial V}{\partial n}\left(r^k - r^d - \frac{\partial r^d}{\partial d} d - \mathsf{c}'(k)\right) + \frac{\partial V}{\partial s}(1-h) + \phi(n\sigma)^2 \frac{\partial^2 V}{\partial n^2}$$

Banks cont.

$$0 = \frac{\partial V}{\partial n}\left(r^k - r^d - \frac{\partial r^d}{\partial d}d - \mathsf{c}'(k)\right) + \frac{\partial V}{\partial s}(1-h) + \phi(n\sigma)^2\frac{\partial^2 V}{\partial n^2}$$

- $r^k - r^d > 0$: Increase d (leverage up)
- $-\frac{\partial r^d}{\partial d}d$: Market power (increasing d requires a higher r^d, lowering the interest margin)
- $c'(k)$: Without portfolio costs, all banks would be constrained
- $(1-h)$: Increase in d today increases customer habits

- Key idea:
  - Unconstrained banks face an intertemporal choice: Raising deposit rate lowers today's profits but builds customer capital (habits & market share) & increases future profits
  - Leverage constrained banks cannot be forward looking

- Rest of the model is very stylized
  - Firms borrow from banks to finance capital
  - Aggregate production: $Y_t = K_t^\alpha$
  - Aggregate capital accumulation: $\dot{K}_t = I_t - \delta K_t$
  - Thus, $r_t^k = \alpha K_t^{\alpha-1} - \delta$ is common across banks
  - Aggregation / market clearing: $K_t = \int_0^1 k_{i,t} \mathrm{d}i$ etc.

- Not for today:
  - (Aggregate) capital/investment adjustment costs
  - New-Keynesian block

Calibration

Parameterization

Parameters	Description	Values
Standard		
$\rho \times 100$	Discount rate	1.010
δ	Capital depreciation rate	0.025
α	Capital share of income	0.333
G/Y	Government spending ratio	0.200
Banks		
λ	Incentive constraint	0.286
ζ	Bank exit rate	0.029
$\sigma^2 \times 100$	Idiosyncratic bank net worth risk	0.010
φ_0	Portfolio cost	0.002
φ_1	Portfolio cost	0.500
Demand for liquidity		
$\vartheta \times 100$	Utility value of liquidity	0.045
ε	$1 - 1/\varepsilon$ elasticity of substitution	0.800
h	Habit persistence	0.950
θ	Habit strength	-0.530

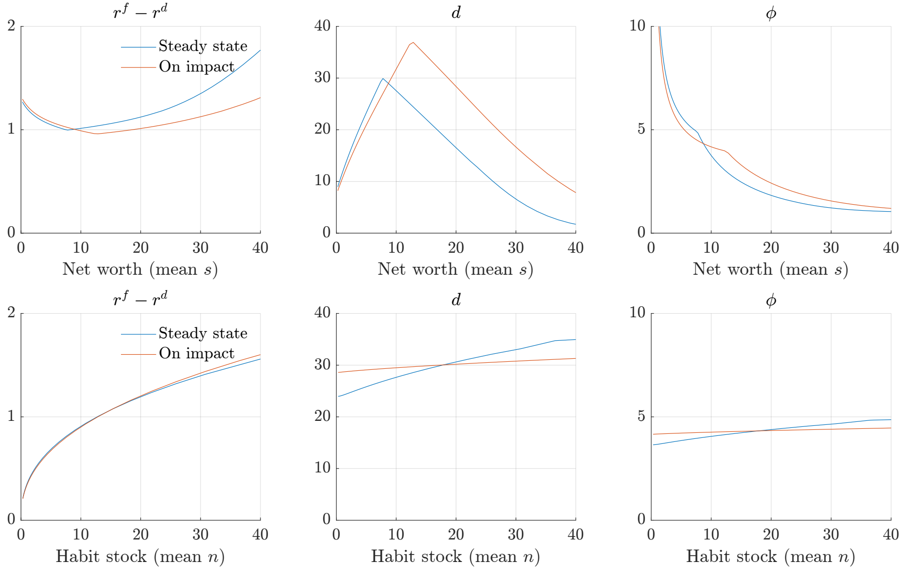
- $u(C_t) = \log(C_t)$ and $\mathsf{c}(k_t) = \varphi_0 k_t^{\varphi_1}$

