

# Net Interest Margins and Monetary Policy

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# Introduction

**October 2022 - Fed rate 3.08%**

US banks gain from Fed rate hikes while keeping deposit interest low

Wall St is charging more for loans but setting aside money for a possible downturn



JPMorgan reported record net interest income — the difference in what it pays on deposits and earns from loans and other assets.  
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**April 2024 - Fed rate at 5.33%**

Net interest income may have peaked for Wall Street banks

The flipside to higher rates is people want more for their savings, too



During the first quarter, Wells paid a rate of 2.34% on its interest-bearing deposits, nearly twice what it paid a year ago  
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▶ More

## This Paper

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- Response of banks' **NIM to a monetary policy shock** is **state-dependent**.
  - ▶ After a period of **low interest rates**, a **contractionary monetary policy** shock leads to a **significant rise in NIM**.
  - ▶ After a period of **high interest rates**, a **contractionary monetary policy** shock leads to a **fall in NIM**.

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  - ▶ After a period of **high interest rates**, a **contractionary monetary policy** shock leads to a **fall in NIM**.
  - ▶ Mainly due to **deposit products** rather than from loan products. Both intensive and extensive margins.
- Response of **aggregate economic activity** displays similar state-dependency:
  - ▶ **Real GDP**, consumption, and investment **fall more sharply** when a contractionary policy occurs **in low interest** versus high interest rate state.

## Empirical Estimates and back-of-the-envelope

- Cumulative effect of a monetary policy shock in **low interest rate state** over three years is an **increase in NIM-related bank profits** of roughly **92 billion dollars**.
- If shock occurs in **high interest rate state**, impact on NIM-related profits is a **decrease** of **98.3 billion dollars**.

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- If shock occurs in **high interest rate state**, impact on NIM-related profits is a **decrease** of **98.3 billion dollars**.
- Counterparts of banks save **191 billion dollars** in **net interest paid** if shock occurs in **high state rather low state**.
  - ▶ These savings represent **0.9 percent of 2019 GDP**.

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⇒ in an economy with nominal rigidities, state-dependence in NIMs creates state-dependence in response of aggregate economic activity to a monetary policy shock.
- Develop tractable PE competitive banking model with customer's varying attention to saving rates and bank's ability to screen.
- Embed in a TANK GE model.

# Social Dynamics and Banking

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- **Fraction varies over time because of social dynamics** arising from random encounters between attentive and inattentive hh's.
  - ▶ Some inattentive hh's become attentive after meeting attentive hh's.
  - ▶ HH's are more likely to take interest in interest rates when rates are high. [▶ Search Volumes](#)
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- **Main Results: PE model accounts very well quantitatively for the dynamic response of NIM to monetary policy shocks** after prolonged periods of high and low interest rates.

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- **State dependency** in response of deposit rates to monetary policy shock interacts with high MPC out-of-liquid wealth hh's .
- **Main Result: GE model accounts well quantitatively for state dependency in response of real GDP to a contractionary monetary policy shock.**

# Related Literature

- **Role of Banks in MP transmission:** Cúrdia and Woodford [2010], Gerali et al. [2010], Driscoll and Judson [2013], Gertler and Karadi [2015], Cucinello and Signoretti [2015], Piazzesi, Rogers, and Schneider [2019], and Bianchi and Bigio [2022]. Particularly: Drechsler, Savov, and Schnabl [2017, 2018, 2021], Begenau and Stafford [2022] and Greenwald et al. [2023].

⇒ document important source of **state-dependence in banks' policy functions** which percolates throughout the **MP transmission to the real economy**.

- **Heterogeneous MPC out of Liquid Wealth:** Johnson, Parker, and Souleles [2006], Parker, Souleles, Johnson, and McClelland [2013], Jappelli and Pistaferri [2014], Kaplan and Violante [2014], Debortoli and Galí [2017], Kueng [2018], Auclert, Rognlie, and Straub [forthcoming], Ganong et al. [2020], and Fagereng, Holm, and Natvik [2021].

⇒ provide a tractable quantitative **TANK setting** connecting banks' rate-setting policies, heterogeneous MPCs out of liquid wealth and MP transmission.

- **Social Dynamics:** Kelly and Gráda [2000], Carroll [2003], Iyer and Puri [2012], Burnside, Eichenbaum, and Rebelo [2016], Carroll and Wang [2023]

⇒ introduce and show **relevance of social dynamics** in powering up **GE effects of monetary policy**.

# Outline

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  - ▶ Results (NIM, Core NIM, GDP)
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- TANK Model
  - ▶ ingredients
  - ▶ study real macro-aggregates implications

## Empirical Analysis

- Use detailed data from the **Consolidated Reports of Condition and Income** (Call Reports) obtained from the FDIC.
- Reports are **filed quarterly** by all **national banks, state-member banks, insured state-nonmember banks, and savings associations**.
- Compute two measures of NIM:
  - ▶ (i) **core NIM** = average loan interest income rate minus average deposit interest expense rate,
  - ▶ (ii) **overall NIM** = difference between average interest income rate minus average interest expense rate (on all assets, liabilities).
- Quarterly data from 1985:1 to 2019:4.

# Monetary Policy Shocks

- **Measure 1:** Bauer and Swanson (2022) shock measure
  - ▶ Movements in one, two, three, and four-month ahead Eurodollar futures contracts (ED1–ED4) in a 30-minute window of time around FOMC announcements.
  - ▶ Orthogonalize shock wrt contemporaneous, four lags of real GDP, PCE prices, investment and consumption, four lags of excess bond premium, and yield curve slope.
- **Measure 2:** Recursive shock measure
  - ▶ residual in a regression of FF rate on contemporaneous, four lags of lagged Real GDP, the PCE price index, and four lags of the Excess Bond Premium.

# Estimation

- Local projection equation:

$$\begin{aligned} Y_{t+h} = & \alpha_h + \beta_{0,h} MP_t + \beta_{1,h} \mathbb{I}_{\{MA(R) > \bar{R}\}} + \beta_{2,h} MP_t \times \mathbb{I}_{\{MA(R) > \bar{R}\}} \\ & + A_h(L) Y_t + B_h(L) MP_t + C_h(L) Z_t + \varepsilon_t \quad h = 1, \dots, H. \end{aligned}$$

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- $MP_t$  : time  $t$  value of monetary policy shock.
- $\mathbb{I}_{\{MA(R) > \bar{R}\}}$  : indicator variable that's one when average level of FF rate across last six quarters is higher than  $\bar{R} = 4\%$  and zero otherwise.

# Estimation

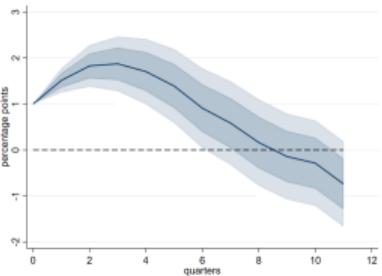
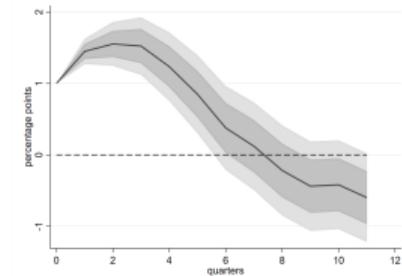
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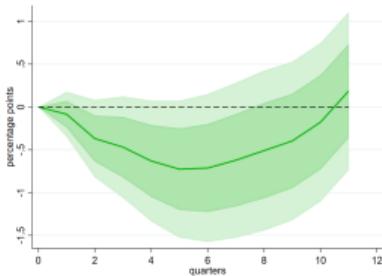
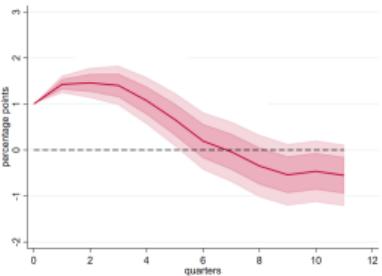
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- $\mathbb{I}_{\{MA(R) > \bar{R}\}}$  : indicator variable that's one when average level of FF rate across last six quarters is higher than  $\bar{R} = 4\%$  and zero otherwise.
- $A_h(L) Y_t$  and  $B_h(L) MP_t$ : values of  $Y_{t-j}$  and  $MP_{t-j}$ ,  $j = 1, 2, 3, 4$ ,  $C_h(L) Z_t$ : contemporaneous, 4 lags of real GDP, PCE prices, investment and consumption, 4 lags of excess bond premium, yield curve slope.

# Results: FF

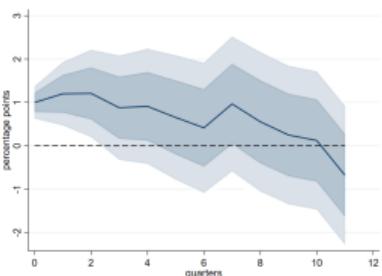
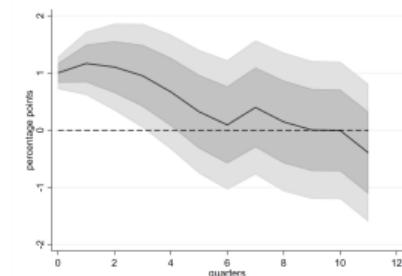
No State Dependence



Allowing for State Dependence



Bauer & Swanson (2023)



Baseline Response

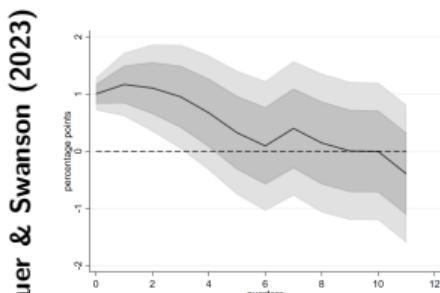
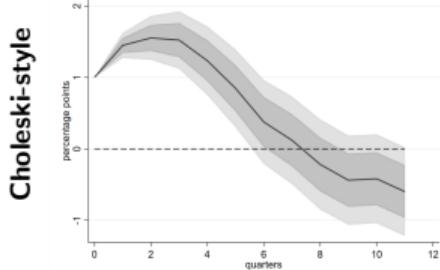
Response in low rate state

Response in high rate state

Difference Low vs High

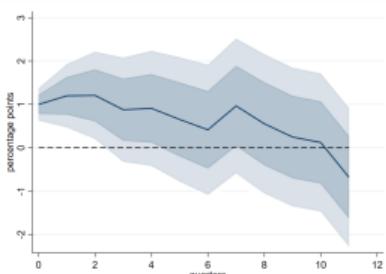
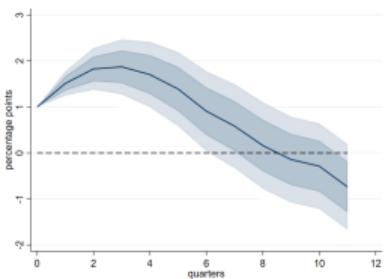
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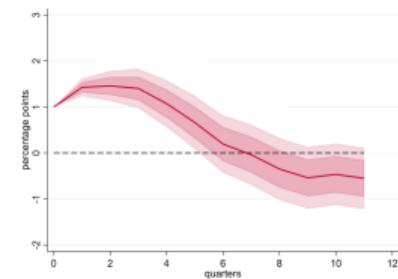


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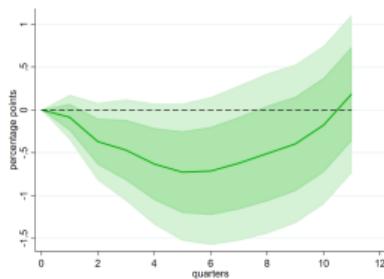
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Response in low rate state



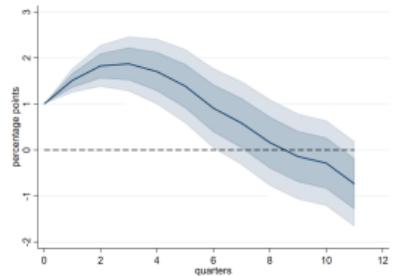
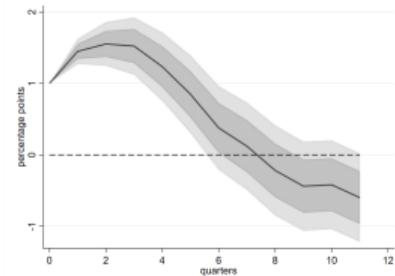
Response in high rate state



