Forward Guidance and the Dynamics of Bank Credit

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Background

Motivation:

- Forward guidance has become an important policy tool for central banks
- From 2008 - 2015, central banks hit zero bound — turned to forward guidance

Key Question:

- Did FG stimulate bank lending? Can it affect bank lending at all?

Finding:

- FG can effectively contract credit, but not expand it

Overview

Of particular interest are commercial banks - how do these banks adjust to FG Shocks?

- “Commercial Banks" = FDIC-insured, federal or state-chartered institutions
- “FG Shocks" = shocks to asset prices around FOMC announcements

What this paper will do:

- Contrast effects of expansionary and contractionary FG shocks in the data
- Fit model to data
- Simulate the effects of an expansionary FG shock at ZLB on credit

Overview

Findings

- Asymmetric responses to contractionary versus expansionary FG shocks
  $\Rightarrow$ Contractionary FG = signaled tightening, Expansionary FG = signaled easing
- FG more effective at *contracting* than *stimulating* credit
  $\Rightarrow$ FG is least effective at stimulating credit when most needed

Transmission: **news about future path of policy rate $\Rightarrow$ asset prices react immediately**

- CB signals surprise future tightening $\Rightarrow$ asset prices $\downarrow$ $\Rightarrow$ treasury yields $\uparrow$ $\Rightarrow$ leverage $\uparrow$ $\Rightarrow$ lending $\downarrow$
- CB signal surprise future easing $\Rightarrow$ results flipped, but...
  statistically indistinguishable from zero

Related Literature

- **Forward Guidance Literature:**
  - Shock identification and effects: Gürkaynak et al. (2005), Nakamura & Steinsson (2018), Swanson (2021), Bauer & Swanson (2023)
  - Effects on firm-level investment: Kroner (2021)
- **Banks and Monetary Policy:**
  - Banks respond strongly to FFR shocks: Bernanke, Gertler (1995), Adrian & Shin (2010)
  - Interest rate sensitivity to policy: Benigno & Benigno (2021)
  - Bank leverage cyclicality: Adrian, Etula, Muir (2014) - procyclical
    He, Kelly, Manela (2017) - countercyclical
- **This Paper**
  - Bridges gap between forward guidance & banking literatures

Outline

- Identifying Forward Guidance Surprises
- Bank Data
- Empirical Results
- Model
- Model Results
- Conclusion

Identification Strategy

High-frequency identification

- Changes in interest-rate futures in a 30-minute window around FOMC announcements (Gürkaynak et al., 2005; Nakamura & Steinsson, 2018)

Sample

- FOMC announcements from July 1995 - December 2019

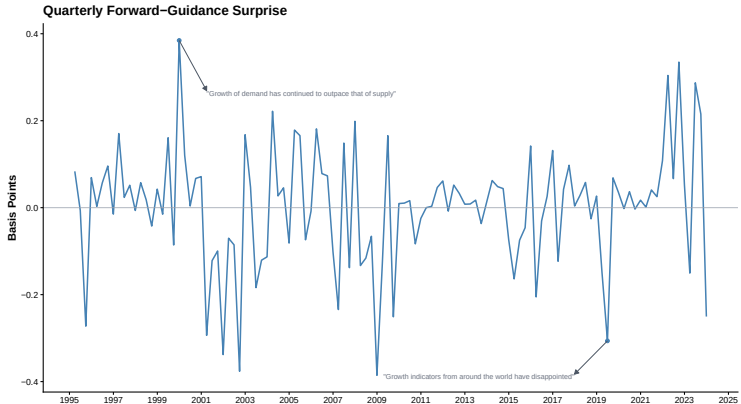
Data Source

- Jacobson, Acosta, and Brennan (2024), Harvard Dataverse

Methodology: Details

- From 30-minute futures moves around FOMC releases, estimate two factors:
  - Extract a *path* shock capturing forward guidance
- Sum bi-quarterly FG shock to an average quarterly measure
  - Control for effects of publicly available data

FG Shocks 1995 - 2023



- **Interpretation:**
  - Positive spike: Contractionary signal
  - Negative spike: Expansionary signal