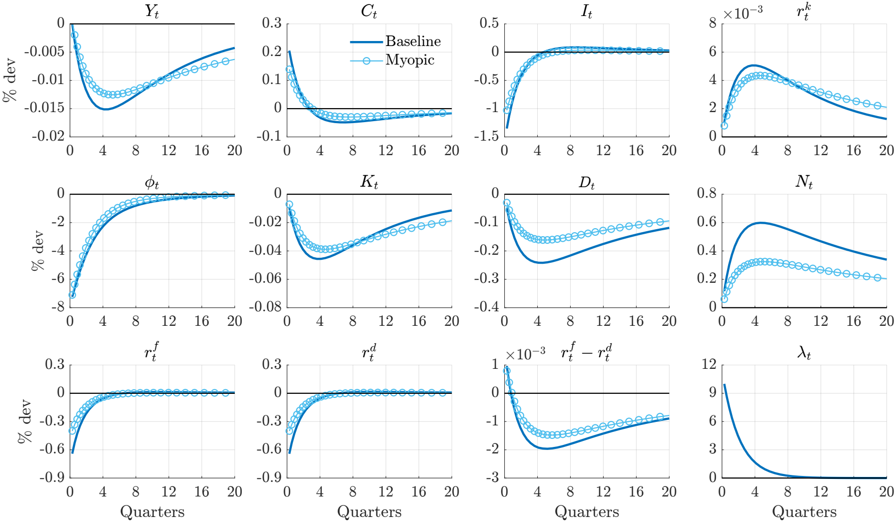
Steady state moments

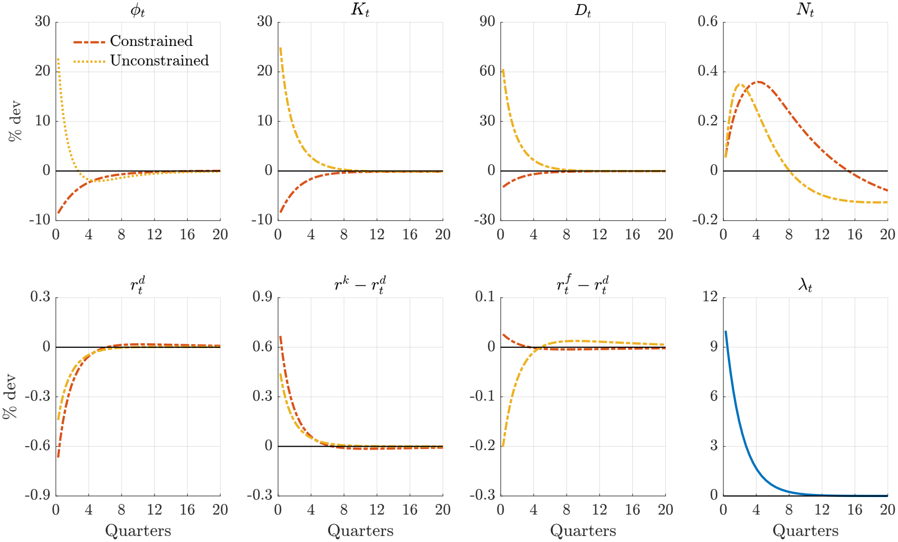
Moment	Model	Data
Leverage, ϕ		
mean	9.467	10.030
st.dev.	6.532	2.670
Deposit rate, r^d (% ann)		
mean	2.890	2.890
st.dev.	0.194	0.520
r^k (% ann)	6.638	5.000
$r^f - r^d$ spread (% ann)	1.150	1.400
Fraction of constrained banks	0.820	.

