Optimal Monetary Policy Response to Belief Distortions: Model-Free Evidence

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- ... but no consensus on what drives aggregate belief distortions
    - Causes vary: Behavioral errors? Information frictions?
    - Effects vary: Expansionary? Contractionary?
- How to determine optimal policy without the microfoundations?

Contribution

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- How should **monetary policy** respond to **inflation belief distortions**?
- We estimate the **model-free** optimal policy response to belief distortion shocks
- Belief distortion shocks are contractionary; optimal interest rate response is roughly 1:1
- Target rate is a more effective tool than forward guidance, QE

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    - Reduced-form approach inspired by McKay and Wolf (2023)
    - Construct optimal monetary policy response to offset BDS effects
    - Counterfactual is robust to the Lucas critique!

Data

- We use (monthly) median household 1-year-ahead inflation forecasts from the Michigan Survey of Consumers.
    - We infer the implied 1-year-ahead CPI forecasts according to:

$$f_t^{CPI} = (1 + f_t^{\pi,12}) \times CPI_t$$

    - Coverage: Jan 1978 - May 2024

- We source high-frequency monetary policy shocks from Swanson (2023)
    - Three instruments: target rate, forward guidance, and large-scale asset purchases
    - Coverage: Feb 1988 - Dec 2023

Data

- The VAR setting is completely standard (similar to Gertler and Karadi (2015))
- We load our (baseline) VAR model with log of CPI, log of IP, unemployment, excess bond premium (Gilchrist and Zakrajšek, 2012), 2-year treasury yield
- Lag length chosen by AIC

Structural Shock to Belief Distortions

- Follow *Adams and Barrett (2024)*: assume that structural BD shocks are the only shocks to drive forecasts away from FIRE contemporaneously

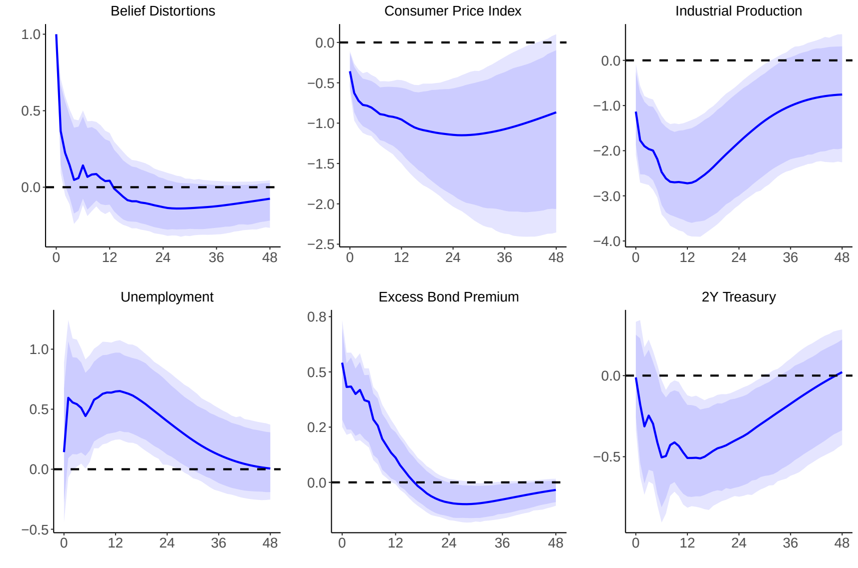
- Stack 1-year-ahead inflation forecasts in a VAR model of the form:

$$\begin{pmatrix} f_t^{CPI,h} \\ x_t \end{pmatrix} = \sum_{j=1}^{J} B_j^s \begin{pmatrix} f_{t-j}^{CPI,h} \\ x_{t-j} \end{pmatrix} + \underbrace{w_t^s}_{A^s \varepsilon_t^s} \tag{1}$$

- VAR identifies B_j^S; structural restrictions decompose $Var(w_t^S)$ to identify first column of A^S. Combine $\implies$ IRFs to BD shocks

- Inflation BD shocks surprisingly robust. Many different specifications: same qualitative effects.