Bank Data

The Data

- Dates: 1995 Q3 - 2019 Q4
- Frequency: Quarterly
- **Sources:**
  - Lending data: FFIEC Call Reports via WRDS
  - Leverage data: Compustat Capital IQ Bank Fundamentals
  - Remaining bank-level and control variables: FDIC, FRB

Structure

- No. of Units: ~ 10,849 commercial banks
- Observations: 642,387
- Controls:
  - Macro: Fed funds rate, RGDP, RINV, BAA10Y, GDP Def
  - Bank: Assets (loans LP), Tier 1 Risk-Based Capital Ratio, Risk-Weighted Assets/Assets, Deposits/Assets, AOCI/Equity

Bank Data

Measure of Lending

- "Total Loans" from RCON Series on WRDS Call Reports

Measure of Bank Leverage

- Leverage is specified as:

$$\text{Leverage}_t = \frac{\text{Assets}_t}{\text{Equity}_t}$$

- Specifically,

$$\text{Leverage}_t = \frac{\sum_i (\text{Market Equity}_{i,t} + \text{Book Debt}_{i,t})}{\sum_i \text{Market Equity}_{i,t}}$$

Across "i" firms at time t

Forward Guidance Shock Setup

Contractionary Signal ($FG_t^{con} > 0$)

- Expectations of higher future rates
- $E_t[i^*_{t+k}] \uparrow \Rightarrow$, tighter funding
- Bank equity $\downarrow$ bank Assets $_{\downarrow} \Rightarrow$ Bank Leverage $\uparrow$ (equity falls faster)
- *Front-loaded IRFs*

Expansionary Signal ($FG_t^{exp} < 0$)

- Expectations of lower future rates
- $E_t[i^*_{t+k}] \downarrow \Rightarrow$ cheaper funding
- Loans $\uparrow$, leverage $\downarrow$ (equity adjusts first)
- *Back-loaded IRFs*

Asymmetry:

- Contractionary shocks generate immediate, amplified responses
- Expansionary shocks are weaker and delayed

Empirical Specification: Local Projections

For each horizon $h = 0, 1, ..., 20$ estimate:

$$\Delta_\tau \log(y_{i,t+h}) = \alpha_{h,i} + \beta_h^C FG_t^C + \beta_h^E FG_t^E + \sum_{j=1}^{4} \Gamma_{h,j} Z_{t-j} + \varepsilon_{i,t+h}$$

Where $\Delta_h \log(y_{i,t+h}) = \log(y_{i,t+h}) - \log(y_{i,t-1})$

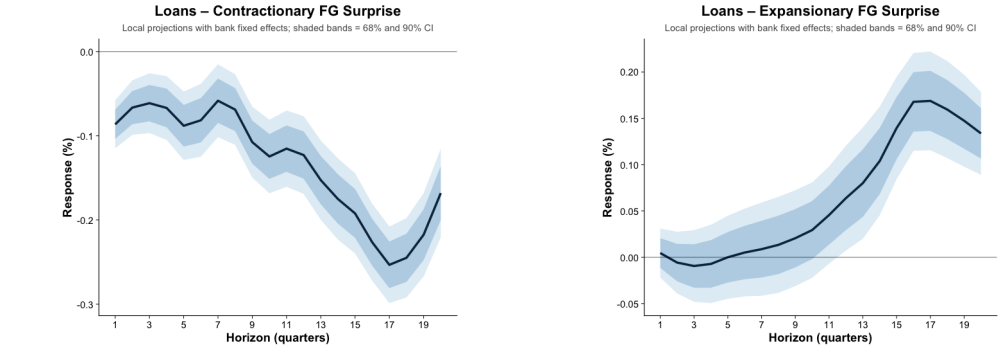
Outcome Variable: $y_{i,t}$ is either loans or leverage

Bank-level fixed effects: $\alpha_{h,i}$

Controls: $Z_{i,t-j}$

FG Shocks: Indicators FG_t^C for contractionary FG shock and FG_t^E for expansionary FG shock at time t

Lending IRFs



The figures are the impulse responses of total loans for banks to a one standard deviation contractionary (left) and expansionary (right) forward guidance shock. The inner dark band corresponds to the 68% confidence band, while the outer light band corresponds to the 90% confidence band.