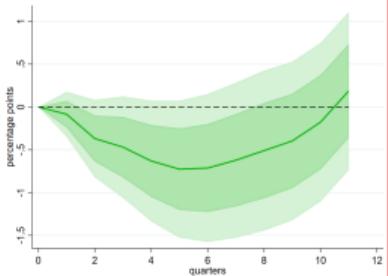
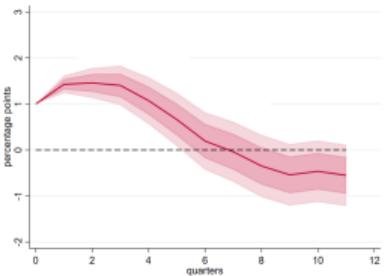
Difference Low vs High

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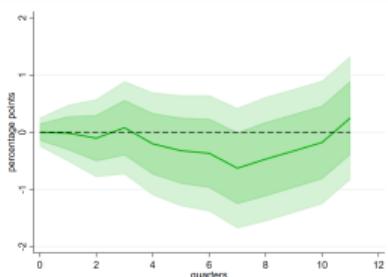
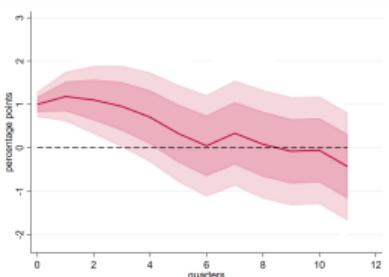
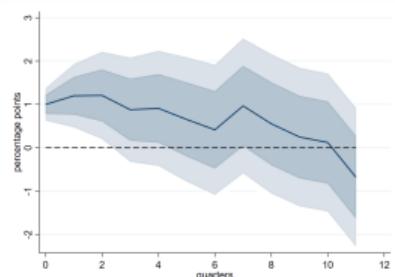
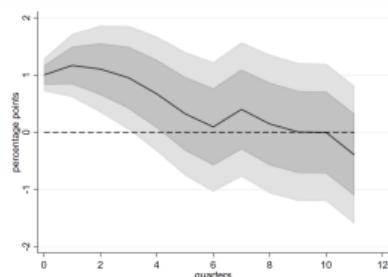
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## Bauer & Swanson (2023)



Baseline Response

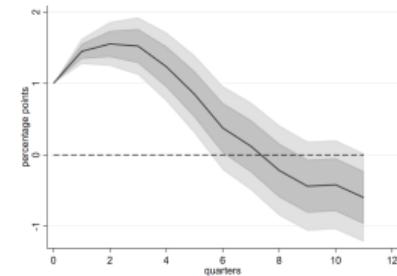
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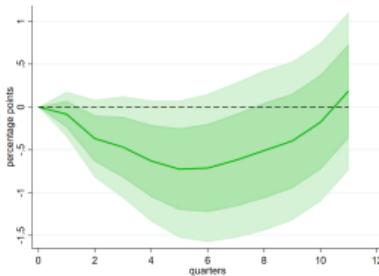
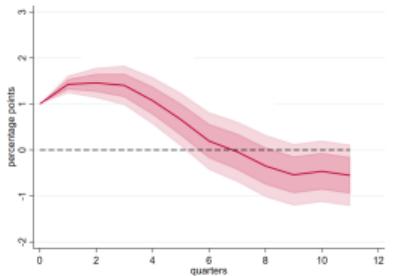
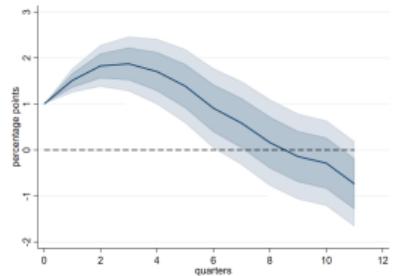
Difference Low vs High

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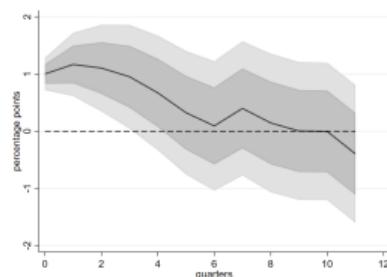
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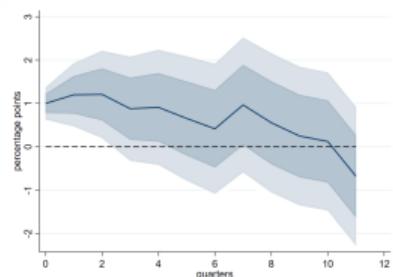
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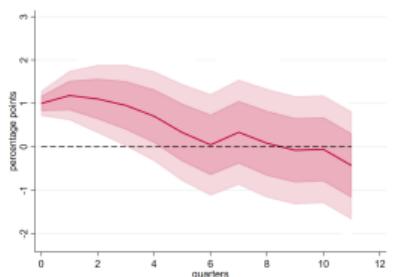
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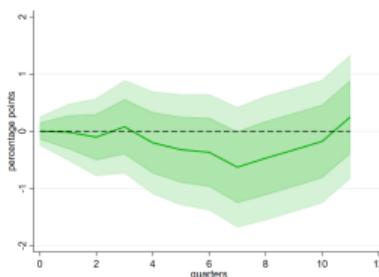
Baseline Response



Response in low rate state



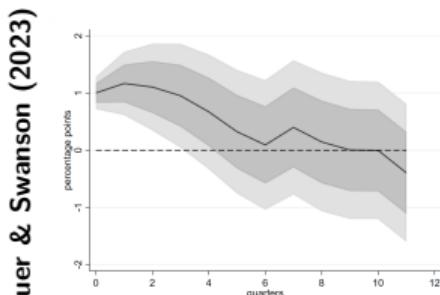
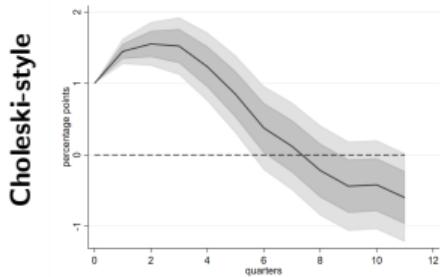
Response in high rate state



Difference Low vs High

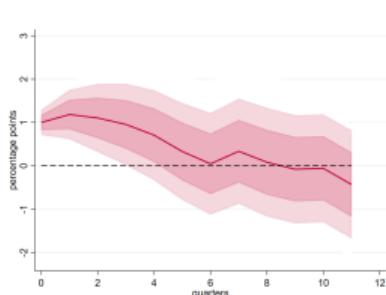
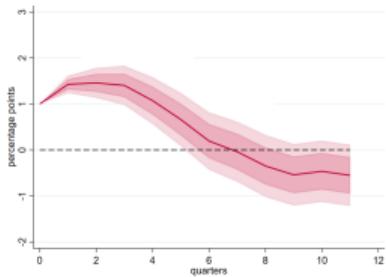
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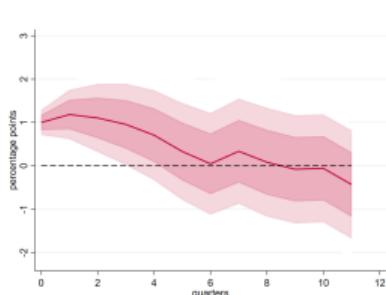
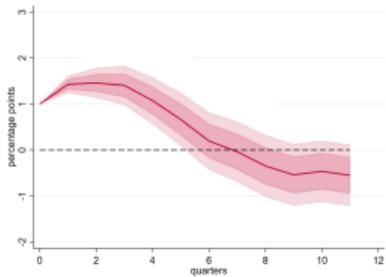


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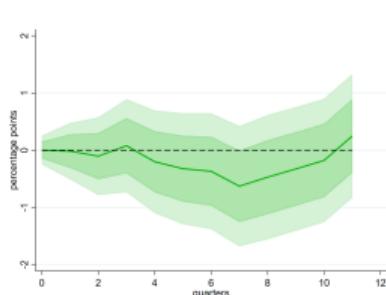
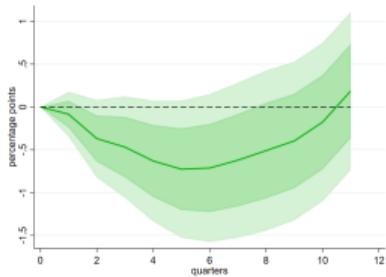
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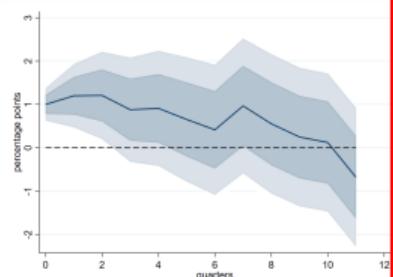
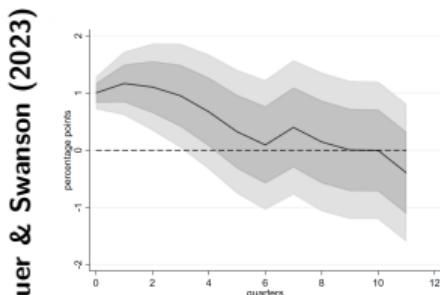
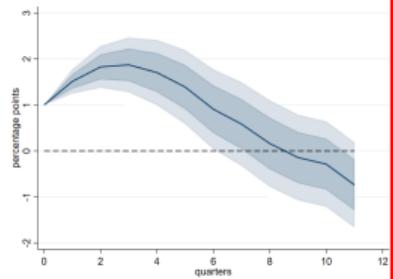
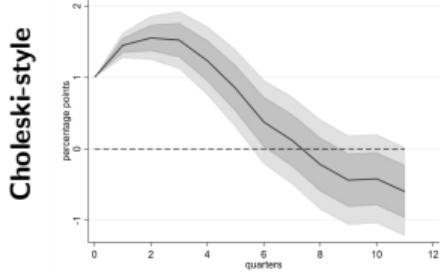
Response in high rate state



Difference Low vs High

# Results: FF

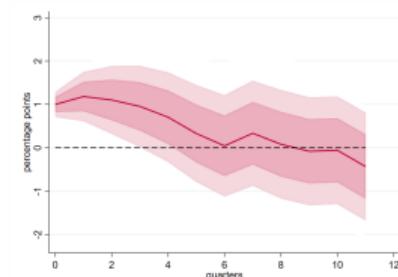
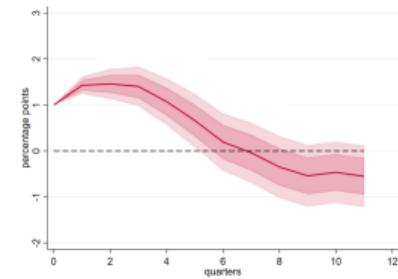
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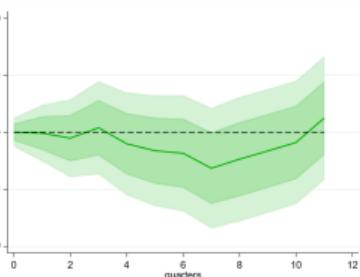
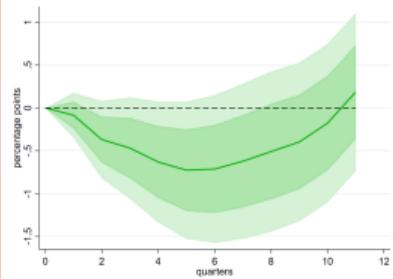
Baseline Response