Structural Shock to Belief Distortions



Reduced-form Shock to Belief Distortions

- An alternative approach (sanity check) is to infer BD shocks as the *statistical innovation* of Belief Distortions.
- Estimate BD from the data: ▸ Rational Expectations ▸ Time Series

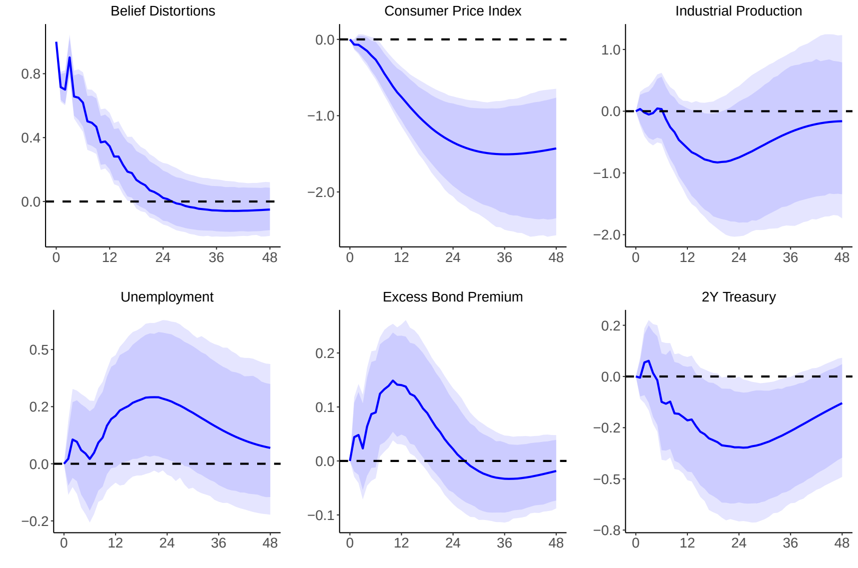
$$d_t^{y,h} \equiv f_t^{y,h} - re_t^{y,h} \tag{2}$$

- Include BD in the VAR model:

$$\begin{pmatrix} d_t^{y,h} \\ x_t \end{pmatrix} = \sum_{j=1}^{J} B_j^r \begin{pmatrix} d_{t-j}^{y,h} \\ x_{t-j} \end{pmatrix} + \underbrace{w_t^r}_{A^r \varepsilon_t^r} \tag{3}$$

- Reduced form:
  - Linear combination of structural shocks (extra assumptions needed for McKay-Wolf)
  - Does it resemble the structural BD shock?

Reduced-form Shock to Belief Distortions

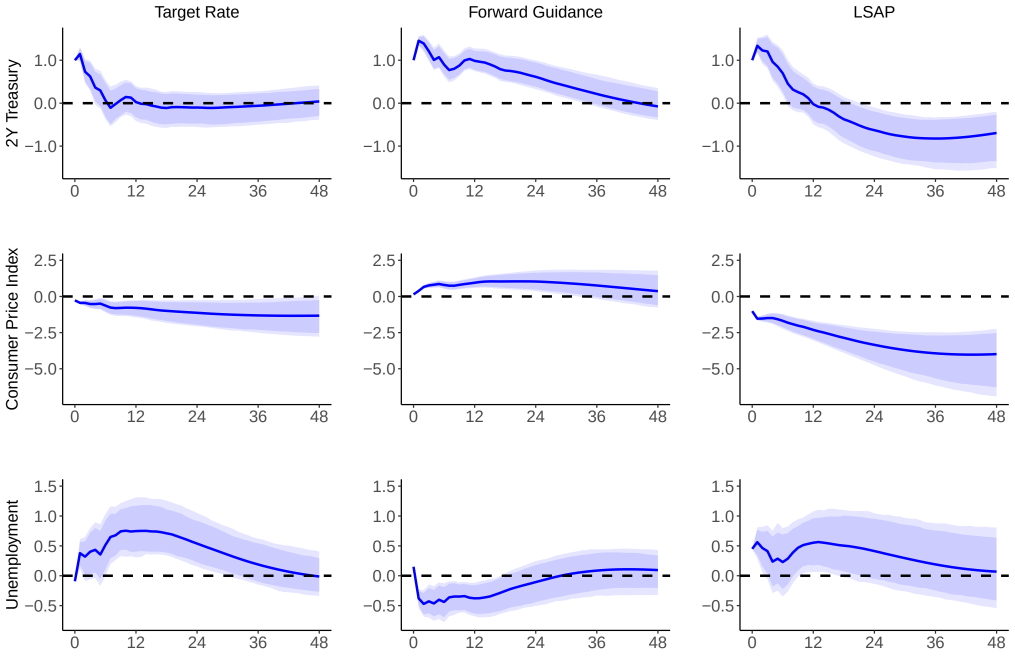


Monetary Policy Shocks (MPS)

