Net Interest Margins and Monetary Policy

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Introduction

- Our paper analyzes role of banks' net interest interest margins (NIM) in monetary transmission mechanism.

- 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.

- 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.

Introduction

- 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.

- Counterparts of banks save 191 billion dollars in net interest paid if shock occurs in high state rather low state.
  - These savings represent 0.68 percent of 2023 GDP.

- Order of magnitude check: 100 basis points times transaction + savings balances of households plus corporations is roughly $80 billion.

Conjecture

- Suppose bank profits accrue to people with much lower MPC out of liquid wealth than people who receive interest income from banks.

- Then, contraction in aggregate demand should be larger when policy shock occurs in low interest rate state.

  $\implies$ in an economy with nominal rigidities, state-dependence in NIMs creates state-dependence in response of aggregate economic activity to a monetary policy shock.

Banking model and social dynamics

- Develop a competitive banking model in which fraction of hh's that are attentive to deposit interest rates depends on level of the interest rate.

- 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 discuss interest rates when rates are high.
  - So more hhs are attentive when rates are high.

- Our 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.

- Impact of interest rates on social dynamics and joint effect of social dynamics and interest rates on PV –would also be present in models of monopolistic competition with free entry.

Aggregate Economic Activity

- Embed banking model in DSGE TANK model where aggregate MPC out-of-liquid wealth is high.

- State dependency in response of deposit rates to monetary policy shock interacts with high MPC out-of-liquid wealth hh's .

- GE model accounts well *quantitatively* for state dependency in response of real GDP to a contractionary monetary policy shock.

Empirical Analysis

- Compute two measures of NIM using data from Call Reports (FDIC):
  - (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.

Key state variable

- Indicator variable that's one when average level of FF rate in previous six quarters is higher than 4%.

- Average value of FFR is 1.47% (5.61%) when average of previous six quarters' FFR is less (greater) than 4.0%.

- Control for binding ZLB using a dummy variable that takes on value 1 when FF rate is lower than 50 basis point, zero otherwise.
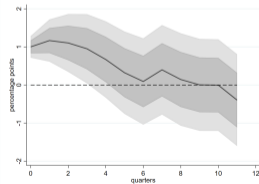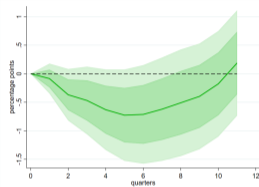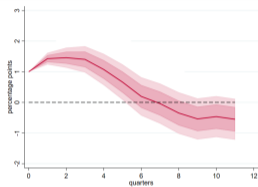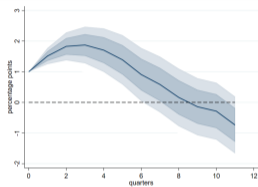
Results: FF

No State Dependence

Allowing for State Dependence

Choleski-style

Bauer & Swanson (2023)

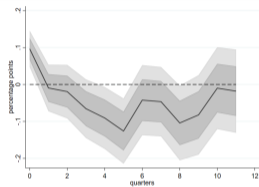Baseline Response

Response in low rate state
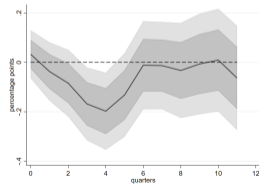
Response in high rate state

Difference Low vs High

Results: Core NIM

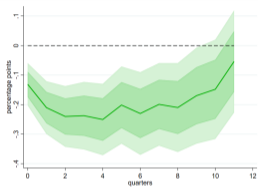**No State Dependence** **Allowing for State Dependence**

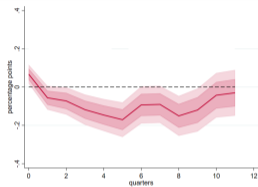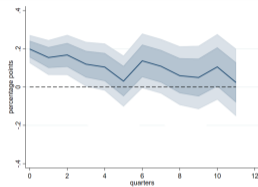

Choleski-style

Bauer & Swanson (2023)

Baseline Response | Response in low rate state | Response in high rate state | Difference Low vs High