Response in low rate state

## Allowing for State Dependence



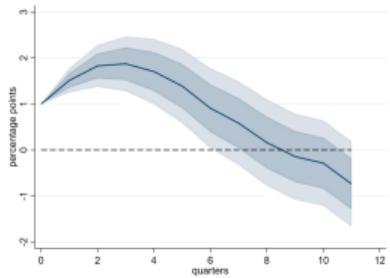
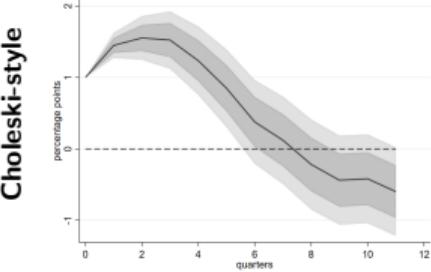
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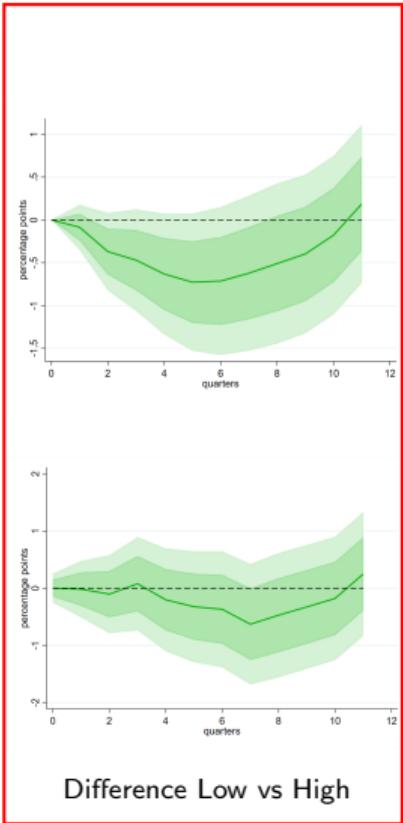
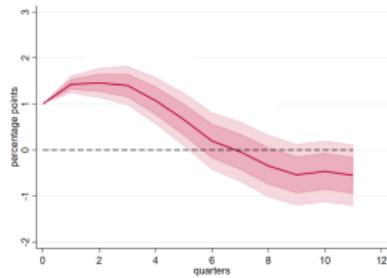
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# Results: FF

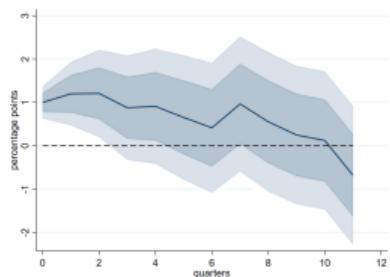
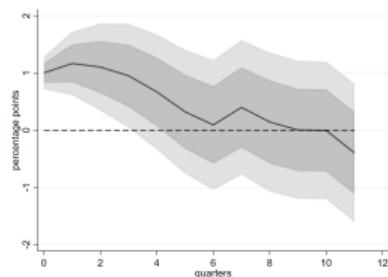
## No State Dependence



## Allowing for State Dependence



Bauer & Swanson (2023)



Baseline Response

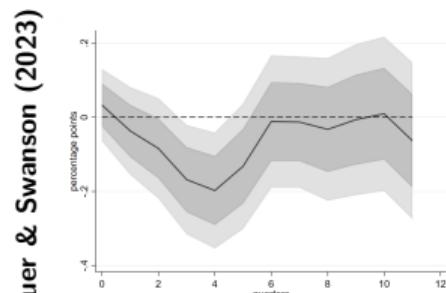
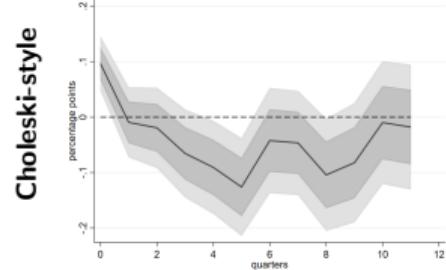
Response in low rate state

Response in high rate state

Difference Low vs High

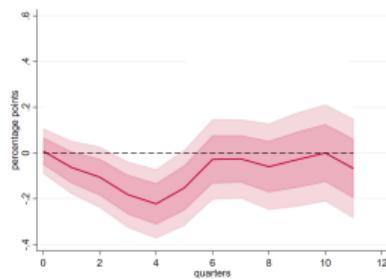
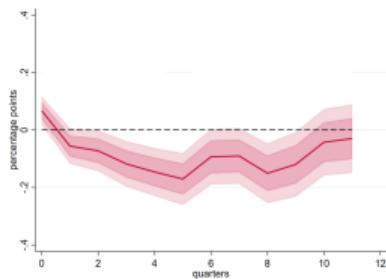
# Results: Core NIM

No State Dependence

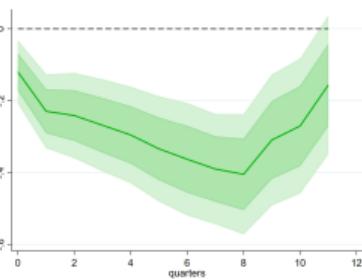
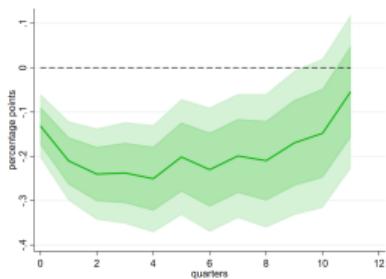


Baseline Response

Allowing for State Dependence



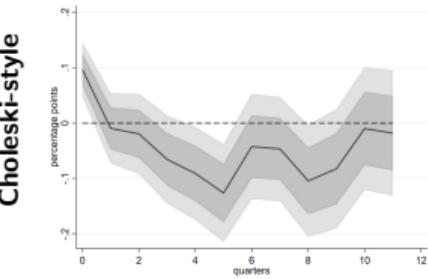
Response in high rate state



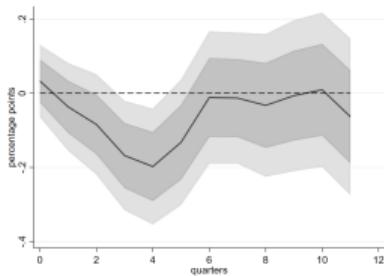
Difference Low vs High

# Results: Core NIM

No State Dependence

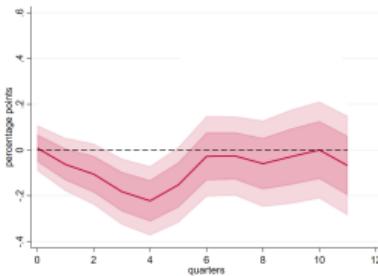
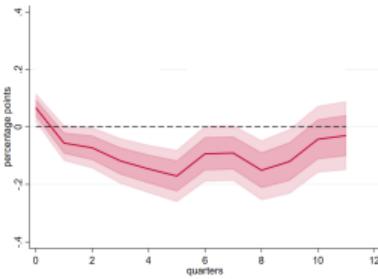


Bauer & Swanson (2023)

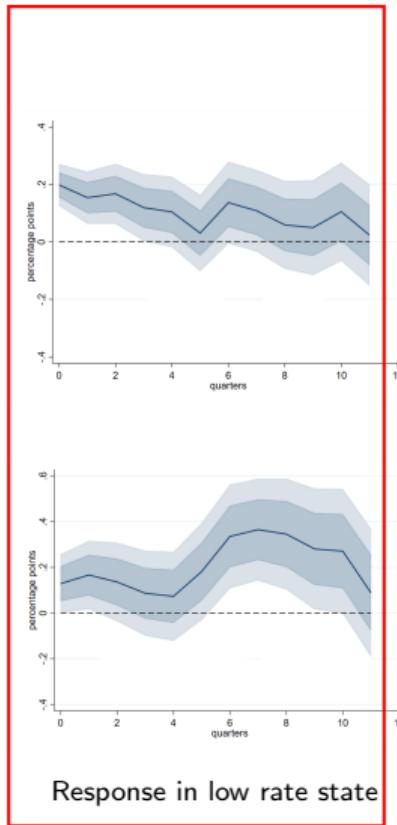


Baseline Response

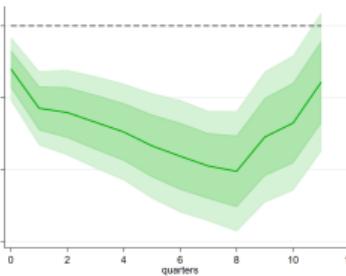
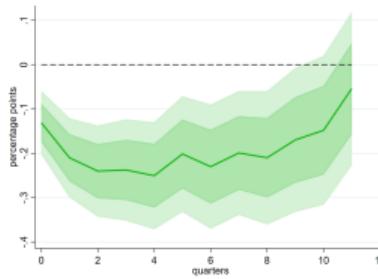
Allowing for State Dependence



Response in high rate state



Response in low rate state

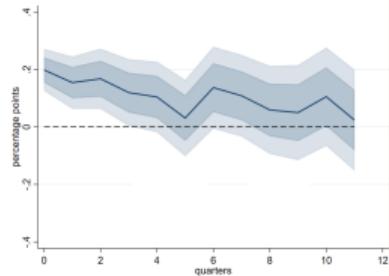
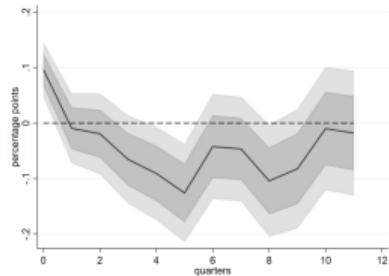


Difference Low vs High

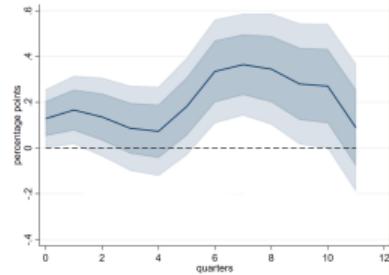
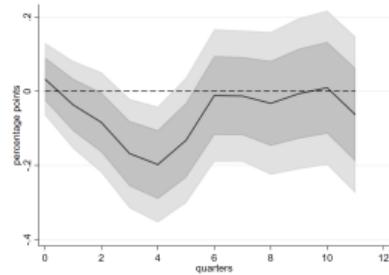
# Results: Core NIM

## No State Dependence

Choleski-style



Bauer & Swanson (2023)

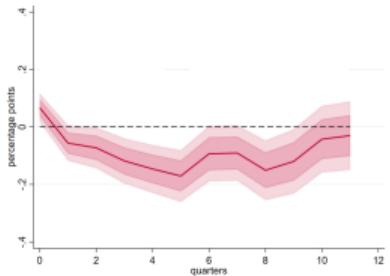


Baseline Response

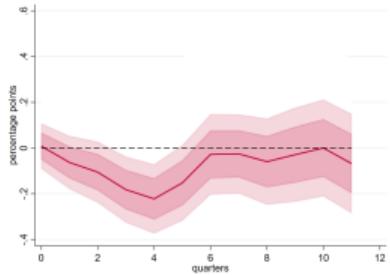
Response in low rate state

## Allowing for State Dependence

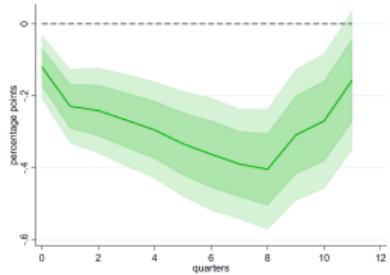
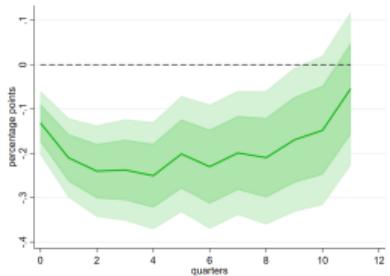
percentage points



percentage points



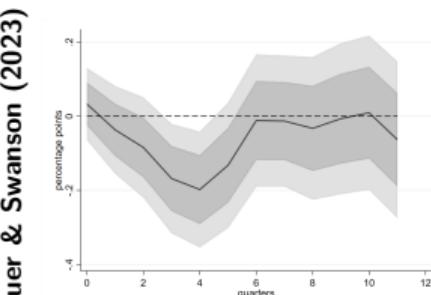
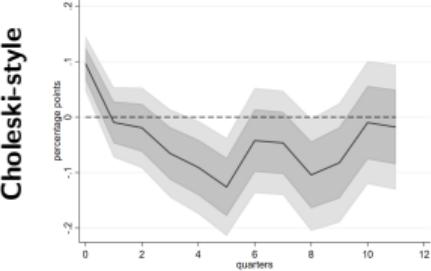
Response in high rate state



