Central Bank Communication that Works: Lessons from Lab Experiments

Oleksiy Kryvtsov Luba Petersen

Bank of Canada

Simon Fraser University

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Communication is changing

Shift away from the mystique of central banking toward more transparency.

Central bank have experimented with communication of their:

- objectives
- explicit targets
- publishing minutes of policy meetings
- language
- future stance of policy
- outlook
- public education

Evidence on Central Bank Projections and Market Expectations

- Delphic inflation forecasts influence professional forecasters' expectations in similar direction and reduce forecast dispersion (Hubert, 2015a,b; Hatori et al. 2016)
  - ECB, Canada, Sweden, UK, Switzerland, and Japan

- Mixed effects of interest rate projections on market yields
  - Andersson and Hoffman (2009), Kool and Thornton, 2014; Brubakk, ter Ellen, Xu, 2017
  - Weakly/strongly improve CE's forecasts of short-term interest rates in Norway and Sweden
  - Effects 5-year yields but not 10-year yields in NZ

- Jain and Sutherland (2018)
  - Cross-country, multiple types of projections on professional forecasters' expectations
  - Inflation projections and forward guidance manage inflation expectations and interest rate expectations

Main questions:
How does communication about interest rates influence expectations and macro aggregates?

Does it matter what information is communicated?

Approach:
Experimentally investigate the effects of interest rate information on expectation formation:

1. past interest rate changes
2. future interest rate changes
3. forward guidance about timing of future rate changes

Advantages of laboratory experimental methods

1. Useful for studying policies, events, or factors that cannot be naturally observed, measured or modelled

2. Increased control over participants' information sets, incentives

3. Experiments can be run many times and for longer horizons to produce more data

4. More opportunities for linking data to real decisions

Challenges for experimental approach

- Making the experiment look like reality: external validity
  - Decisions may be affected by the amount and complexity of information
- Sample sizes are small, usually only 7-10 participants interacting together, 100-200 participants per study
  - May not be enough to study economy-wide phenomena
  - Groups should be large enough to limit the effects of individuals
  - Challenge in finding representative pool of subjects
- Simplicity forces researchers to interpret results with caution
  - Qualitative rather than quantitative inference

New Keynesian Learning-to-Forecast (LTF) Experiments

Emphasis is on expectations

- Subjects submit their short-term forecasts and aggregate expectations endogenously influence the economy
- Assumes that agents act on their expectations
- Simplifies both subject and researchers' lives...

New Keynesian Learning-to-Forecast (LTF) Experiments

- **How do individuals and groups form expectations?:**
  Adam (2007), Assenza et al. (2014), Petersen (2014), **Mauersberger (2017)**, Cornand and Hubert (2019)

- **How do monetary policy rules influence expectations?:**
  Pfajfar and Zakelj (2014, 2018), Assenza et al. (2014), Kryvtsov and Petersen (2013), Arifovic and Petersen (2015), Hommes et al. (2015a)

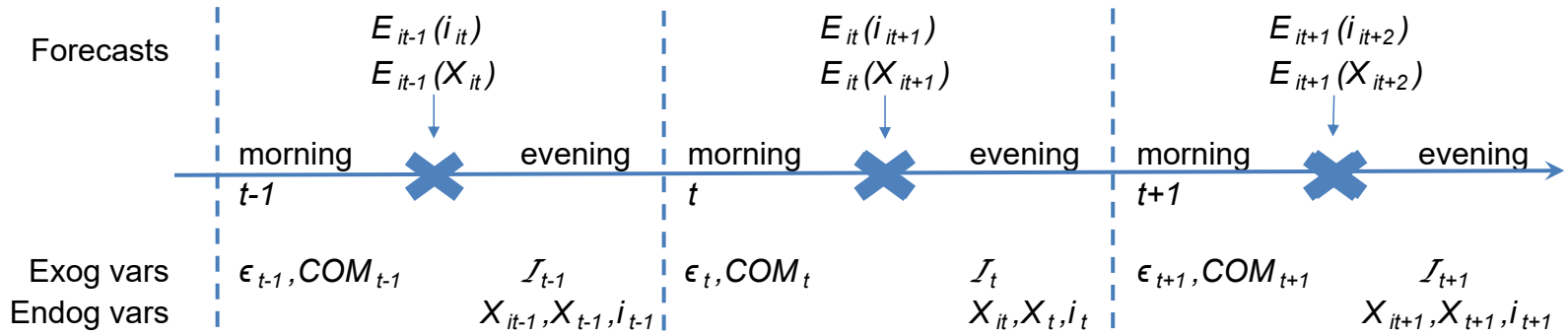
- **How are expectations formed at the zero lower bound and periods of monetary policy inaction?:**
  Arifovic and Petersen (2015), Hommes et al. (2015b), Ahrens et al. (2017)