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.
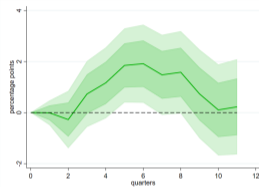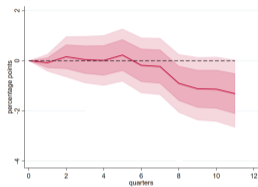
Results: GDP
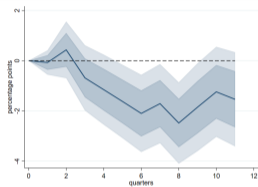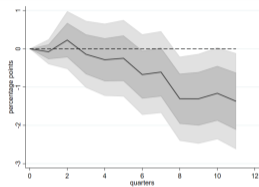
No State Dependence   **Allowing for State Dependence**
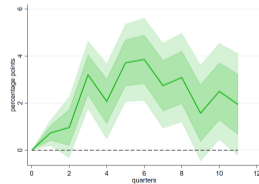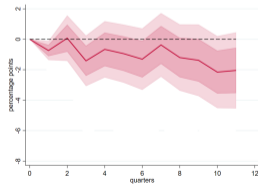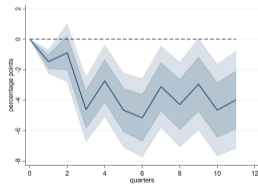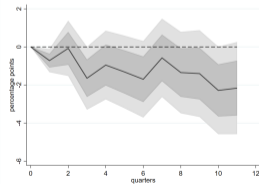
Baseline Response   Response in low rate state   Response in high rate state   Difference Low vs High

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 recognize this variation and consider it 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.

- Every period, a fraction δ of dollar deposits leave their bank due to exogenous factors.
  - So, there's δa_t and δi_t dollars belonging to attentive and inattentive customers seeking a new bank at time t.

- Banks can identify which depositors are 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 ones, i.e., $\tau_i > \tau_a$.
  - Reason is that inattentive depositors are less likely to notice bank offers.

- Matches between banks and deposits of attentive and inattentive hh's form according to

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

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

A simple competitive banking model

- In equilibrium, all deposits find a match so

$$v_{at} = \delta a_t \quad \text{and} \quad v_{it} = \delta i_t. \tag{1}$$

- Deposit markets are perfectly competitive.

- R_{at} and R_{it}: time t gross interest on deposits owned by attentive and inattentive customers.

Value of Deposits

- 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 ε^l.

- Since banks are perfectly competitive, equilibrium lending rate, R^l, is

$$R^l = R + \varepsilon^l. \tag{2}$$

Interest-Rate Spreads

- **Note**: spreads increase with R

- Future profits are discounted by R.
  - When R rises, PV of future profits from a deposit decreases.
  - Since banks earn zero profits in equilibrium, current spreads must increase to compensate for this discounting effect.

- **Note**: 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.

- **Note**: since $\tau_i > \tau_a$, when R rises, spread earned by bank on deposits owned by inattentive hh's increases more than spread for attentive depositors.

$\Longrightarrow$ Attentive depositors benefit more from a rise in FF rate than inattentive depositors.

NIM

- Bank's NIM is given by

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

- 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 κ_a of attentive hh's become inattentive, and a fraction fraction κ_i of inattentive hh's become attentive.

- Transitions arising from social interactions:
  - ▶ Each period there's $a_t i_t$ pairwise meetings between attentive and inattentive hh's.
  - ▶ During these meetings, some inattentive hh's become attentive by learning about interest rate offers through conversations with attentive hh's.

Social Dynamics

- Conversion rate, $\omega(R_t)$: increasing function of annualized quarterly net interest rate.

- Function takes simple quadratic form:

$$\omega(R_t) = \chi \left(4R_t - 4\right)^2.$$

  ▶ Attentive depositors are more likely to discuss the interest rates they earn on their deposits when rates are high.

- Important effect of $\omega(R_t)$: it yields a low (high) level of attentive depositors when interest rates have been low (high) for an extended period.

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 are more valuable to the bank because, with probability κ_a, they become inattentive in the future.
  - Zero profit condition implies current spread on these customers must decline.

Spreads with social dynamics

- 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.
  - With probability $\omega(R_t)a_t + \kappa_i$, inattentive depositors become less valuable attentive customers in future.
  - Zero profit condition implies current spread on these customers must increase.
  - Effect is stronger when interest rates are higher because conversion rate, $\omega(R_t)$, is higher.

NIM with social dynamics

- Marginal impact of R_t on nim_t:

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

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 associated with a rise in R_t.
  - A rise in R_t reduces PV of future profits. Zero profit condition implies that 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.
  - When interest rates rise, banks discount more heavily future losses that occur 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 rate, $\omega(R_t)$, at which inattentive hh's become attentive.
  - Reduces future profits from inattentive hh's.
  - So, current spread on inattentive consumers must rise to compensate for that effect.