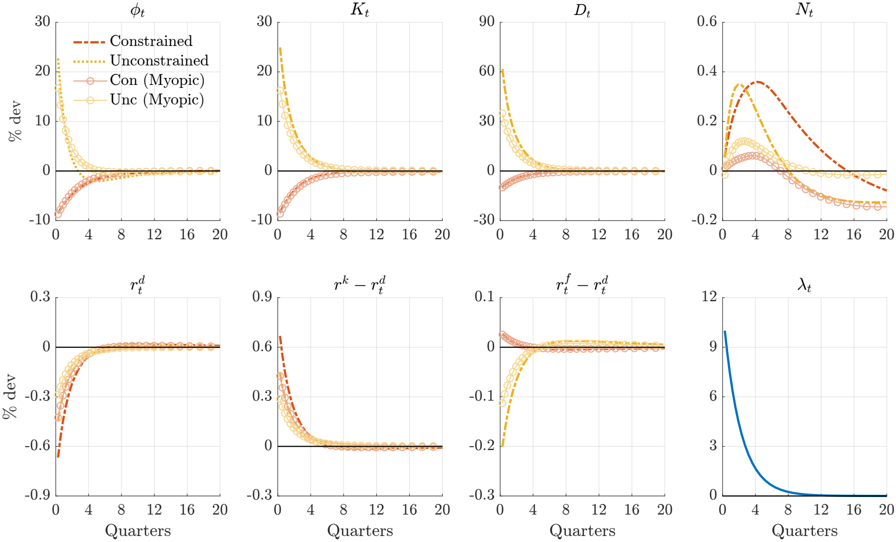
Results

Today, focus on a financial shock: 10% increase in λ


$r^f - r^d$
d
ϕ
Steady state
On impact
Net worth (mean s)
Habit stock (mean n)


Y_t
C_t
I_t
r_t^k
$\times 10^{-3}$
Baseline
Myopic
ϕ_t
K_t
D_t
N_t
r_t^f
r_t^d
$r_t^f - r_t^d$
λ_t
% dev
Quarters


ϕ_t
K_t
D_t
N_t
Constrained
Unconstrained
% dev
r_t^d
$r^k - r_t^d$
$r_t^f - r_t^d$
λ_t
Quarters


ϕ_t
K_t
D_t
N_t
r_t^d
$r^k - r_t^d$
$r_t^f - r_t^d$
λ_t
Constrained
Unconstrained
Con (Myopic)
Unc (Myopic)
% dev
Quarters

Conclusion

- Empirical heterogeneity across banks in the dynamic setting of deposit rates
- We build a heterogeneous bank model to capture this heterogeneity
- Much still to do—comments very welcome!

3 period model

Stylized model Ia

Representative household

$$\max \sum_{t=0}^{2} \beta^t u\left(C_t\right) + \sum_{t=0}^{1} \beta^t \vartheta \left(\int_0^1 \left(\frac{d_t}{s_t^{\theta}}\right)^{\varepsilon}\right)^{\frac{1}{\varepsilon}}$$

s.t.

$$C_t + B_t + \int_0^1 d_t = Y_t - N_t$$

$$C_{t+1} + B_{t+1} + \int_0^1 d_{t+1} = Y_{t+1} + R_t B_t + \int_0^1 r_{d,t} d_t + \Pi_{t+1},$$

$$C_{t+2} = R_{t+1} B_{t+1} + \int_0^1 r_{t+1}^d d_{t+1} + \Pi_{t+2},$$

Stylized model Ib

Representative household

Deposit demand curve

$$r_{d,t} = R_t \left(1 - \frac{1}{u'\left(C_t\right)} \vartheta \left(\frac{d_t}{\tilde{D}_t}\right)^{\varepsilon - 1} s_t^{-\theta\varepsilon}\right) \quad \text{for} \quad t = 0, 1.$$

The deposit rate is

- a spread below the risk-free rate
- increasing in the quantity of deposits $(0 < \epsilon < 1)$
- decreasing in the stock of habits $(\theta < 0)$

Stylized model II

Individual bank

$$v_t = \max \Lambda_{t,t+1}\pi_{t+1} + \Lambda_{t,t+2}\pi_{t+2}$$

s.t.

$$n_{t+1} + \pi_{t+1} = R_k k_t - r_{d,t} d_t - \frac{\varphi}{2} d_t^2,$$

$$\pi_{t+2} = R_k k_{t+1} - r_{d,t+1} d_{t+1} - \frac{\varphi}{2} d_{t+1}^2,$$

$$\text{Leverage constraints:} \quad v_t \geq \lambda k_t \quad \text{for} \quad t = 0, 1$$

$$v_{t+1} = \Lambda_{t+1,t+2}\pi_{t+2},$$

$$\text{Balance sheet:} \quad k_t = d_t + n_t \quad \text{for} \quad t = 0, 1$$

$$\text{Deposit demand curve:} \quad r_{d,t} = r_d\left(d_t, s_t\right) \quad \text{for} \quad t = 0, 1$$