Difference Low vs High

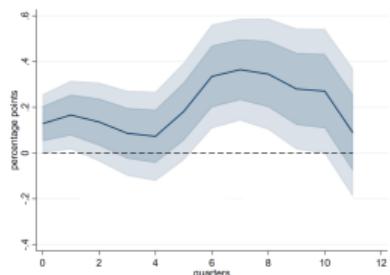
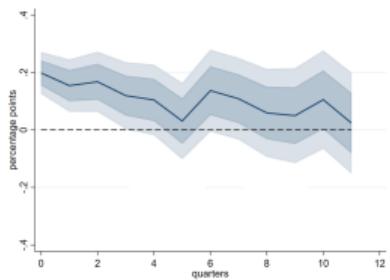
# Results: Core NIM

No State Dependence

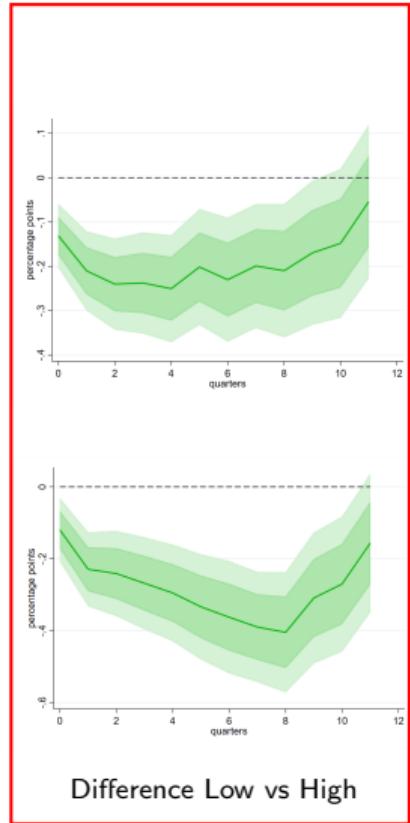


Baseline Response

Allowing for State Dependence



Response in high rate state



Difference Low vs High

## Results: Core NIM

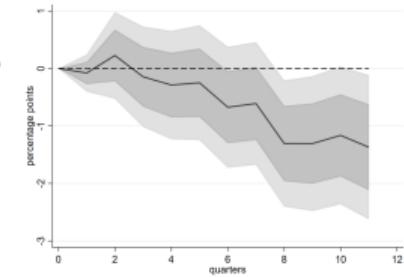
- For both shock measures, Core NIM
  - ▶ rises when shock occurs in low state
  - ▶ falls when shock occurs in *high* state.
- Peak rise is 20 to 35 basis points, depending on shock measure.
- Peak decline is roughly 17 to 21 basis points, depending on shock measure.
- Difference between response rates is negative and statistically significant.

## Decomposing movements in core NIM

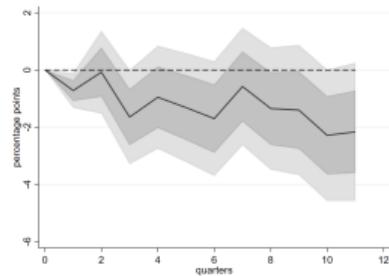
- **Intensive margin:** changes in interest rates on savings and time deposits.
- **Extensive margin:** changes in ratio of time deposits to saving deposits.
- Extensive margin plays a larger role than intensive margin.
  - ▶ a contractionary monetary policy shock induces a switch from savings deposits to time deposits.
- Less evidence of state dependence in extensive margin than intensive margin.
  - ▶ But movements in **extensive margin exacerbates impact of state dependence in intensive margin.**

# Results: GDP

No State Dependence

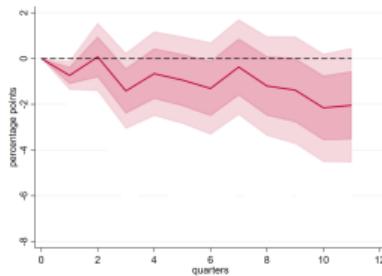
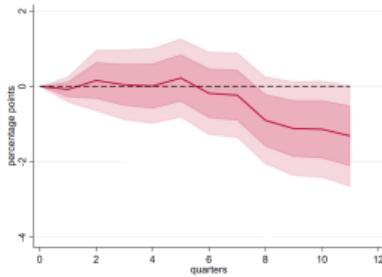


Bauer & Swanson (2023)

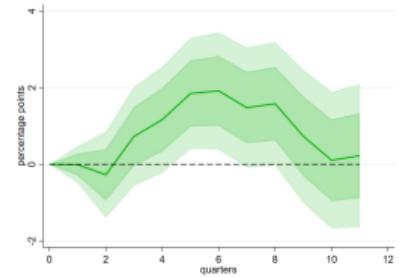


Baseline Response

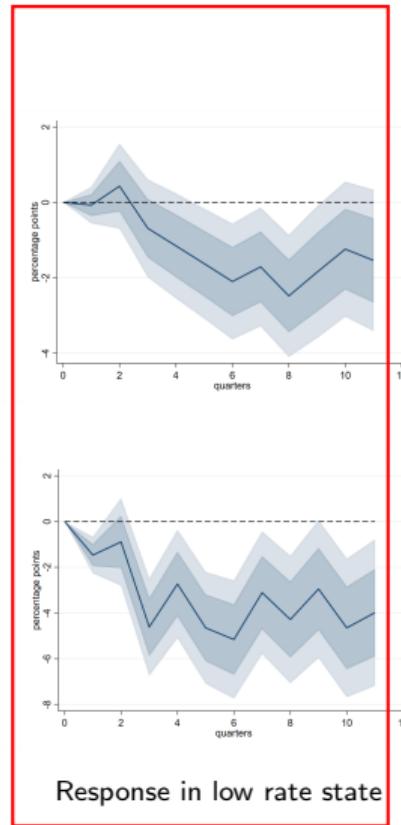
Allowing for State Dependence



Response in high rate state



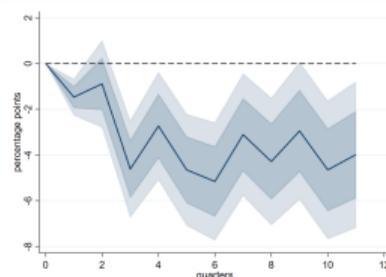
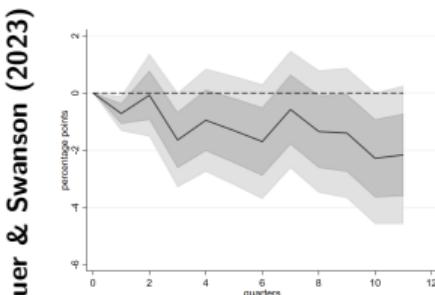
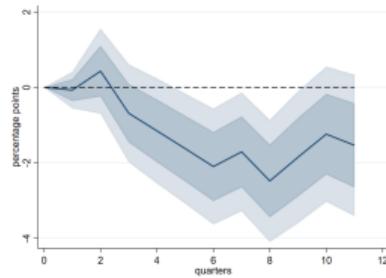
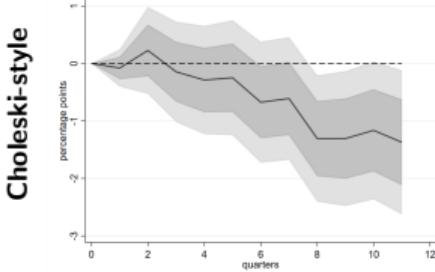
Difference Low vs High



Response in low rate state

# Results: GDP

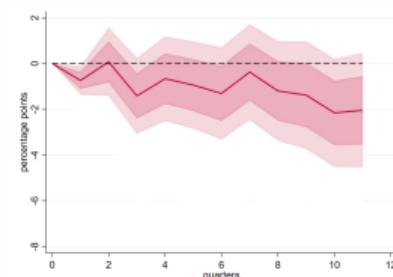
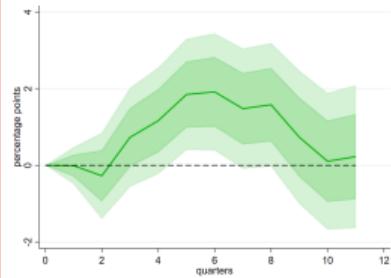
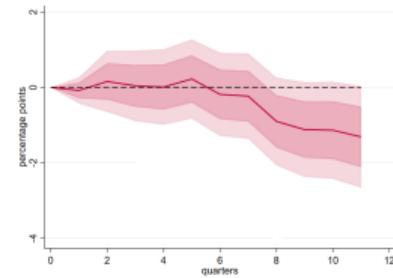
## No State Dependence



Baseline Response

Response in low rate state

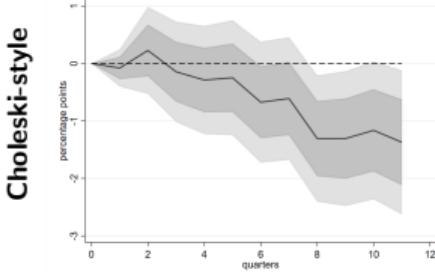
## Allowing for State Dependence



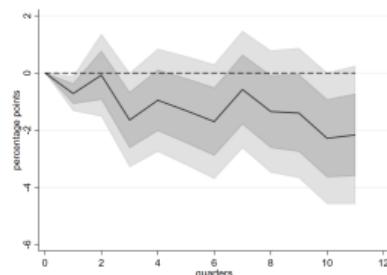
Difference Low vs High

# Results: GDP

No State Dependence

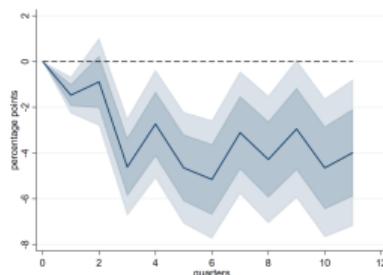
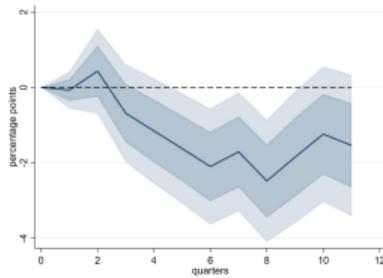


Bauer & Swanson (2023)



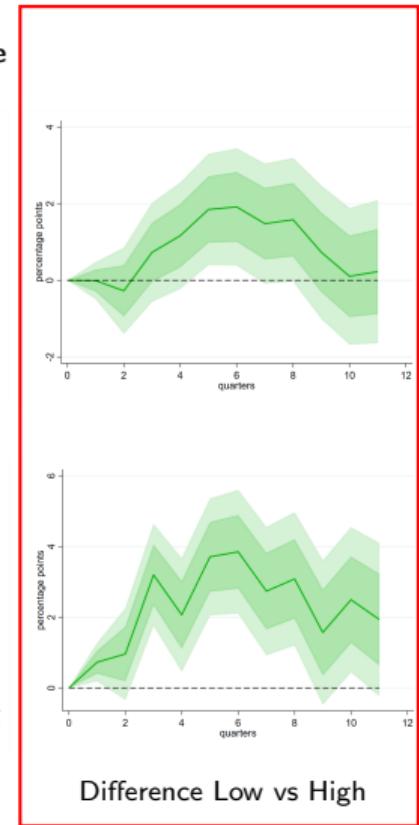
Baseline Response

Allowing for State Dependence



Response in low rate state

Response in high rate state



## Results: GDP

- A contractionary monetary policy shock induces a persistent decrease in real GDP for roughly two years.
- Strong evidence of **state dependence** in response of real GDP.
- Decline in real GDP is larger when shock occurs in low state.
  - ▶ Difference in response is statistically significant for both shock measures.
- Parallels our findings about state dependence in response of NIM to a contractionary monetary policy shock.
- More results: Consumption, Investment and Inflation. 