- Leverage IRFs show similar asymmetry: View IRFs
  - Significant spike in leverage after contractionary shock
  - Statistically insignificant change after expansionary shock

Lending and Capital Constraints

Capital Requirements:

- Tier 1 Capital Ratio: 4.5% of Risk-Weighted Assets
- Basel III: Total Capital Ratio must exceed 8%

Of interest is how lending responds as capitalization adjusts:

	(1) Linear baseline	(2) Low-capital interaction
Dependent variable:	$\Delta \log(\text{Loans}_{i,t})$	
Tier 1 Ratio$_{i,t-1}$	0.210**	0.210**
	(0.075)	(0.075)
Low capital$_{i,t-1}$ (Tier 1 $\leq$ p25)		-0.047**
		(0.017)
Tier 1 Ratio$_{i,t-1}$ $\times$ Low capital$_{i,t-1}$		0.434**
		(0.153)
Controls	Yes	Yes
Bank fixed effects	Yes	Yes
Quarter fixed effects	Yes	Yes
Observations	117,558	117,558
R^2	0.243	0.243
Within R^2	0.109	0.109

Model

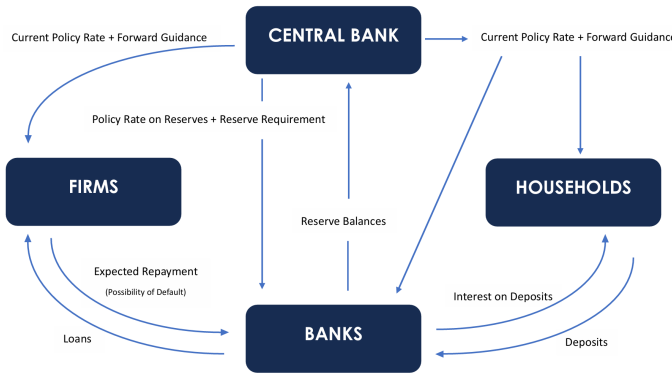


Figure 1: Model Structure

Forward Guidance Structure

$$i_t^R = \phi_\pi \pi_t + \phi_y y_t + \theta_t,$$

$$\theta_t = \sum_{j=1}^{20} \varepsilon_{t-j}^{(j)}$$

- θ_t: represents past deviations from the policy rule
- $\varepsilon_t^{(j)}$: j-period **policy rule deviation** — announced at t but realized in $t + j$

Forward Guidance Shock:

$$\epsilon_t^{FG} = [s_t^0 \;\; s_t^1 \;\; \dots \;\; s_t^{20}]$$

A vector of noisy **signals** about future policy deviations

Signals and Belief Filtering

Noisy observation of each future component:

$$s_t^j = \varepsilon_t^j + \eta_t, \qquad \eta_t \sim N(0, \sigma^2)$$

With perfect information about today's deviation:

$$s_t^0 = \epsilon_t^0$$

Belief updating (reduced-form Kalman filter):

$$E_t\theta_{t+j} = E_{t-1}\theta_{t+j} + K_j\, s_t^j$$

Perfect information today:

$$E_t\theta_t = \theta_t$$

Intuition

- Agents receive a vector of signals ϵ_t^{FG} from the central bank about the future path of the policy rate i_t
- The signals contain ambiguity about the true realization of future policy rates
- These signals feed into forward looking equations that effect outcomes today, without affecting i_t today

Forward Guidance Transmission

Say that the central bank announces a three-period ahead shock ϵ_t^3 to the policy rate