- **How does central bank communication influence expectations?:**
  Kryvtsov and Petersen (2015), Cornand and M'Baye (2015), Arifovic and Petersen (2015), Ahrens et al. (2017), **Mokhtarzadeh and Petersen (2018)**, Mirdamadi and Petersen (2018)

Heterogeneous-Expectations LTF Game

Groups of 7 subjects play the role of professional forecasters who submit one-period ahead forecasts for three variables:

1. Nominal expenditures of an assigned household, $\nu_{i,t+1}$
2. Price of an assigned firm, $p^*_{j,t+1}$
3. Nominal interest rate, i_{t+1}



with information about

- current variables, ϵ_t, and communication, COM_t
- lagged variables, $X_{t-1} \in \{\pi_{t-1}, x_{t-1}, r_{t-1}\}$, $X_{i,t-1} \in \{p^*_{i,t-1}, \nu_{i,t-1}\}$, i_{t-1}
- CB inaction, I_{t-1}

Data-generating process: Woodford (2013)

Individual household's Euler equation:

$$\overline{v}_{it} = (1-\beta)\sum_i \overline{v}_{it} - \beta\sigma(i_t - \pi_t) + \beta E_{it}\overline{v}_{it+1},$$

Individual firm's pricing equation:

$$p^*_{jt} = (1-\alpha)\sum_j p^*_{jt} + (1-\alpha\beta)\zeta y_t + \alpha\beta E_{jt} p^*_{jt+1},$$

Central bank's reaction function:

$$i_t = \begin{cases} \phi_\pi \pi_t + \phi_y y_t & w.p.\ \iota \\ i_{t-1} & w.p.\ 1-\iota. \end{cases}$$

where

$$\pi_t = (1-\alpha)\sum_j p^*_{jt}$$

$$y_t - r^n_t + \sigma\pi_t = \sum_i \overline{v}_{it},$$

$r^n_{t+1} = \rho_r r^n_t + \epsilon_{t+1}$, with i.i.d. innovations $\epsilon_t \sim N\left(0, \sigma^2_r\right)$.

Calibration

Parameter values chosen to replicate salient features of inflation and output-gap fluctuations in Canada between 1993Q1 and 2017Q4.

A. Calibrated Parameters

σ_r	st dev of r^n_t innovations, %	1.20
ρ_r	ser corr of r^n_t	0.45
ζ	degree of real rigidities	0.80
ϕ_π	Taylor-rule coef, inflation	1.4

B. Targets

	Data	Model
st dev of π_t, %	0.54	0.54
ser corr of π_t	0.40	0.40
$std(x_t)/std(\pi_t)$	2.1	2.1
$std(i_t)/std(\pi_t)$	1.0	1.0

C. Assigned Parameters

	period	1 quarter
β	discount factor	$0.96^{1/4}$
σ	risk aversion	1
$1-\alpha$	prob of price changes	0.49
ϕ_x	Taylor-rule coef, output gap	$\phi_\pi/20 = 0.07$
ι	Fraction of periods with $i_t \neq 0$	0.56

Scoring rule

Points awarded based on accuracy of forecasts:
$S_{i,t} = 0.3\left(2^{-0.01\left|E_{i,t-1}\pi_t - \pi_t\right|} + 2^{-0.01\left|E_{i,t-1}x_t - x_t\right|} + 2^{-0.01\left|E_{i,t-1}i_t - i_t\right|}\right)$

Exchange rate of 1 point = CDN 0.75.

Maximum earnings of 69 points or \$51.75.

Earnings, with \$10 show up fee, ranged from \$15-\$43, averaged \$32 for two hours.