$$\text{Evolution of habit stock:} \quad s_{t+1} = s_t^h d_t^{1-h}.$$

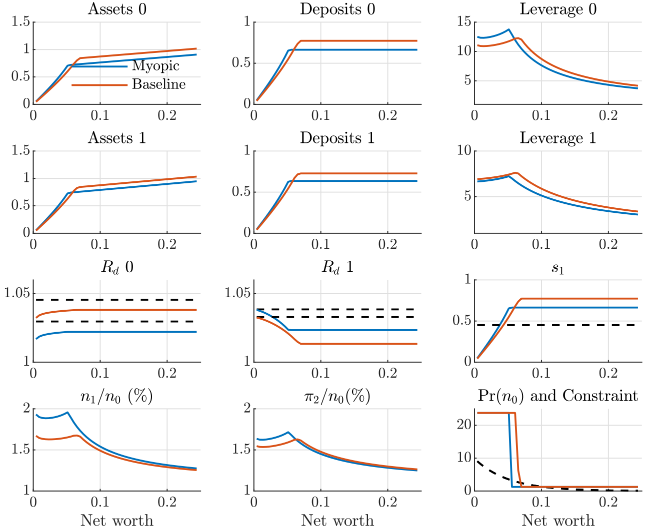
Calibration I

Parameters	Description	Values
R_k	Return on capital	1.090
β	Discount factor	0.952
λ	Incentive constraint	0.200
N_0	Aggregate bank net worth	0.050
n_0^{min}	Minimum bank net worth	0.010
n_0^{max}	Maximum bank net worth	0.250
φ	Portfolio cost	0.100
ϑ	Utility value of liquidity	0.075
ε	$1 - 1/\varepsilon$ elasticity of substitution	0.800
h	Habit persistence	0.000
θ	Habit strength	-2.000

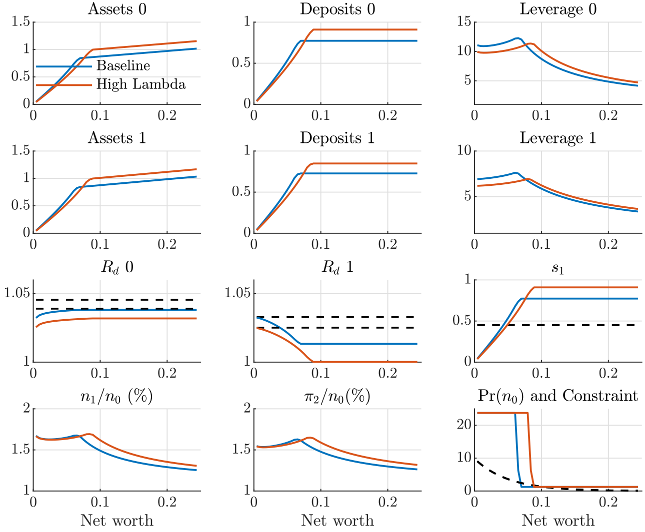
Calibration II

Variables	$t=0$	$t=1$	$t=2$
C	0.533	0.531	0.522
K	0.467	0.483	
D	0.417	0.402	
$N(\Pi)$	0.050	0.076	0.112
Leverage	9.345	6.318	
$R(\%)$	4.554	3.286	
$R_d(\%)$	3.751	1.886	
Pr(binding) (%)	0.738	0.711	