# Robustness

- **Methodology:**

- ▶ Different interest rate thresholds for state variable, controls and lags. Equally weighting baa
- ▶ Alternative interaction with indicator variable contractionary vs expansionary MP. **Tenreyro and Thwaites [2016]**

- **Banking Variables:**

- ▶ Transaction Accounts and Foreign Deposit Accounts.
- ▶ Average Income Rate earned on assets and average rate paid on liabilities
- ▶ Robustness with aggregates Ratewatch data on selected loan and deposit products.

- **Aggregate Variables:**

- ▶ Durable, Non-Durable, Services Consumption
- ▶ S&P500, Case-Shiller House Price Index, Excess Bond Premium and Yield Curve Slope.

- **Micro-Data Exercise (kicked out of the paper):**

- ▶ Bank Level Data (Call Reports)
- ▶ Bank and Product Level Data (Ratewatch)

# A partial equilibrium model of banking

- Key features
  - ▶ (i) **some hh's are attentive, others are inattentive** to interest rate they earn on bank deposits,
  - ▶ (ii) **banks can screen and consider this variation** when valuing household deposits.
  - ▶ (iii) a **matching framework** in which competitive banks invest resources to attract attentive, inattentive hh's.
- Initially shut down social dynamics to get intuition for mechanisms in model.
- Then study social dynamics that govern changes in fraction of attentive and inattentive hh's.

# A simple competitive banking model

- Two types of hh's: *attentive* and *inattentive* to interest rates offered by banks on deposits.

$$a_t + i_t = 1.$$

- Each household has one dollar of deposits.
- A continuum of banks with measure one.

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- Every period, a fraction  $\delta$  of dollar deposits leave their bank due to exogenous factors.
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- **Banks can identify** who is attentive and inattentive, **can invest resources to attract the two types of depositors.**

## A simple competitive banking model

- Costs  $\tau_j v_j$  dollars to attract  $v_j$  dollars of type  $j$  deposits,  $j = a, i$ .
  - ▶ It's **more costly to attract inattentive** depositors than attentive, i.e.,  $\tau_i > \tau_a$ .
  - ▶ Reason: **inattentive depositors are less likely to notice bank offers.**

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  - ▶ Reason: **inattentive depositors are less likely to notice bank offers.**
- **Matches between banks and deposits** of attentive and inattentive hh's form according to

$$m_{at} = \mu (\delta a_t)^\alpha v_{at}^{1-\alpha},$$

$$m_{it} = \mu (\delta i_t)^\alpha v_{it}^{1-\alpha}$$

where  $\mu > 0$ , and  $\alpha \in (0, 1)$ .

## A simple competitive banking model

- In equilibrium (EQ), **all deposits find a match** so  $v_{at} = \delta a_t$  and  $v_{it} = \delta i_t$ .
- Deposit markets are perfectly competitive, so banks have **zero profits** (ZP).
- By ZP we have  $\tau_{j,t} = \frac{\mu(\delta j_t)^\varsigma v_{jt}^{1-\varsigma}}{v_{jt}} V_{j,t}$  and hence by EQ  $\tau_j = \mu V_{j,t}$ .

## Value of Deposits

- Value to bank of dollar deposit from attentive household:

$$V_{a,t} = R_t - R_{at} + \frac{1 - \delta}{R_t} V_{a,t+1}.$$

- $R_t - R_{at}$  : spread or profit per dollar of deposits owned by an attentive household that banks earn.
- Continuation value  $V_{a,t+1}$ , is discounted at rate  $R_t$  and multiplied by  $(1 - \delta)$  to account for fraction  $\delta$  of depositors that leave bank.

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- Value to a bank of a dollar deposit from an inattentive household is

$$V_{i,t} = R_t - R_{it} + \frac{1 - \delta}{R_t} V_{i,t+1}.$$

# Interest-Rate Spreads

$$R - R_a = \frac{\tau_a}{\mu} \left(1 - \frac{1 - \delta}{R}\right), R - R_i = \frac{\tau_i}{\mu} \left(1 - \frac{1 - \delta}{R}\right)$$

- Spreads increase with  $R$  (when  $R \uparrow$ , PV(profits)  $\downarrow$ , Zero-Profit  $\Leftarrow$  Spreads  $\uparrow$ )

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- **Spreads increase more when interest rates are low than when interest rates are high.**
  - ▶ Consider an annuity that pays  $y$  in every period. PV of annuity is  $y/R$ . Change in PV when  $R$  rises is  $-R^{-2}y$ , which is lower when  $R$  is high.

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- Note: since  $\tau_i > \tau_a$ , when  $R$  rises, spread earned by banks on inattentive deposits increases more than attentive deposits.

⇒ Attentive depositors benefit more from a rise in FF rate than inattentive depositors.

- Assume perfect pass-through on asset side rates. Equilibrium lending rate is  $R^I = R + \varepsilon^I$ . [More](#)
- Bank's NIM is given by

$$nim_t = \varepsilon^I + a_t (R_t - R_{at}) + i_t (R_t - R_{it}).$$

- $nim_t$  decreases with fraction of attentive hh's in the economy.
- Reason: interest rate spread earned by banks is lower for attentive hh's.

# Social Dynamics

Laws of motion for number of attentive and inattentive hh's:

$$a_{t+1} = a_t(1 - \kappa_a) + \omega(R_t)a_t i_t + \kappa_i i_t$$

$$i_{t+1} = i_t(1 - \kappa_i) - \omega(R_t)a_t i_t + \kappa_a a_t$$

- **Exogenous transitions:**

- ▶ Fraction  $\kappa_a$  of attentive hh's become inattentive, and viceversa.

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- **Exogenous transitions:**

- ▶ Fraction  $\kappa_a$  of attentive hh's become inattentive, and viceversa.

- **Endogenous transitions arising from social interactions:**

- ▶ Each period there's  $a_t i_t$  **pairwise meetings** with intensity  $\omega(R_t) = \chi(4R_t - 4)^2$
- ▶ **Note:** strength is maximal when  $a_t = 0.5$  and minimal when  $a_t$  approaches 0 or 1.

# Banking with Social Dynamics

- Value of a dollar deposit from an attentive household is

$$V_{a,t} = R_t - R_{at} + \frac{1 - \delta}{R_t} [\kappa_a V_{i,t+1} + (1 - \kappa_a) V_{a,t+1}] .$$

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- The value of a dollar deposit from an inattentive consumer is given by

$$V_{i,t} = R_t - R_{it} + \frac{1-\delta}{R_t} ([\omega(R_t)a_t + \kappa_i] V_{a,t+1} + \{1 - [\omega(R_t)a_t + \kappa_i]\} V_{i,t+1}) ,$$

- Takes into account probability that inattentive household becomes a less-valuable-attentive household ( $\omega(R_t)a_t + \kappa_i$ ).

## Spreads with social dynamics

- Interest rate spread for **attentive depositors** is:

$$R_t - R_{at} = \frac{\tau_a}{\mu} - \frac{1-\delta}{R_t} \left( \kappa_a \frac{\tau_i - \tau_a}{\mu} + \frac{\tau_a}{\mu} \right).$$

- **Spread is lower** than in model **without social dynamics**:

- ▶ Attentive depositors with probability  $\kappa_a$  become more-valuable-inattentive in the future. ZP: **current spread on these customers must decline wrt previous.**

## Spreads with social dynamics

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- **Spread is lower** than in model **without social dynamics**:

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- The interest rate spread for **inattentive depositors** is:

$$R_t - R_{it} = \frac{\tau_i}{\mu} - \frac{1-\delta}{R_t} \left\{ \frac{\tau_i}{\mu} - [\omega(R_t)a_t + \kappa_i] \frac{\tau_i - \tau_a}{\mu} \right\}.$$

- **Spread is higher than** in model **without social dynamics** for the same reasoning.
- **Stronger effect with higher interest rate** as  $\omega(R_t)$ , is higher.

## NIM with social dynamics

$$nim_t = \varepsilon^I + \frac{a_t \tau_a + (1 - a_t) \tau_i}{\mu} \left( 1 - \frac{1 - \delta}{R_t} \right) + \frac{1 - \delta}{R_t} \frac{\tau_i - \tau_a}{\mu} (a_{t+1} - a_t).$$

- **First two terms equal** the value of  $nim_t$  in an economy **without social interactions**.
- **Third term:** impact of social interactions on  $nim_t$ .
  - ▶  $\uparrow a_{t+1} - a_t \Leftarrow nim_t \uparrow$  because inattentive spread rises to compensate for higher probability of becoming attentive.

## NIM with social dynamics

$$\frac{dnim_t}{da_t} = -\frac{\tau_i - \tau_a}{\mu} \left(1 - \frac{1-\delta}{R_t}\right) + \frac{1-\delta}{R_t} \frac{\tau_i - \tau_a}{\mu} [\omega(R_t)(1-2a_t) - (\kappa_i + \kappa_a)] a_t$$

- First effect of a rise in  $a_t$  is **negative**:
  - ▶ Increase in  $a_t$  lowers average interest rate spread.

# NIM with social dynamics

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- **First effect** of a rise in  $a_t$  is **negative**:
  - ▶ Increase in  $a_t$  lowers average interest rate spread.
- **Second effect** fundamental for **state dependence** in  $nim_t$ .
  - ▶ Effect is positive when  $a_t < 0.5$  and  $R_t$  is high: many inattentive hh's will become attentive.
  - ▶  $\uparrow$  inattentive,  $\downarrow$  future profits, by ZP current margins  $\uparrow$  to compensate.

# NIM with social dynamics

- Marginal impact of  $R_t$  on  $nim_t$ :

$$\frac{dnim_t}{dR_t} = \frac{a_t \tau_a + (1 - a_t) \tau_i}{\mu} (1 - \delta) R_t^{-2} - R_t^{-2} (1 - \delta) \frac{\tau_i - \tau_a}{\mu} (a_{t+1} - a_t) + \frac{1 - \delta}{R_t} \frac{\tau_i - \tau_a}{\mu} \frac{da_{t+1}}{dR_t}$$

where

$$\frac{da_{t+1}}{dR_t} = \omega'(R_t) a_t (1 - a_t) = 32\chi(R_t - 1) a_t (1 - a_t).$$

- First effect is positive** and stems from change in discount rate:

- A rise in  $R_t$  reduces PV of future profits. ZP: current interest rate spreads **must rise** to offset this impact.

# NIM with social dynamics

$$\frac{dnim_t}{dR_t} = \frac{a_t \tau_a + (1 - a_t) \tau_i}{\mu} (1 - \delta) R_t^{-2} - R_t^{-2} (1 - \delta) \frac{\tau_i - \tau_a}{\mu} (a_{t+1} - a_t) + \frac{1 - \delta}{R_t} \frac{\tau_i - \tau_a}{\mu} \frac{da_{t+1}}{dR_t}$$

- **Second effect is negative:**

- ▶ Consider future losses occurring when some inattentive depositors become attentive.
- ▶ PV of these losses declines when  $R_t$  increases.
- ▶ So current spread on inattentive deposits **must increase by less** to compensate.

- **Third effect is positive:**

- ▶ Higher  $R$  raises  $\omega(R_t)$ , at which inattentive hh's become attentive. Future profits from inattentive hh's  $\downarrow$
- ▶ So, current spread on inattentive consumers **must rise to compensate** for that effect.

# Quantitative Properties

- Calibrate our banking model parameters:
  - ▶ (i)  $R_{i,t}, R_{a,t}$  are never lower than one.
  - ▶ (ii) Spreads  $R_t - R_{i,t}, R_t - R_{a,t}$  are also always non-negative
  - ▶ (iii) Theoretical impulse responses of core NIMs to a 100 b.p. monetary policy shock are as close as possible to their empirical counterparts associated with Bauer and Swanson shock measure .