- High frequency-identified MPS from Swanson (2023): Target Rate, Forward Guidance, Large-Scale Asset Purchases (LSAP)
- For each response variable i, we regress each residual $w_{i,t}$ on the MPS

$$w_{i,t} = \alpha_i + \underbrace{\omega_i}_{\text{impact}} m_t + \eta_{i,t} \tag{4}$$

and estimate IRFs by proxy-VAR



Target Rate
Forward Guidance
LSAP
2Y Treasury
Consumer Price Index
Unemployment
1.0
0.0
−1.0
2.5
0.0
−2.5
−5.0
1.5
1.0
0.5
0.0
−0.5
0
12
24
36
48

Optimal Response to Belief Distortions

- We set a *welfare criterion* consistent with the Fed's dual mandate:

$$\mathcal{W}_s = \lambda V_s^u(H) + (1-\lambda) V_s^\pi(H) \tag{5}$$

- $V_s^u(H)$ and $V_s^\pi(H)$: variance of unemployment and inflation due to BD shocks s (up to horizon h)

- $\mathcal{W}_s$ is a function of the IRF to shock s

- Baseline: equal weight to *full-employment* and *price stabilization* i.e. $\lambda = 1/2$ ▸ Computation

Optimal Response to Belief Distortions

- As in McKay and Wolf (2023) we construct a counterfactual rule for MP shock m:

$$m_t = \psi s_t$$

- By responding to the shock, the IRF to a BD shock becomes:

$$\phi_\psi(k) = \phi_s(k) + \phi_m(k)\psi$$

- $\phi_\psi(k)$ is the counterfactual IRF to a BD shock
- $\implies$ implies counterfactual welfare $\mathcal{W}_\psi$

Optimal Response to Belief Distortions

- The optimal policy response is the ψ that minimizes the counterfactual welfare loss $\mathcal{W}_\psi$. ▸ Minimization Problem

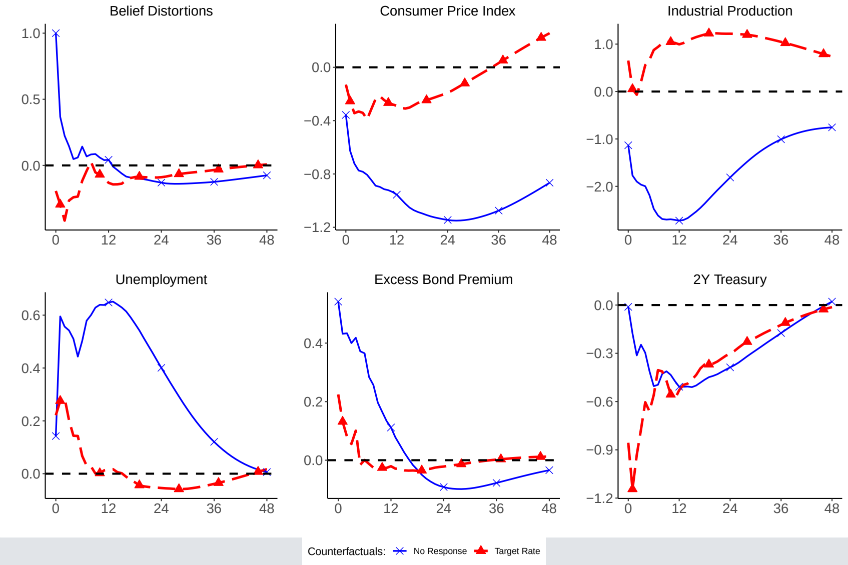
- To be robust to Lucas critique: shocks must be unanticipated.
  - Definitely for Swanson MPS
  - Yes for structural BD shocks, if structural assumptions hold
  - Yes for reduced-form shocks, if our rational expectation estimation is accurate

Optimal Policy Response

▸ Reduced-form alternative

Policy Tools	Structural Methodology			R^2
	Target	FG	LSAP	R^2
Independent	**-0.85**			**0.95**
	(0.30)			
		1.42		0.73
		(0.46)		
			-0.95	0.85
			(0.35)	
Pairwise	**-0.68**	0.41		0.97
	(0.25)	(0.34)		
	-0.65		-0.26	0.96
	(0.28)		(0.23)	
Triplewise	**-0.46**	0.43	-0.28	**0.99**
	(0.21)	(0.27)	(0.18)	