Forward Guidance Transmits Through Forward Looking Variables

Take the Euler equation:

$$
\begin{aligned}
c_t &= E_t[c_{t+1}] - \frac{1}{\sigma}(i_t - E_t[\pi_{t+1}]) \\
&= E_t[c_{t+2} + \frac{1}{\sigma}(i_{t+1} - \pi_{t+2})] + \frac{1}{\sigma}(i_t - E_t[\pi_{t+1}) \\
&\vdots \\
&= E_t\{c_{t+4} + \frac{1}{\sigma}[\phi_\pi \pi_{t+3} + \phi_y y_{t+3} + \theta_{t+3} - \pi_{t+4}]\} + \frac{1}{\sigma}\sum_{j=0}^{2}(i_{t+j} - \pi_{t+j+1})
\end{aligned}
$$

Inserting the definition of θ_{t+3} and s_t^3, we get:

$$
c_t = E_t\{c_{t+4} + \frac{1}{\sigma}[\phi_\pi \pi_{t+3} + \phi_y y_{t+3} + K_3(\underbrace{\epsilon_t^3}_{\text{forward guidance shock}} + \eta_t) + E_{t-1}\theta_{t+3} - \pi_{t+4}]\} + \frac{1}{\sigma}\sum_{j=0}^{2}(i_{t+j} - \pi_{t+j+1})
$$

Forward guidance with asymmetric Kalman filtering

Belief updating (reduced-form Kalman filter):

$$E_t\theta_{t+j} \;=\; E_{t-1}\theta_{t+j} \;+\; K_j\, s_t^j.$$

Asymmetric Kalman update (bad news bites harder)

$$K_j(s) \;=\; \begin{cases} K_j^-, & \text{if } s_t^{(j)} > 0 \;\; \text{(contractionary news)} \\ K_j^+, & \text{if } s_t^{(j)} \le 0 \;\; \text{(expansionary news)} \end{cases} \qquad \text{with } K_j^- > K_j^+ \ge 0,$$

Intuition: downturns tighten the capital constraints faced by banks

Financial Frictions

Banks face

- Budget Constraint: $L_t + B_t + R_t = D_t + (1 - f(\delta_t))X_t$ where $\delta_t = \frac{L_t}{X_t}$
- Cost of Raising Equity: $f(\delta_t) = \frac{\alpha}{2}\delta_t^2$
- Reserve Requirement: $R_t \geq \rho D_t \qquad 0 \leq \rho < 1$

Firms face

- Marginal Cost: $(1 + i_t^L)[1 - \phi_{d,t+1}(j)]W_t(j)$
- Possibility of Default: $\phi_{d,t+1}(j) = \max\left(1 - \frac{Y_t(j)}{(1 + i_t^L)}, 0\right)$

Calibration

Parameter	Value	Description	Source
β	0.99	Discount Factor	–
σ	2	Risk Aversion	–
η	2	Frisch Elasticity of Labor Supply	–
θ	1	Labor Disutility Weight	–
ϕ	0.1	Liquidity Services Weight	–
ρ	0.1	Reserve Ratio	Benigno & Benigno (2021)
τ	0.3	Tax Rate	OECD Centre for Tax Policy and Administration

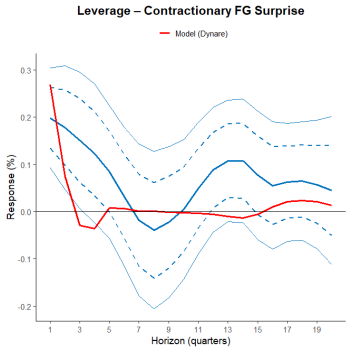
These parameters are fixed, the remainder are estimated using Bayesian methods

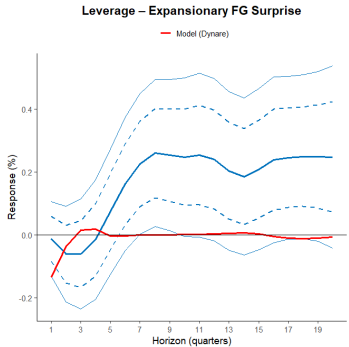
Estimation: Priors and Posteriors

- The remainder of the parameters are estimated using Bayesian methods (Smets & Wouters, 2007)
- I use 16 observables from FRED to estimate the model