Treatments

1. Control Treatment
2. COM-BACK
3. COM-FWD
4. COM-COMMIT

Treatments

1. Control Treatment
   - No communication
2. COM-BACK
3. COM-FWD
4. COM-COMMIT

Treatments

1. Control Treatment
2. COM-BACK
   - "The interest rate increased last period" or "The interest rate decreased last period"
   - No announcement if the interest rate has not changed, or if the change is smaller than 25 bps in magnitude (16% of all non-zero changes)
   - Occasionally, the interest rate may stay unchanged between the last two periods. In this case the central bank will not make an announcement.
3. COM-FWD
4. COM-COMMIT

Treatments

1. Control Treatment
2. COM-BACK
3. COM-FWD
   - "The interest rate will likely increase this period" or "The interest rate will likely decrease this period"
   - No announcement if the interest rate is expected to stay within 25 bps from zero

$$E_{t-1}^{CB} i_t = 0.007 + 0.317 i_{t-1} + 0.084 r_{t-1}^n$$

   - "Occasionally, the interest rate may stay unchanged between the last two periods. In this case the central bank will not make an announcement."
4. COM-COMMIT

Treatments

1. Control Treatment
2. COM-BACK
3. COM-FWD
4. COM-COMMIT
   - "Occasionally, the interest rate may stay unchanged, and during those periods, the the central bank will announce the number of periods before the next change. At the end of these periods of inaction, the central bank will announce that the interest rate will change in the current period."
   - "The interest rate will remain unchanged for k periods"
   - "The interest rate will change in the next period."
   - "The interest rate will change this period."
   - No announcement during periods of changing interest rates

Interface

Subject: Subject-1
Period: 13
Time Remaining:
Total Points: 8.41

CB Announcement
The interest rate decreased last period.

News
Shock: -128
Shock Forecast: -58

Next Period

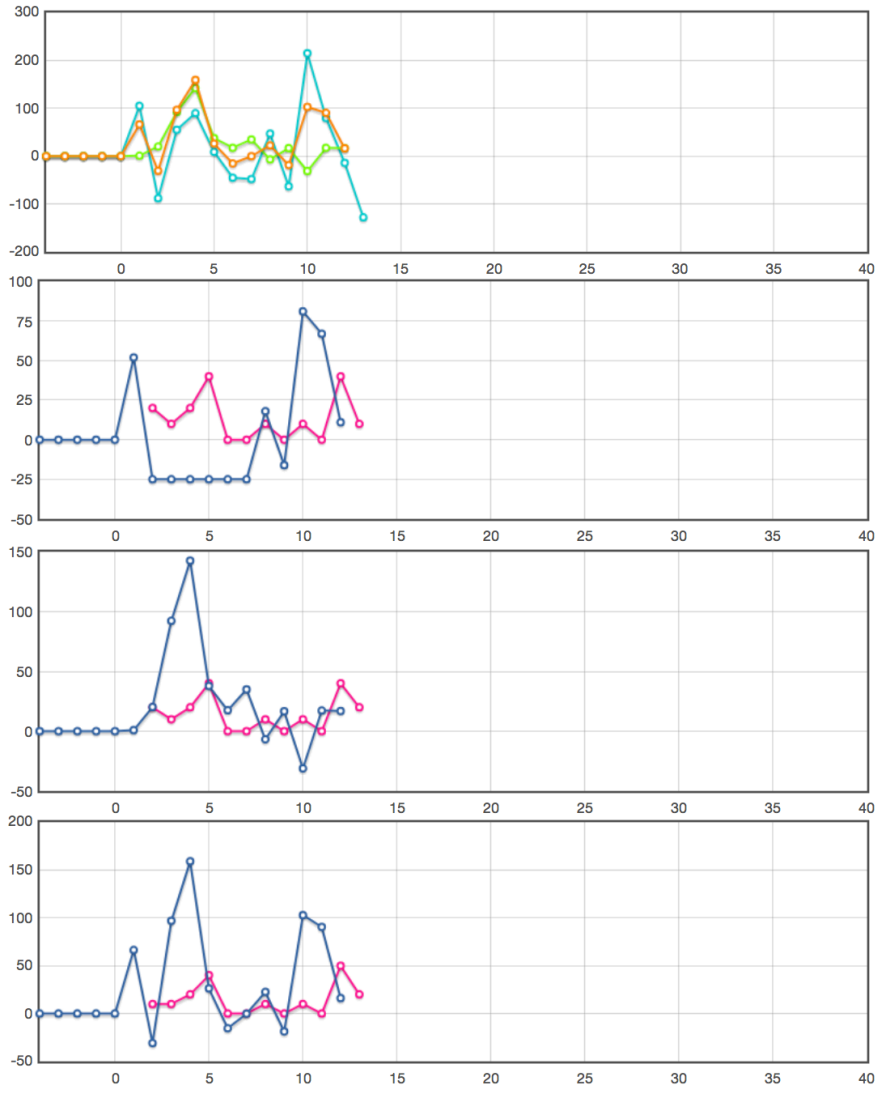
Please input your forecasts.