Counterfactual Responses to BD shocks (Structural Method)



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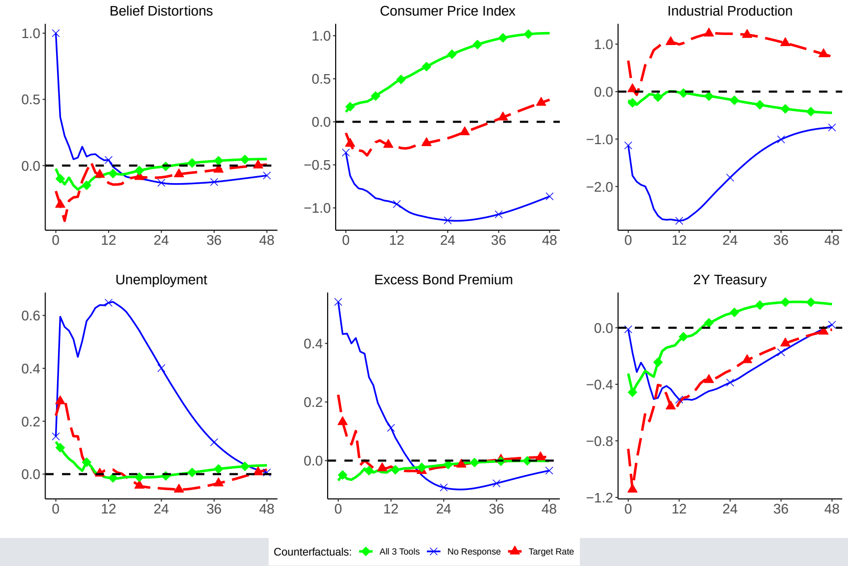


Conclusion

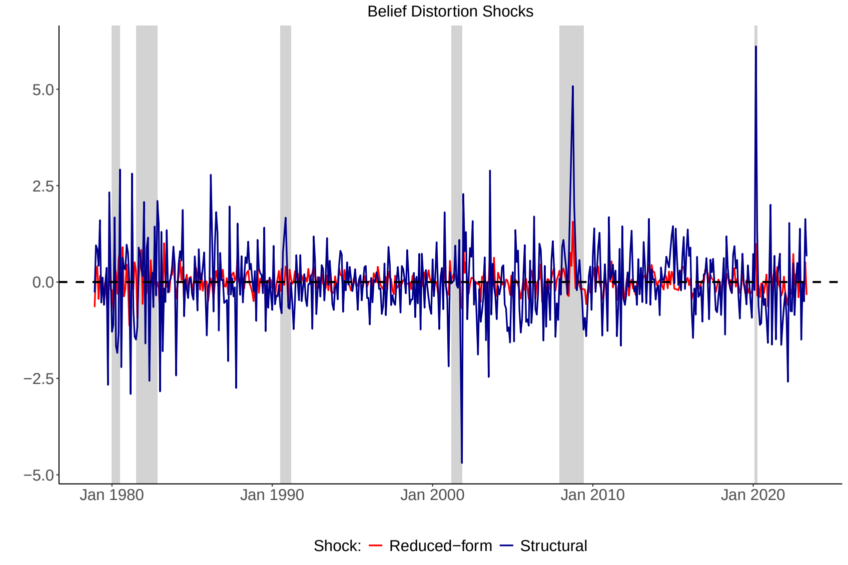
- Evidence: Belief distortions exert contractionary effects (why?)
- Intuitively, MP should respond by easing
- We employ model-free counterfactuals following McKay and Wolf (2023) and find optimal policy in line with this intuition.
- Quantitatively: respond $\sim$1:1
- Monetary easing through short-term rates is the most effective tool
- Robustness checks confirm our conclusions across many specification choices

▸ List

Appendix

Time Series of Belief Distortion Shocks

Back



Rational Expectations ▸ Back

- Rational Expectation (RE) is the conditional expectation of y_{t+h} for some information set Ω_t:

$$re_t^{y,h} = \mathbb{E}_t[y_{t+h}|\Omega_t]$$

- The Rational Expectation is not directly observed in the data.

- We proxy for the info set using lags of macro variables and inflation forecasts.