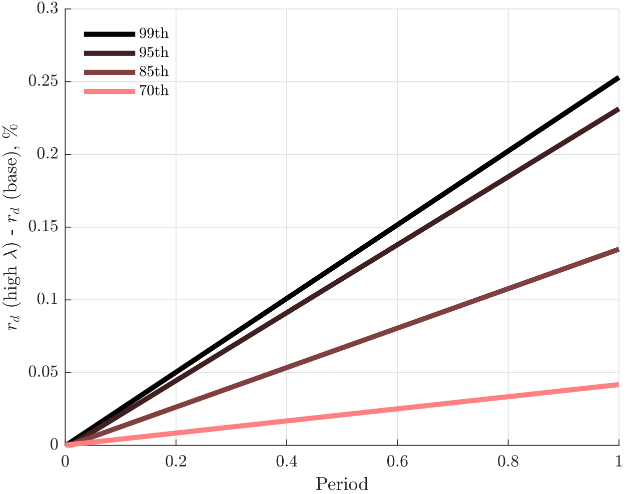
Results I: Frictions and habits



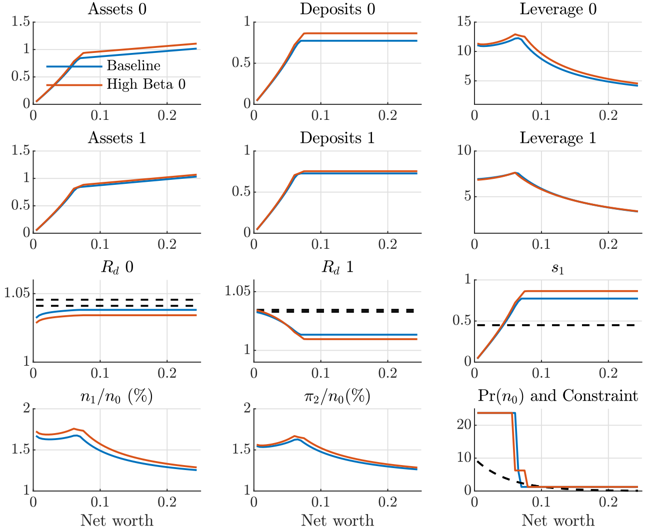
Results IIa: Tightening financial conditions



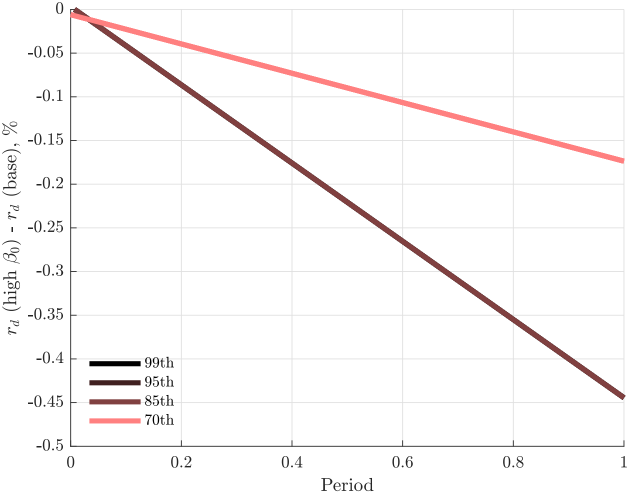
Results IIb: Tightening financial conditions



Results IIIa: Falling interest rates

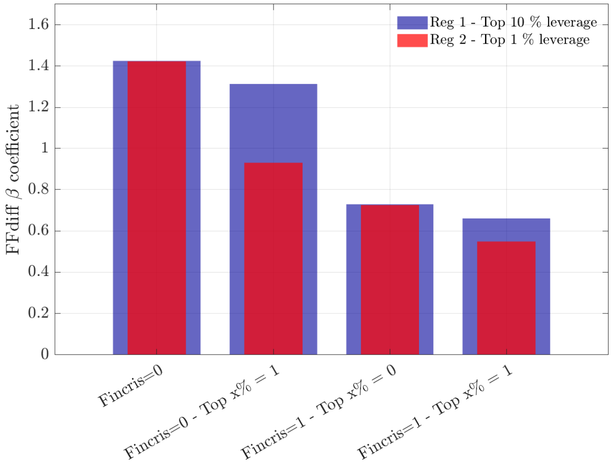


Results IIIb: Falling interest rates



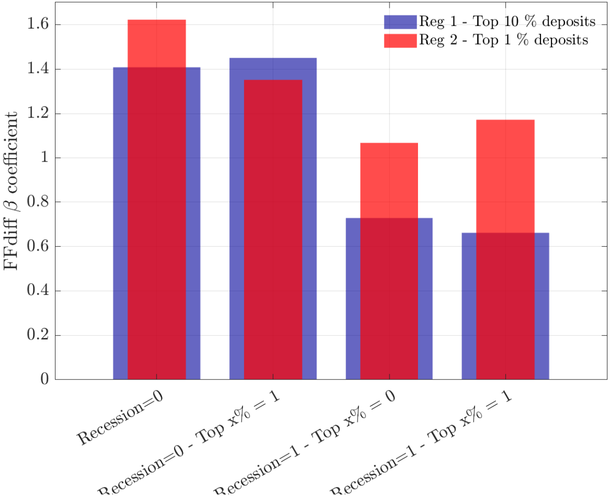
Regressions I - Leverage and financial crisis

More leveraged banks cut deposit rates less when FFR ↓ during the financial crisis