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.

- Interest rate shocks are first nine estimates of the impulse response function of FF rate to a 100 basis points policy shock associated with Bauer Swanson shock measure.

Model and Data Responses
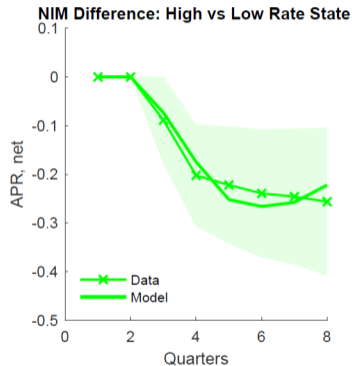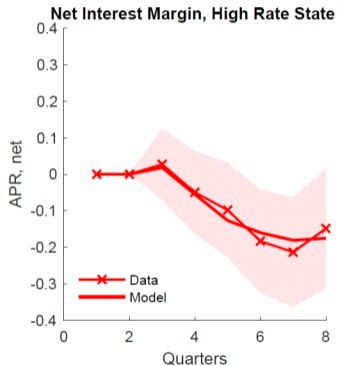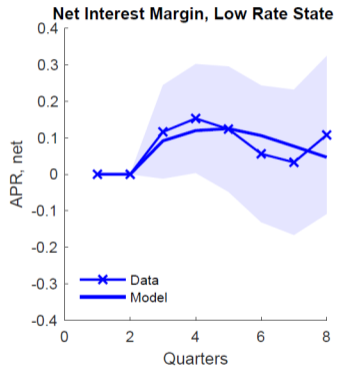
Banking in a DSGE TANK model

- Production sector of the economy as in CEE (2005).

- Calvo - sticky prices (no indexing to previous or steady state inflation).

- To produce in period t, retailer must borrow nominal wage bill and capital services bill from banks at the beginning of the period.

- The retailer repays the loan at end of period t after receiving sales revenues.

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.

Hand-to-mouth HH's

- The economy has a fraction ϕ of hand-to-mouth hh's who may be attentive or inattentive.

- 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.

PIH hh's

- Representative PIH hh owns firms in economy and stock of capital, habit formation in consumption.

- For simplicity, we assume that all of PIH hh's are attentive.

- Results aren't very sensitive to this assumption.
    - PIH hh's smooth their consumption over time, so changes in their interest income have a small impact on their current consumption.

- CEE style costs of adjustment in investment.

Monetary policy and our experiment

- Want to redo experiment of partial equilibrium.

- We can't directly feed two different interest rate paths into DSGE model policy rate because interest rate is endogenously determined by Taylor Rule.

- Construct an observationally equivalent specification.
  - Steady state real rate, determined by β, remains constant. Generate different 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%.

- 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.

GE Responses. Empirical vs Model.
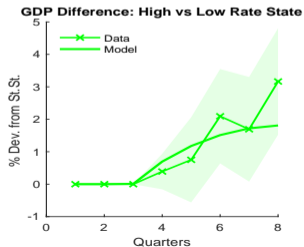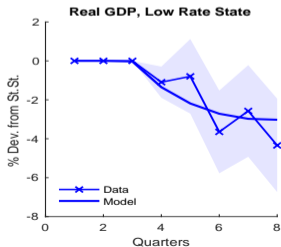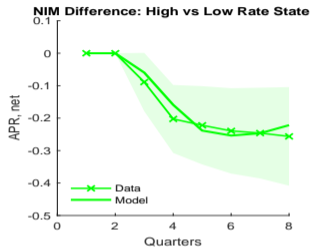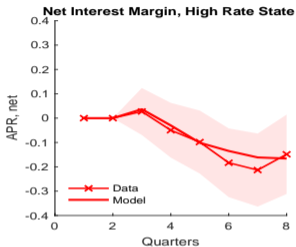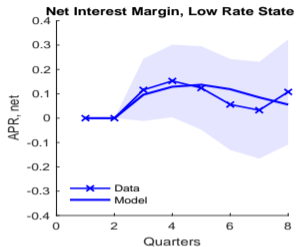
Conclusion

- Impact of monetary 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, including GDP, consumption, and investment.

- Empirical findings can be explained in a GE model featuring competitive banks with two key characteristics.
  - Some depositors are inattentive to interest rates offered by banks.
  - Inattentive fraction increases when interest rates are low.
  - State dependence in deposit interest rates affects broader economy because there's with a high propensity to save out of liquid wealth.