Parameter	Description	Dist.	Prior Mean / SD	Mean	5%	95%
Model Parameters						
ρ_A	TFP AR(1) persistence	Beta	0.800 / 0.150	0.8590	0.8022	0.9201
ϕ_π	Taylor-rule inflation	Normal	1.500 / 1.000	0.3155	-1.3936	2.0172
ϕ_y	Taylor-rule output	Normal	0.500 / 0.600	1.3405	0.3804	2.3038
ξ	Calvo *price* stickiness	Beta	0.550 / 0.250	0.7824	0.7189	0.8538
ϕ_w	Calvo *wage* stickiness	Beta	0.750 / 0.150	0.4930	0.4535	0.5353
ρ_b	Bank shock persistence	Beta	0.850 / 0.080	0.9426	0.9036	0.9838
ϕ_x	Loan adjustment-cost	Gamma	1.200 / 0.600	0.3670	0.0939	0.6319
γ_b	Bank intermediation cost	Gamma	0.100 / 0.050	0.1372	0.0718	0.2011
λ_h	External habit persistence	Beta	0.900 / 0.050	0.9554	0.9274	0.9848
ε	Elast. sub w.r.t goods	Normal	6.000 / 2.000	6.0186	2.7377	9.2301
ε_w	Elast. sub w.r.t labor	Normal	4.500 / 1.000	3.1864	2.3972	4.1106

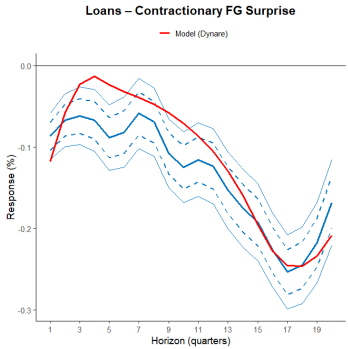
Bank Leverage Responses to FG Shock

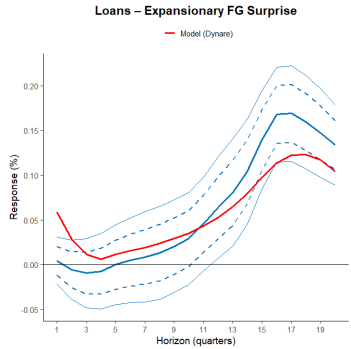




Note: The blue IRFs are data-based estimates (solid line with bands). The dashed lines represent the 68% confidence bands, and the outer solid lines represent the 90% confidence bands. The red IRF is generated by the quantitative model.

Loan Responses to FG Shock





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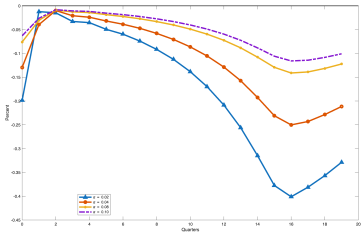
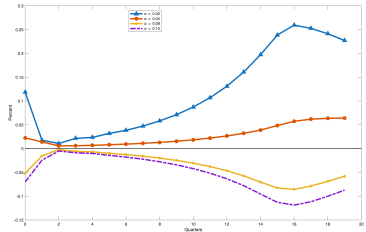
Lending and the Cost of Raising Equity



Lending



Leverage

Note: Varying costs of raising equity. Blue line represents least costly environment. Purple represents most costly environment.

- Deteriorating capitalization ⇒ stronger credit contraction
- Consistent with asymmetry logic:
  - Contractionary FG pushes banks closer to capital constraint than expansionary FG
  - In model: capitalization is key driver of credit

Zero Bound

- To implement an expansionary FG shock at the ZLB, I force the policy rate to remain at zero for longer
- Later liftoff = more accommodative policy
- Fix the policy rate $i_t^R = 0$ by setting $\phi_\pi, \phi_y = 0$
- Introduce a shock ε_t^4 (tightening four quarters into the future)
- Separately, introduce a shock ε_t^8 (tightening eight quarters into the future)
- Take differences in impulse responses between two shocks across all horizons:

$$\Delta Y_{8,4} = Y_{t,\varepsilon_t^8} - Y_{t,\varepsilon_t^4} \equiv Y_{t,\varepsilon_t^{FG}}^{ZLB}$$