Interest:

Spending.:

Price:

Submit

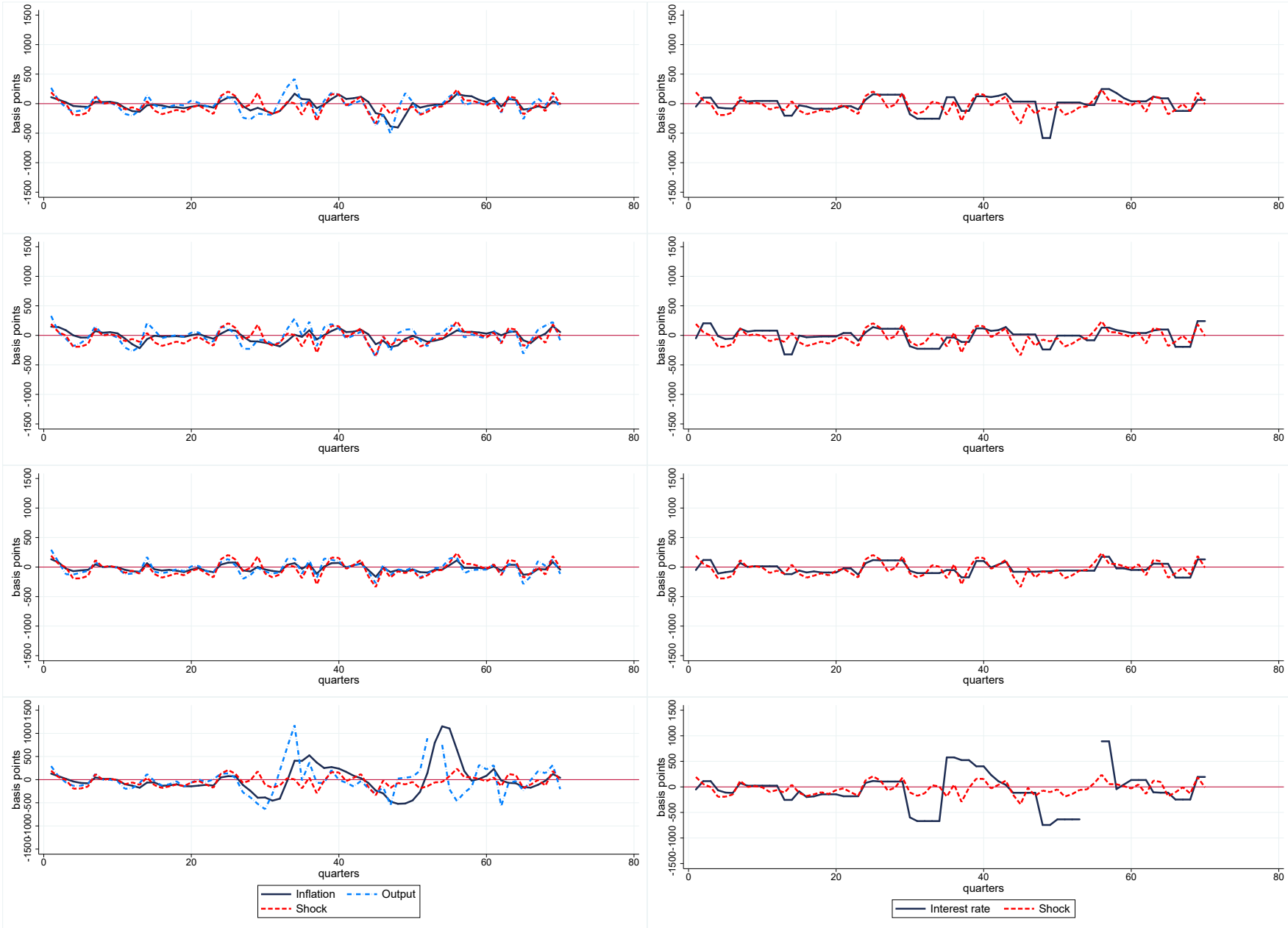