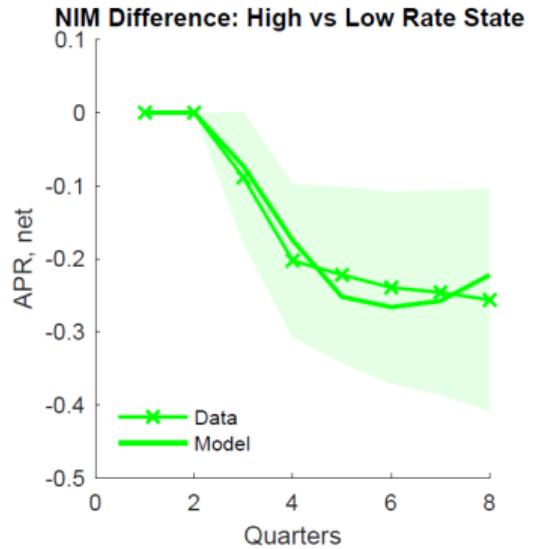
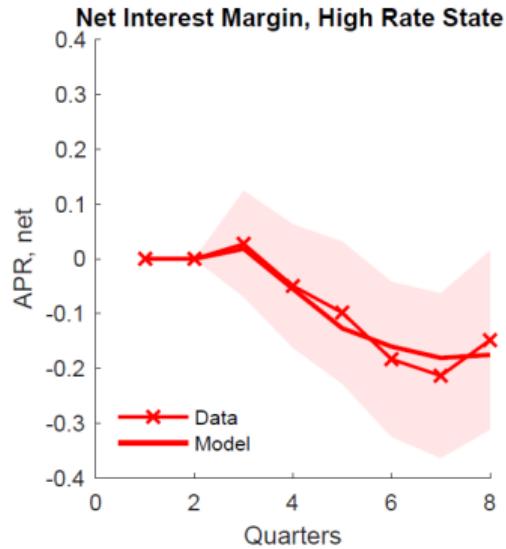
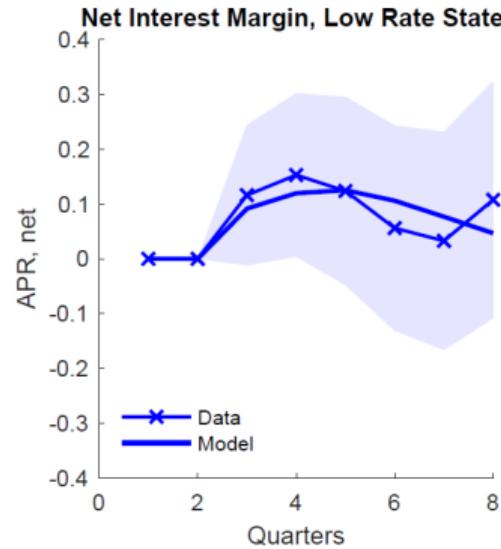
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  - ▶ (iii) Theoretical impulse responses of core NIMs to a 100 b.p. monetary policy shock are as close as possible to their empirical counterparts associated with Bauer and Swanson shock measure .
- Assume social dynamics take place on a daily basis but economic interactions occur at the end of the quarter (200 social interactions a quarter).
- In progress: formal estimation.

## Quantitative Properties

- **Compute equilibrium response** of  $nim_t$  to a temporary rise in policy rate.
- **Begin from two steady states** corresponding to **low** interest rate,  $R = 1.015$ , and a **high** interest rate,  $R = 1.056$ .
- Consider **dynamic response** of  $nim_t$  to a temporary rise in interest rates, **beginning in these two steady states**.
- Policy rate responses to MP shocks derived from empirical estimates.

# Model and Data Responses



▶ Calibration ▶ Intuition

## GE effects: Banking in a TANK model

- Two types of Households: **Hand-to-Mouth and Optimizing agents**. Fractions are fixed.

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- Production sector of the economy as in [Christiano, Eichenbaum, and Evans \[2005\]](#). **Calvo - sticky prices** (no indexing to previous or steady state inflation).
- **Retailer must borrow nominal wage and capital services bills from banks at the beginning of the period.**  
Repays at end of period  $t$  after receiving revenues.
- $i^{th}$  firm's real marginal cost is  $s_{i,t} = \left(\frac{1}{1-\alpha}\right) \left(\frac{1}{\alpha}\right)^\alpha \left(\mathbf{R}_t^d r_t^k\right)^\alpha \left(\mathbf{R}_t^d w_t\right)^{1-\alpha}$

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- Reduced form **wage stickyness**:  $w_t = \gamma w_{t-1} + (1 - \gamma) w^{ss} + (1 - \gamma) Ld_t / Ld^{ss}$ . (See **Christiano et al. [2016]** for equivalence with micro-founded alternatives. 

## Hand-to-mouth Households

- The economy has a fraction  $\phi$  of hand-to-mouth hh's who **may be attentive or inattentive**.
- Hand-to-mouth hh of type  $j = \{i, a\}$  maximizes

$$E_t \sum_{l=0}^{\infty} \beta^l \left\{ \ln(C_{j,t+l}^H - bC_{j,t+l-1}^H) - \psi \frac{(N_{j,t+l}^H)^{1+\eta}}{1+\eta} \right\}$$

subject to **budget constraint**

$$P_t C_{j,t}^H = R_{j,t} W_t N_{j,t}^H + \Psi_t.$$

- Note: **HH's wages are deposited at bank**, available to be used for consumption at end of period.
- Since employment is demand determined and the budget constraint holds with equality, the preferences of the hand-to-mouth hh's are irrelevant.

# Optimizing Households

- For simplicity, we assume that all of PIH hh's are attentive. **Results not sensitive** due to **consumption smoothing**.
- Maximizes lifetime utility:

$$U_t = E_t \sum_{l=0}^{\infty} \beta^t \left\{ \ln(C_{t+l}^P - bC_{t+l-1}^P) - \psi \frac{(N_{t+l}^P)^{1+\eta}}{1+\eta} \right\}, \quad (1)$$

subject to budget constraint:

$$P_t C_t^P + I_t + \delta(u_t \bar{K}_t) = R_t^a W_t N_t^P + R_t^K u_t \bar{K}_t + \Phi_t + \Psi_t. \quad (2)$$

- Capital utilization; Depreciation depending on utilization; Quadratic Investment Adj Costs. 

# Experiment Design

- **Replicate PE experiment in GE model to study macro-aggregate effects.**
- **Taylor Rule** determines  $R_t$ : can't directly feed two different interest rate paths.

# Experiment Design

- Replicate PE experiment in GE model to study macro-aggregate effects.
- Taylor Rule determines  $R_t$ : can't directly feed two different interest rate paths.
- Construct an **observationally equivalent specification**.
  - ▶ Constant steady state **real** rate, determined by  $\beta$ . Generate **two** steady state **nominal** rates corresponding to **different steady state inflation rates**.
  - ▶ Level of nominal interest rate only matters for the social dynamics and the banking block.

## Monetary policy and our experiment

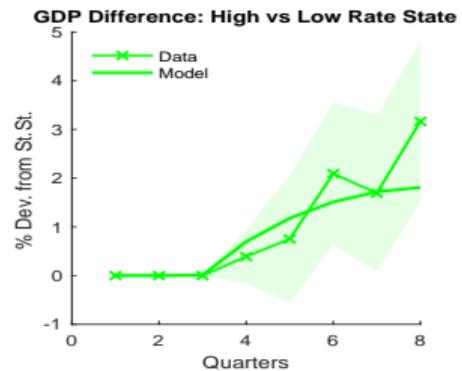
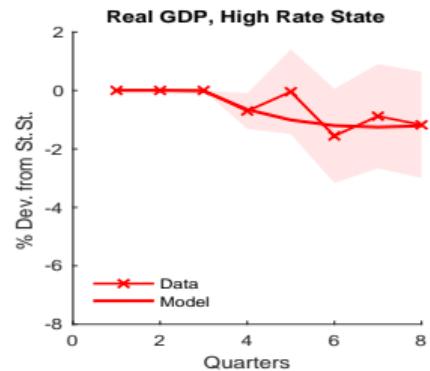
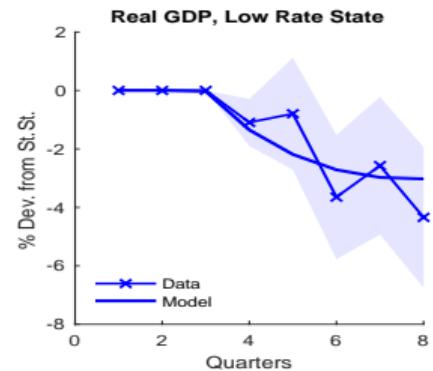
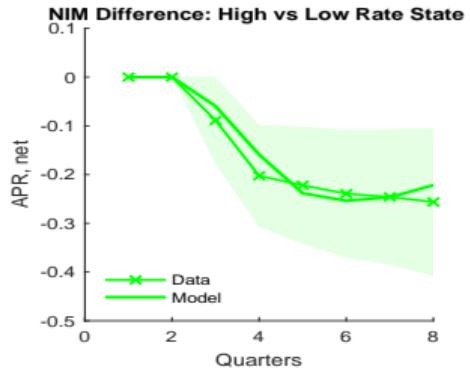
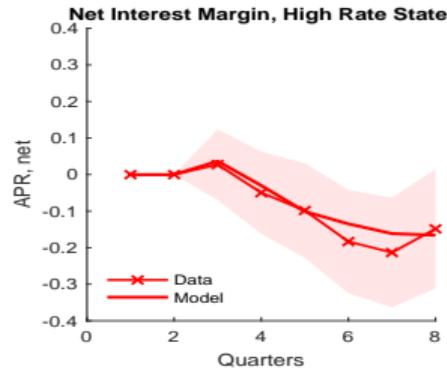
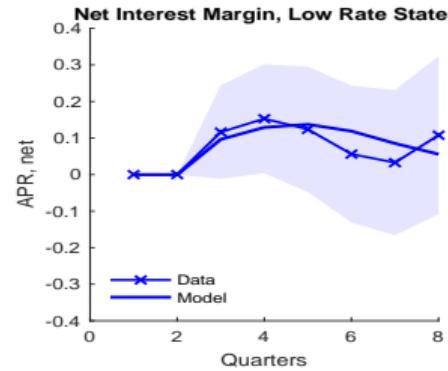
- Construct our “**high state**” by setting annualized inflation target to 4%.
- Construct our “**low state**” by setting or annualized inflation target to 0%.

## Monetary policy and our experiment

- Construct our “**high state**” by setting annualized inflation target to 4%.
- Construct our “**low state**” by setting or annualized inflation target to 0%.
- **Calibrate steady state value of annualized real rate**  $r^* = 1.5\%$ ,  $\beta = 0.9963$ .
- Delivers a **steady state nominal rate of 5.5% and 1.5%** , respectively, for the “high state” and “low state”.
  - ▶ Empirical averages of FF rate in high, low rate subsamples.
- Then feed in sequence of MIT shocks to Taylor rule so that  $R_t$  in the high and low scenarios are the same those estimated using Bauer and Swanson shock.

▶ Calibration

# GE Responses. Empirical vs Model.



## Conclusion

- **Impact of monetary policy shocks** on economy varies depending on whether **they occur after a period of low or high interest rates.**
- This state dependence is evident in banking sector profitability measures and key macroeconomic variables, (GDP, consumption, and investment).
- Empirical findings can be reconciled in a **GE TANK model featuring competitive banks** with two key characteristics.
  - ▶ Banks optimize their rate-setting policies accounting for attentive and inattentive customers.
  - ▶ Attentive vs Inattentive customers change as a function of the level of interest rates.
  - ▶ State dependence affects broader economy due to heterogeneous MPCs out of liquid wealth.