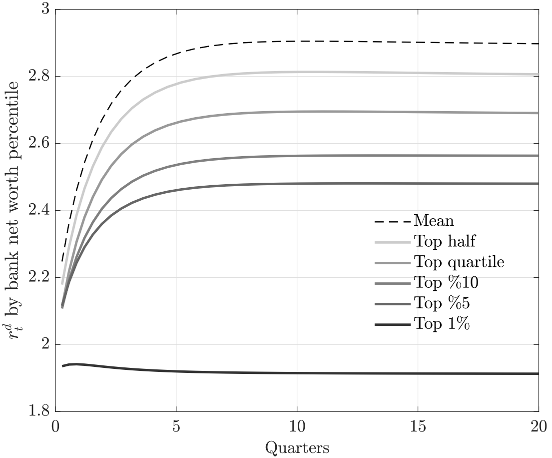
Regressions II - Bank size and recessions

During recessions bigger banks cut r^d more as FFR $\downarrow$.



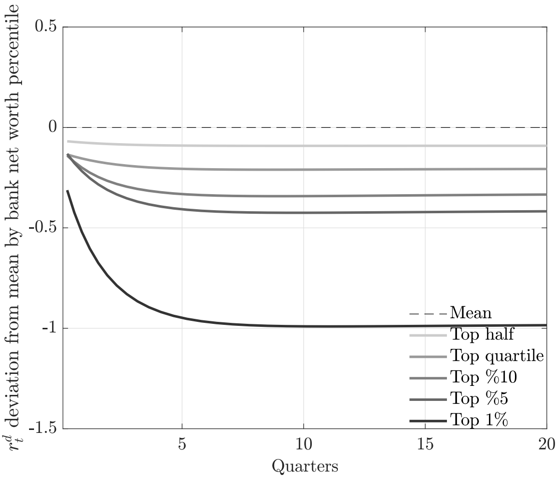
Transition - deposit rates

Increase in λ (by bank net worth)

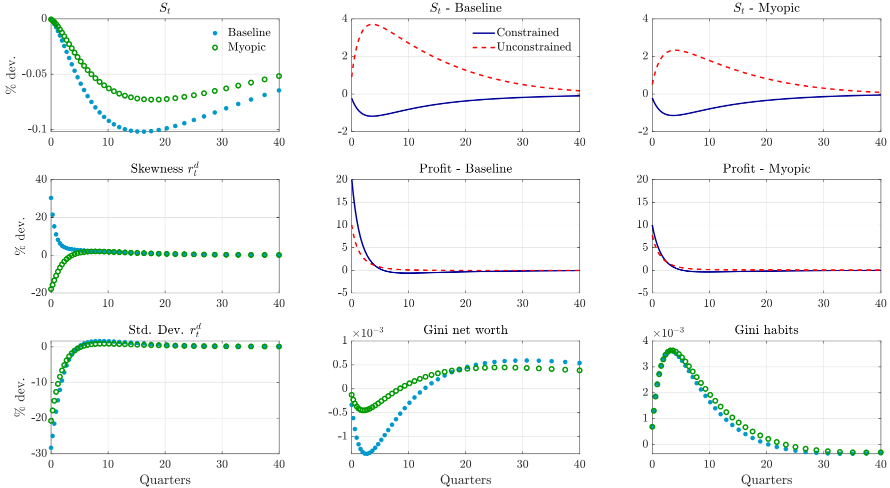


Transition - deposit rates

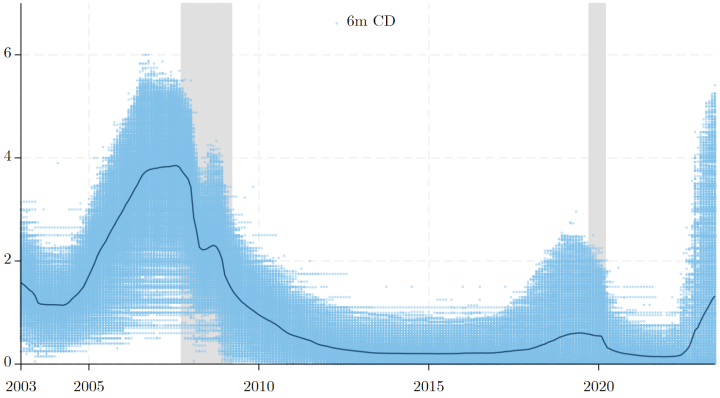
In deviation from mean



Transition - Habits



6m CD deposit rates



12m CD deposit rates