- Where $Y_{t,\varepsilon_t^{FG}}^{ZLB}$ is the impulse response of Y to an expansionary forward guidance shock at the ZLB

Zero Bound

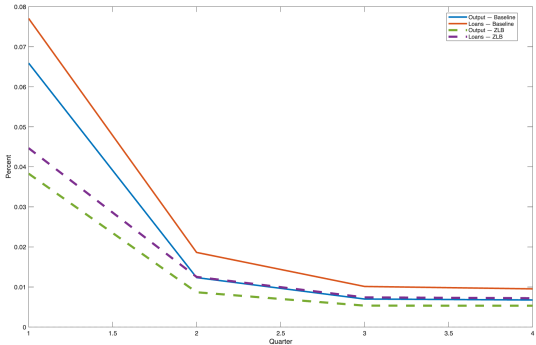


Figure 2: FG Stimulus: ZLB vs Normal Times

Note: This compares the effects of a four-quarter ahead shock in two cases: 1) ZLB FG that holds rates down for another year. 2) FG under normal times that signals a rate cut one year ahead.

Conclusion

- **Objectives**:
  - Assess the effects of central bank forward guidance on stimulating credit
  - Build a model that simulates the response of credit to forward guidance

- **Findings**
  - Asymmetry in credit responses to contractionary versus expansionary FG shocks
    $\Rightarrow$ The same is true of bank leverage
  - Bank capitalization a major driver of credit issuance
  - Evidence that contractionary forward guidance forces credit contraction
    $\Rightarrow$ Expansionary forward guidance does not force credit expansion
  - Forward guidance is least effective at stimulating credit when most needed

Thank You

Appendix

Eurodollar Futures

- Eurodollars: are U.S. dollars held in deposit accounts in banks outside the United States.
- Interest of Eurodollar is the rate at which banks lend Eurodollars to one another
- Eurodollar futures: instrument traders used to hedge the direction of short-term interest rates.
- Price = 100 - implied interest rate
  $\Rightarrow$ Implied rate = 100 - Price
- Bauer & Swanson calculate:

$$\Delta ED^h = ED^h_{20+} - ED^h_{10-}$$

- ED^h_{20+}: first traded hth nearest Eurodollar future contract 20 min after FOMC announcement
- ED^h_{10-}: last traded hth nearest Eurodollar future contract 10 min before FOMC announcement

Construction of MP Shock Return

Eurodollar Futures

- There are two parties involved:
  - Short position: party expects interest rates to rise (price to fall)
  - Long position: party expects interest rates to fall (price to rise)
- Loser pays winner

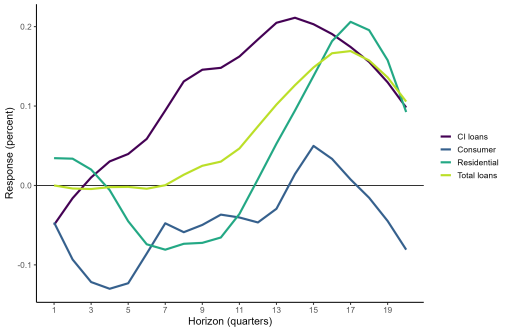
Federal Funds Futures

- Similar to Eurodollar futures, except Eurodollars used LIBOR
- Fed Funds Futures use Effective Federal Funds Rate

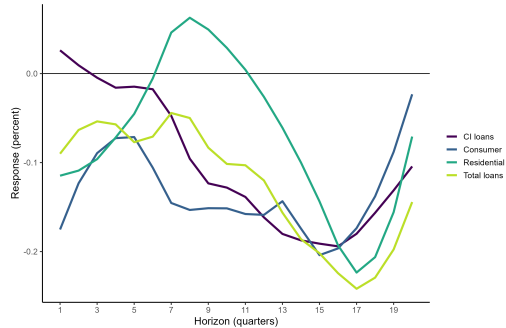
PCA

- Track changes in prices of futures contracts around FOMC announcement
- Extract two factors — second factor is rotated so as not to load on fed funds surprise