**THANKS!**

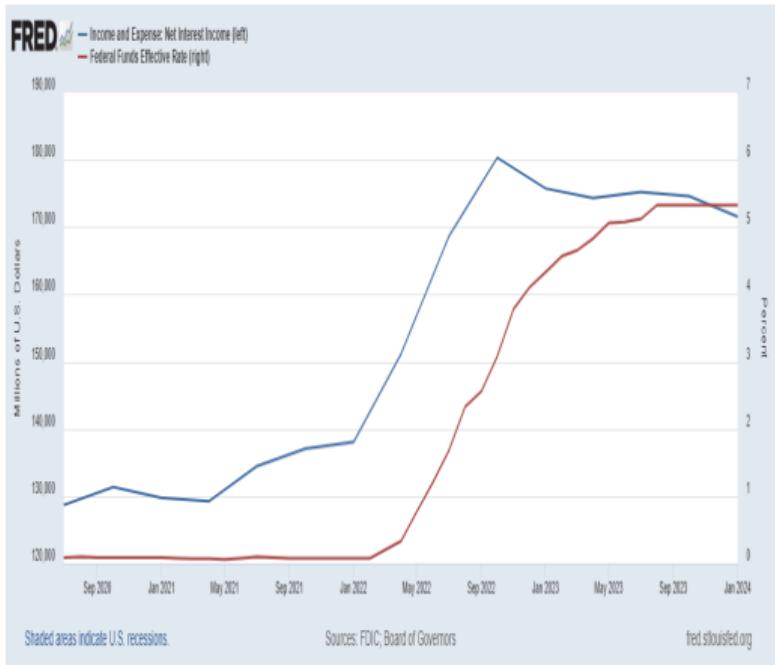
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- Lawrence J Christiano, Martin S Eichenbaum, and Mathias Trabandt. Unemployment and business

# APPENDIX

# Introduction

## Federal Funds Rate and Banks' NIMs



July 2024 - Fed rate at 5.33%

US banks get Main Street blues as savers balk at low rates

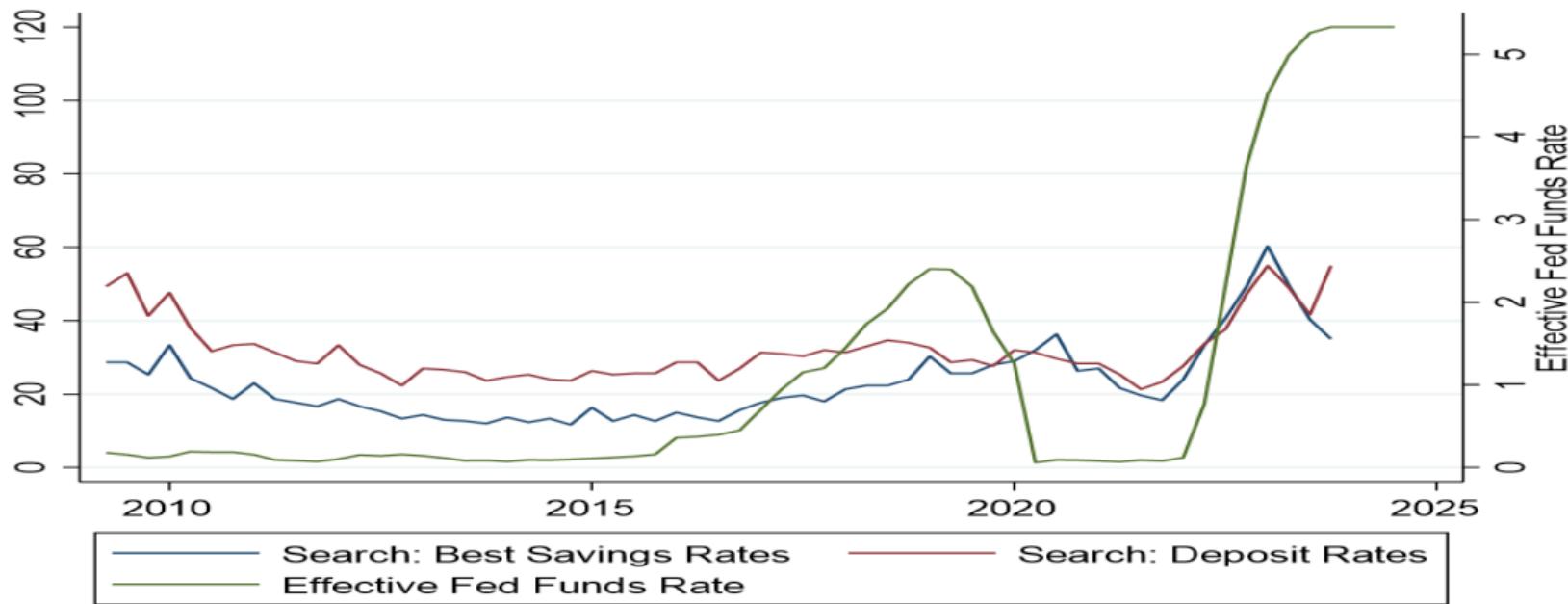
The longer the Fed keeps rates on hold, the more incentive Americans have to move their money to higher-yield products



The four biggest US banks delivered a record high last year of more than \$253bn in combined net interest income — but it is a feat that is unlikely to be repeated © FT montage/Bloomberg/AP/Reuters

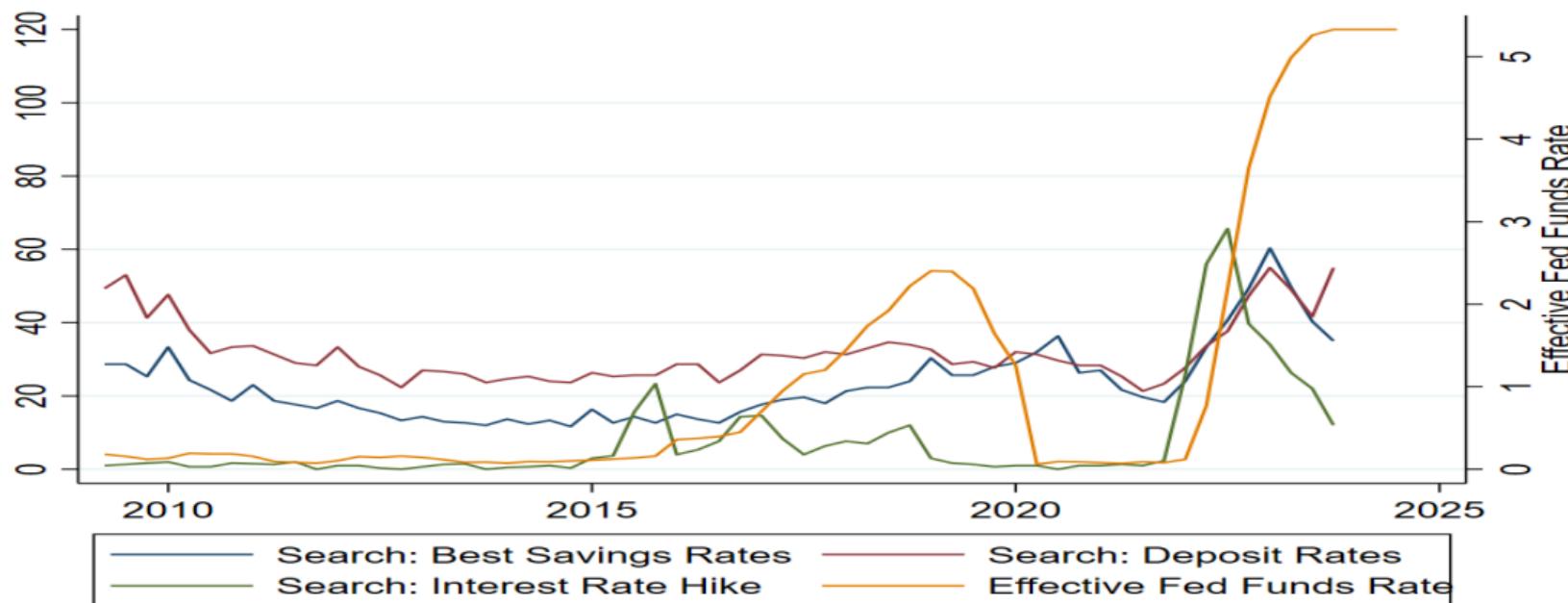
▶ back

## Google Trends: Searching Saving Products



▶ back

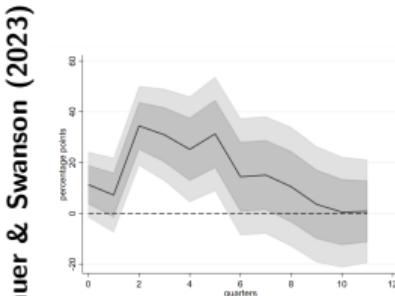
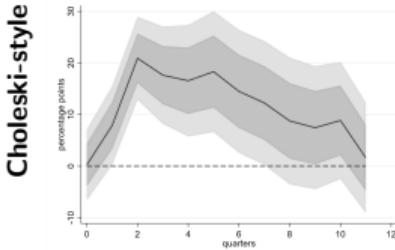
# Google Trends: Searching Saving Products vs searching for Monetary Policy Stance



▶ back

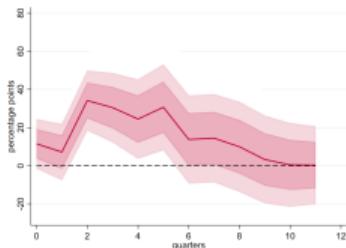
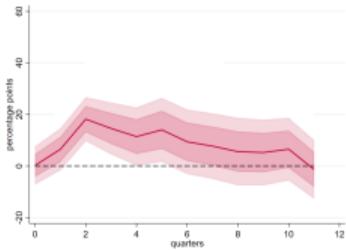
# Extensive Margin

No State Dependence

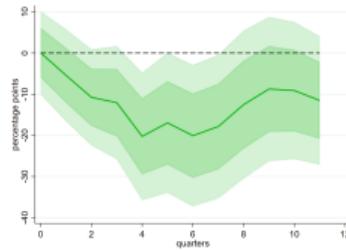


Baseline Response

Allowing for State Dependence



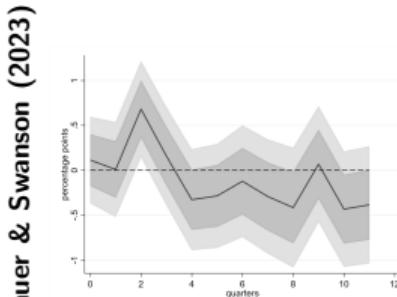
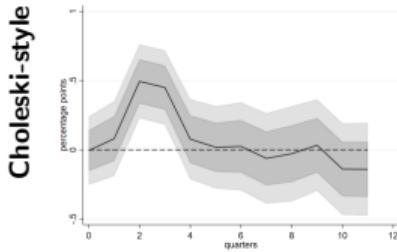
Response in low rate state



Difference Low vs High

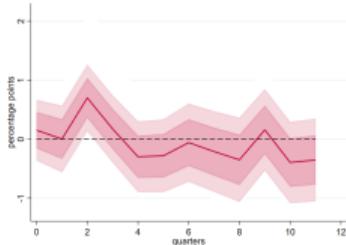
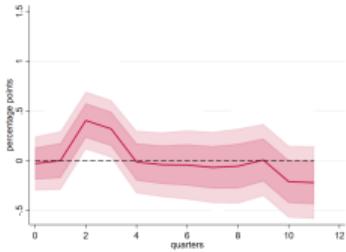
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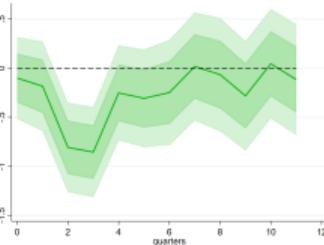
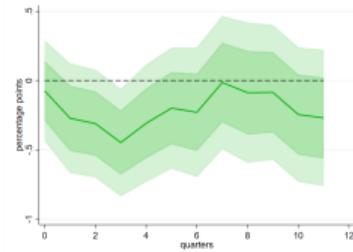


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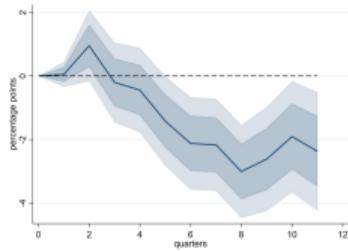
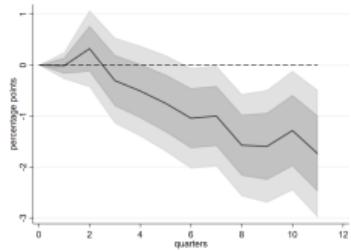


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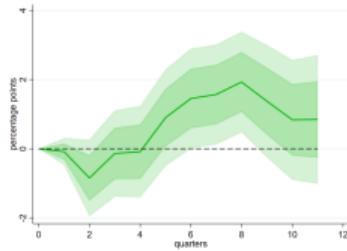
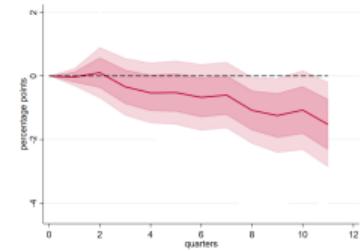
# Consumption