General Implementation

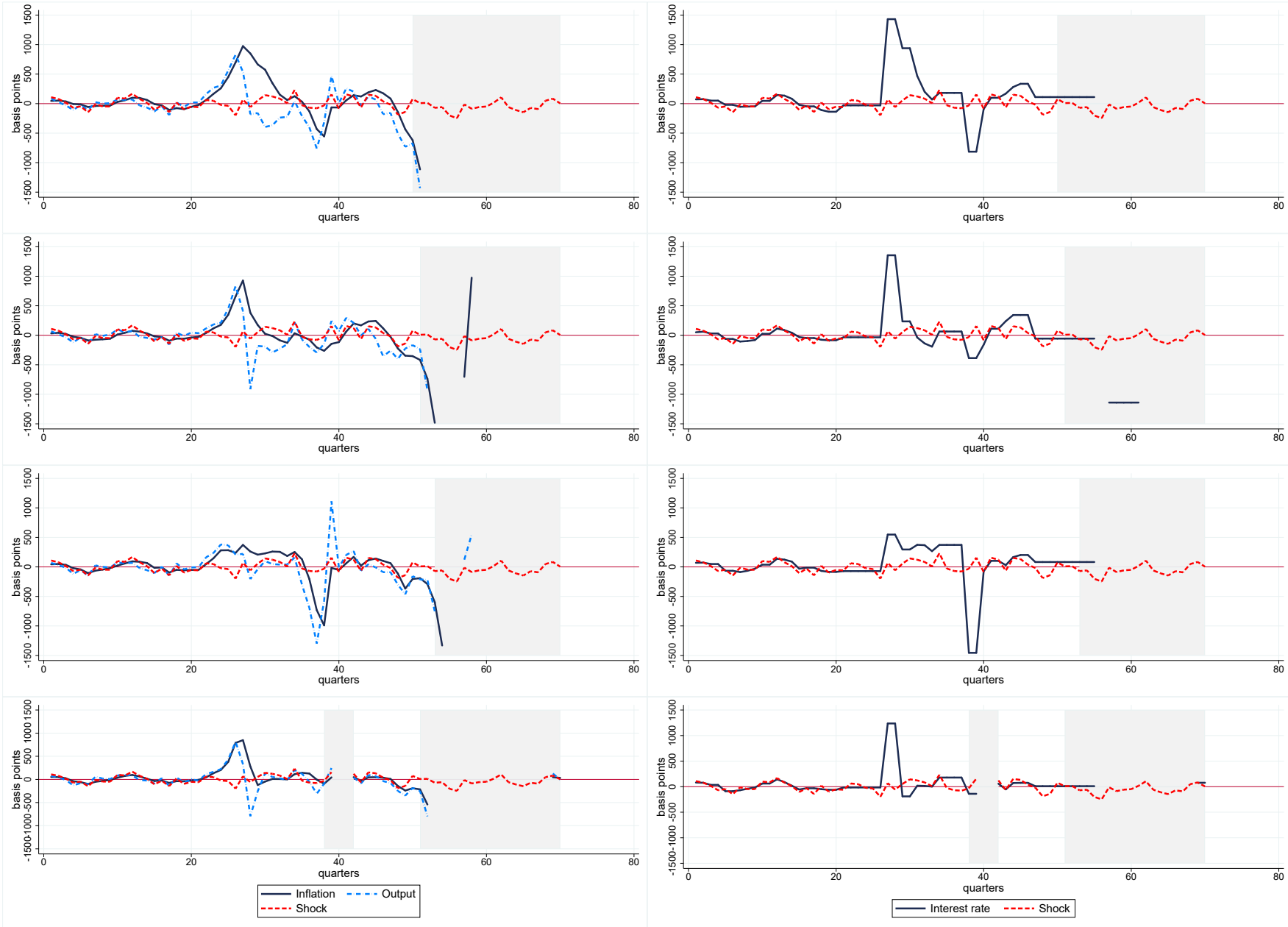
Experiments conducted at UBC's ELVSE.