- We estimate ex-post RE using the fitted values of the following model:

$$y_{t+h} = \sum_{j=0}^{J} \left(\alpha_j f_{t-j}^{y,h} + \beta_j x_{t-j} \right) + \upsilon_{t+h} \tag{6}$$

Optimal Response Identification ▸ Back

- The Welfare criterion:

$$\mathcal{W}_s = \lambda V_s^u(H) + (1-\lambda) V_s^\pi(H) \tag{7}$$

- where $V_s^x(H)$ is the horizon-H conditional variance of x:

$$V_s^x(h) = \sum_{k=0}^{H} Var(x_{t+k}|s_t) = \sum_{k=0}^{H} (\phi_w^x(k))^2 \, Var(w_t)$$

- Example: Any shock s would give the following welfare loss over H horizons:

$$\mathcal{W}_s = \sum_{k=0}^{H} \left(\lambda \left(e_u \phi_w(k)\right)^2 + (1-\lambda) \left(e_\pi \phi_w(k)\right)^2 \right) \tag{8}$$

Minimization Problem ▸ Back

- Welfare criterion:

$$\mathcal{W}_s = \sum_{k=0}^{H} \left(\lambda \left(e_u \phi_\psi(k) \right)^2 + (1 - \lambda) \left(e_\pi \phi_\psi(k) \right)^2 \right) \tag{9}$$

- Can minimize $\mathcal{W}_s$ by linear projection of IRFs, i.e. run the regression:

$$\left(\lambda \phi_s^u (k)^2 + (1 - \lambda) \phi_s^\pi (k)^2 \right) = - \left(\lambda \phi_m^u (k)^2 + (1 - \lambda) \phi_m^\pi (k)^2 \right) \times \hat{\psi} + \hat{\epsilon} \tag{10}$$

Optimal Policy Response

Back

Policy Tools	Structural Methodology				Reduced-form Methodology			
	Target	FG	LSAP	R^2	Target	FG	LSAP	R^2
Independent	**-0.85**			**0.95**	-0.44			0.81
	(0.30)				(0.34)			
		1.42		0.73		0.24		0.08
		(0.46)				(0.40)		
			-0.95	0.85			-0.42	0.32
			(0.35)				(0.34)	
Pairwise	**-0.68**	0.41		0.97	-0.52	-0.26		0.87
	(0.25)	(0.34)			(0.48)	(0.48)		
	-0.65		-0.26	0.96	-0.42		-0.04	0.81
	(0.28)		(0.23)		(0.32)		(0.25)	
Triplewise	**-0.46**	0.43	-0.28	**0.99**	-0.54	-0.28	0.05	0.88
	(0.21)	(0.27)	(0.18)		(0.44)	(0.44)	(0.21)	

Robustness Checks ▸ Back

- Inflation vs. Full Employment Targeting
  - We shift $\lambda \in (0, 1)$.
  - Conventional policy responds with $\psi \in (-1.01, -0.84)$
- Change number of lags p in VAR(p) model.
- Exclude COVID-19 Era from baseline VAR model.
- Truncate Welfare Horizon.
  - Suppose the monetary authorities care about welfare effects over a 1-year vs. 10-year horizon. Conventional policy responds with $\psi \in (-0.87, -0.82)$
- Run parsimonious a VAR model
- Use a high-frequency MPS from a natural-language approach (Aruoba and Drechsel, 2024)
  - This robustness check suggests a more aggressive monetary easing.

Robustness Checks

Back

	Structural		Reduced-form	
	Target	R^2	Target	R^2
Baseline Model	-0.845	0.948	-0.435	0.806
	(0.301)		(0.344)	
Inflation Targeting ($\lambda = 0$)	-1.006	0.718	0.075	0.004
	(0.263)		(0.284)	
Employment Targeting ($\lambda = 1$)	-0.843	0.955	-0.439	0.857
	(0.339)		(0.354)	
VAR with 3 lags	-1.046	0.892	-0.524	0.894
	(0.456)		(0.341)	
VAR with 12 lags	-0.599	0.861	-0.186	0.275
	(0.262)		(0.229)	
Belief Distortion estimation	-	-	-0.378	0.773
with 12 lags	-		(0.237)	
Excl. COVID-19 Era	-0.828	0.736	-0.677	0.793
	(0.239)		(0.475)	
24-Month Truncation of	-0.874	0.954	-0.378	0.764
Welfare Objective	(0.366)		(0.291)	
120-Month Truncation of	-0.822	0.913	-0.397	0.596
Welfare Objective	(0.303)		(0.377)	
Aruoba-Drechsel Monetary	-2.092	0.705	-0.912	0.845
Policy Shock	(1.059)		(0.942)	

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