## No State Dependence

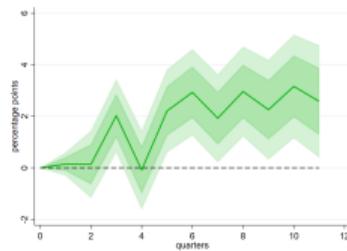
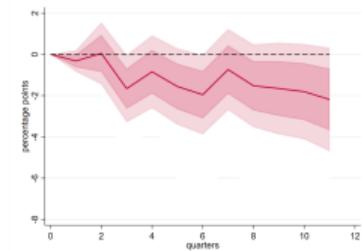
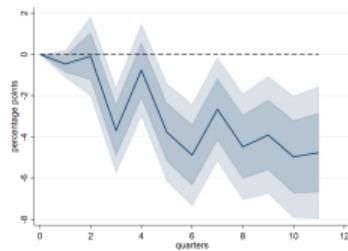
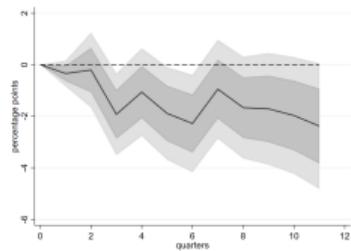
Choleski-style



## Allowing for State Dependence



Bauer & Swanson (2023)



Baseline Response

Response in low rate state

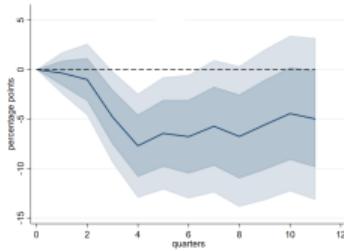
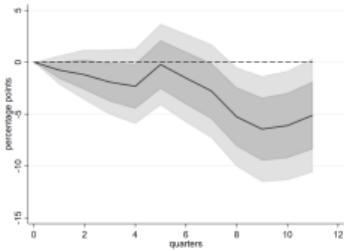
Response in high rate state

Difference Low vs High

# Investments

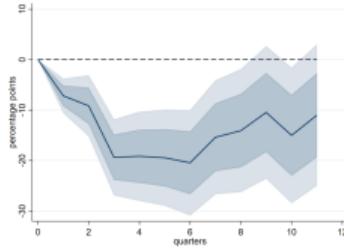
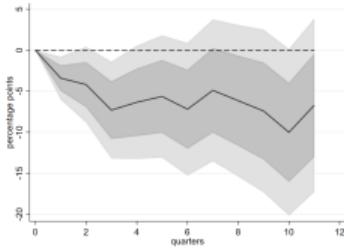
## No State Dependence

Choleski-style



## Allowing for State Dependence

Bauer & Swanson (2023)

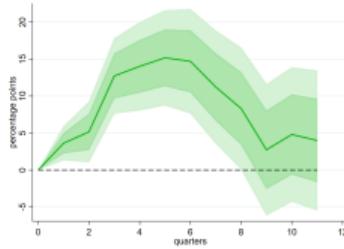
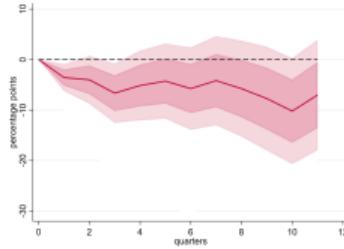
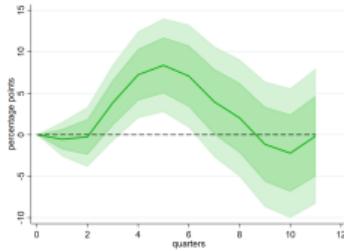
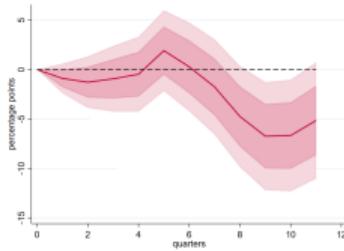


Baseline Response

Response in low rate state

Response in high rate state

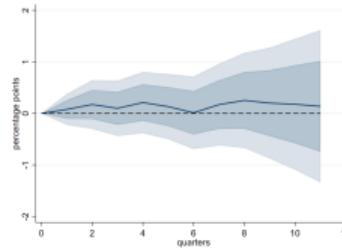
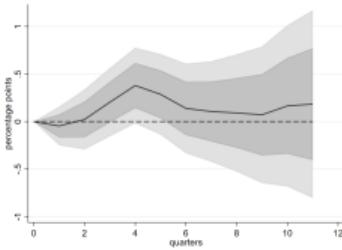
Difference Low vs High



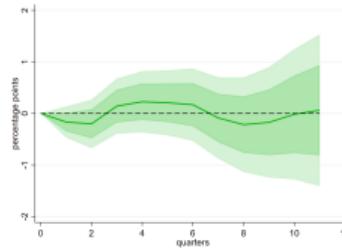
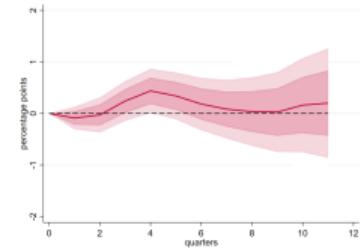
# Inflation

## No State Dependence

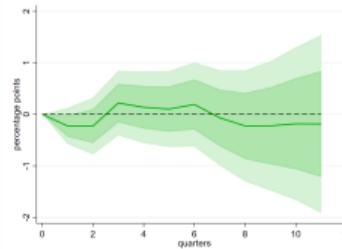
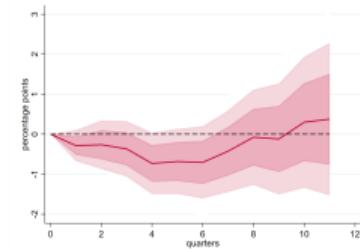
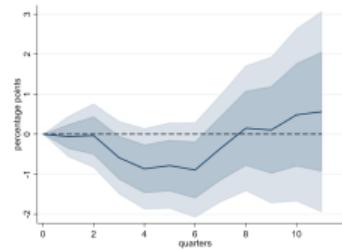
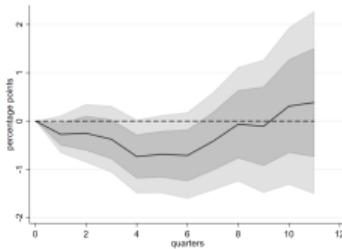
Choleski-style



## Allowing for State Dependence



Bauer & Swanson (2023)



Baseline Response

Response in low rate state

Response in high rate state

Difference Low vs High

## Lending Rate

- Monetary authority sets policy rate,  $R_t$ , which coincides with inter-bank borrowing and lending rate.
- Banks extend loans to firms to meet their working capital needs.
- Marginal cost of lending one dollar is  $\varepsilon^l$ .
- Since banks are perfectly competitive, equilibrium lending rate,  $R^l$ , is

$$R^l = R + \varepsilon^l. \tag{3}$$

▶ back

# Banking model calibration

Parameter	Parameter value	Description
$\kappa_i$	0.0008	Rate at which inattentive become attentive
$\kappa_a$	0.0029	Rate at which attentive become inattentive
$\chi$	1.2173	Social dynamics interaction parameter
$\tau_a/\mu$	0.0123	Cost of attracting attentive depositors/matching function parameter
$\tau_i/\mu$	0.1333	Cost of attracting inattentive depositors/matching function parameter
$\delta$	0.0237	Fraction of depositors who leave banks for exogenous reasons
$R_L$	1.015	Gross annual interest rate, low interest rate state
$R_H$	1.056	Gross annual interest rate, high interest rate state
$\epsilon_I$	0.005	Cost per dollar of making loans
$T_q$	200	Frequency of social interactions in a quarter of time

▶ back

## Wage determination

- CET (2016): estimated versions of three models of wage determination have virtually identical implications for macroeconomic aggregates:
  - ▶ Search and matching matching model with Hall and Milgrom wage bargaining.
  - ▶ Calvo-style sticky wages.
  - ▶ Reduced-form specification of nominal wages embodying inertia.
- We adopt last model and assume that after a shock, nominal wages evolve according to

$$w_t = \gamma w_{t-1} + (1 - \gamma) w^{ss} + (1 - \gamma) Ld_t / Ld^{ss}.$$

- Employment is demand determined, hh's vary their work in proportion to their steady state values to satisfy demand.

▶ back

# Capital and Investment

- $\bar{K}_t$ : beginning of period physical capital stock. Standard capital law of motion. Note:  $K_t = u_t \bar{K}_t$
- $\Phi_t$  and  $\Psi_t$ : profits from monopolistically competitive firms and lump-sum taxes, respectively.
- $\delta(u_t)\bar{K}_t$ : cost, in units of consumption goods, of setting utilization rate to  $u_t$ . Quadratic Investment adjustment costs.

$$\bar{K}_{t+1} = (1 - \delta(u_t))\bar{K}_t + F(I_t, I_{t-1}). \quad (4)$$

$$F(I_t, I_{t-1}) = \left[ 1 - S\left(\frac{I_t}{I_{t-1}}\right) \right] I_t$$

where

$$S\left(\frac{I_t}{I_{t-1}}\right) = \frac{s_I}{2} \left( \frac{I_t}{I_{t-1}} - 1 \right)^2.$$



## Model responses beginning from low interest rate state

- A rise in  $R_t$  leads to a substantial increase in fraction of attentive hh's.
- Deposit rates rise but by less than loan interest rate.
- Policy shock induces a substantial increase in  $nim_t$ .
- Intuition
  - ▶ PV effect is stronger when  $R_t$  is low.
  - ▶ There's a high level of inattentive depositors, a substantial fraction of which will become attentive in the future.
  - ▶ Those types of customers will be less profitable in future.
  - ▶ Creates substantial upward pressure on current  $nim_t$  to ensure zero profits in equilibrium.

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## Model responses beginning from high interest rate state

- Intuition
  - ▶ Impact of a rise in  $R$  on PV on PV future profits is weaker when  $R_t$  is high.
  - ▶ Since most depositors are attentive, banks have few inattentive depositors who will turn attentive in future.
  - ▶ So, a small number of customers will become attentive in future.
  - ▶ Those types of customers are less profitable for the bank in future, creating upward pressure on current  $nim_t$  to counteract that effect.
  - ▶ Since there's few such customers, rise in  $nim_t$  that's required to have zero profits in equilibrium is small.
- Rise in  $R_{at}$  is very large.
  - ▶ Since  $nim_t$  is dominated by the high share of attentive hh's,  $nim_t$  doesn't react much to change in FF rate.

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# B-TANK Calibration

Parameter	Parameter value	Description	Parameter	Parameter value	Description
$\beta$	0.9963	discount factor	$\phi^P$	0.85	Calvo stickyness for retail firms
$bb$	0.8	habit formation	$\gamma_1$	0.99	wage stickyness
$\phi$	0.75	share of Non-Hand-to-Mouth	$\rho_1^r$	0.4	Taylor rule: persistance first coefficient
$\chi^N$	0.5	labour disutility scale	$\rho_2^r$	0.4	Taylor rule: persistance second coefficient
$\eta$	1	inverse Frish Elasticity	$\theta^\Pi$	1.5	Taylor rule: inflation gap reaction
$\psi_K$	1.25	investment adjustment cost scale	$\theta^Y$	0	Taylor rule: output gap reaction
$\delta_0$	0.025	capital depreciation	$\sigma^r$	0.0025	Taylor rule: shock standard deviation
$\delta_1$	0.047	capital depreciation due to utilization (linear)	$\bar{\Pi}$	1.01 or 1	Taylor rule: inflation Target (High and Low)
$\delta_2$	0.001	capital depreciation due to utilization (quadratic)	$\rho^A$	0.9	Technology process: persistance
$\alpha$	1/3	capital share	$\sigma^A$	0.01	Technology process: shock standard deviation
$\varepsilon^P$	11	demand elast. for retail firms	$G/Y$	0.18	Steady State ratio of Government Spending to Output

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