IRFs by Loan Category



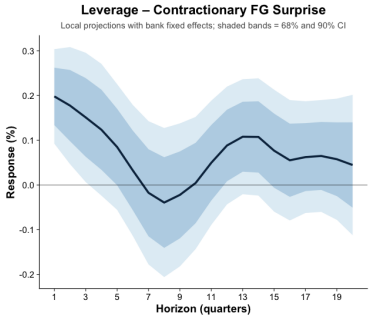
Responses to Expansionary Forward Guidance

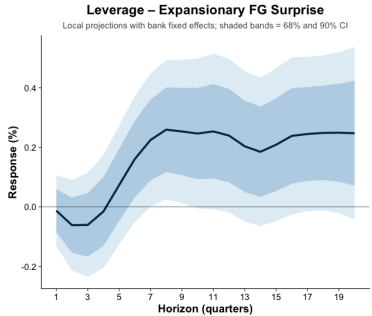


Responses to Contractionary Forward Guidance

Leverage IRFs

Return





The figures are the impulse responses of total loans for banks to a one standard deviation contractionary (left) and expansionary (right) forward guidance shock. The inner dark band corresponds to the 68% confidence band, while the outer light band corresponds to the 90% confidence band.

Policy Rate Response to FG Shock

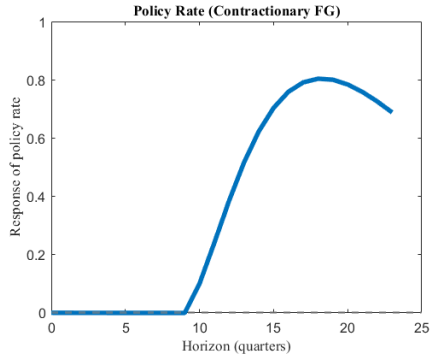
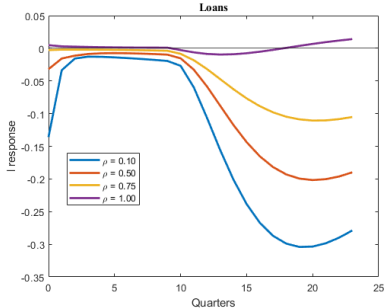


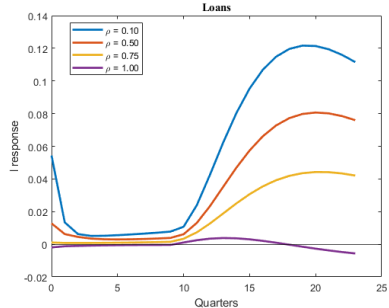
Figure 3: Policy Rate Response to Expansionary FG Shock

Note: This is the response to the policy rate after a forward guidance shock that is announced be going into effect 10 periods hence. We have no lift-off until the actual implementation of the policy rate change.

Lending by Reserve Ratio



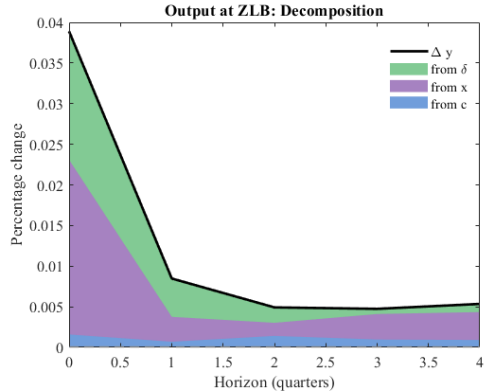
Contractionary FG Surprise



Expansionary FG Surprise

Note: ρ represents the reserve ratio. When $\rho = 0.10$, banks must hold 10% of deposits in reserves. When $\rho = 1$, deposits are fully backed by reserves.

Banks and the Real Economy



Note: δ, x, and c are bank leverage, bank equity, and consumption, respectively. This figure decomposes the response of output by contribution from each variable that y is a function of in the model. The IRF is output's response to an expansionary forward guidance shock at the ZLB.