- 30 minutes of instruction and 90 minutes of game participation.
- Quantitative and qualitative description of DGP ▸ Details
- N=8 sessions per treatment
  - $\tau = 70$ rounds per session
  - 75 seconds per round for first nine periods, 60 seconds thereafter
  - 8 sessions x 7 subjects x 70 rounds = 3920 obs per treatment
- Shock sequences differed by session, but kept constant across treatments

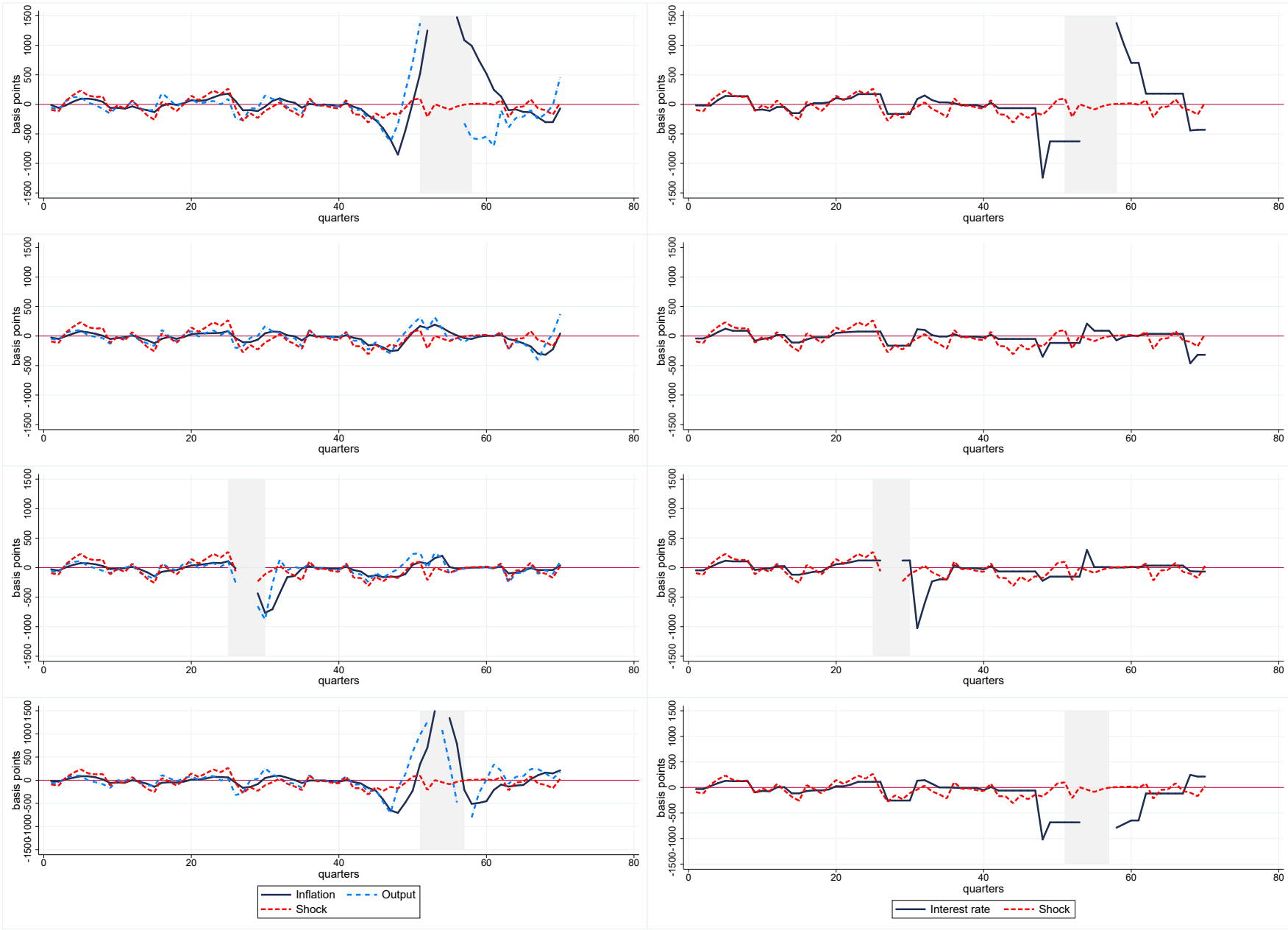
Session 1 (NoCOM, BACK, FWD, COMMIT)



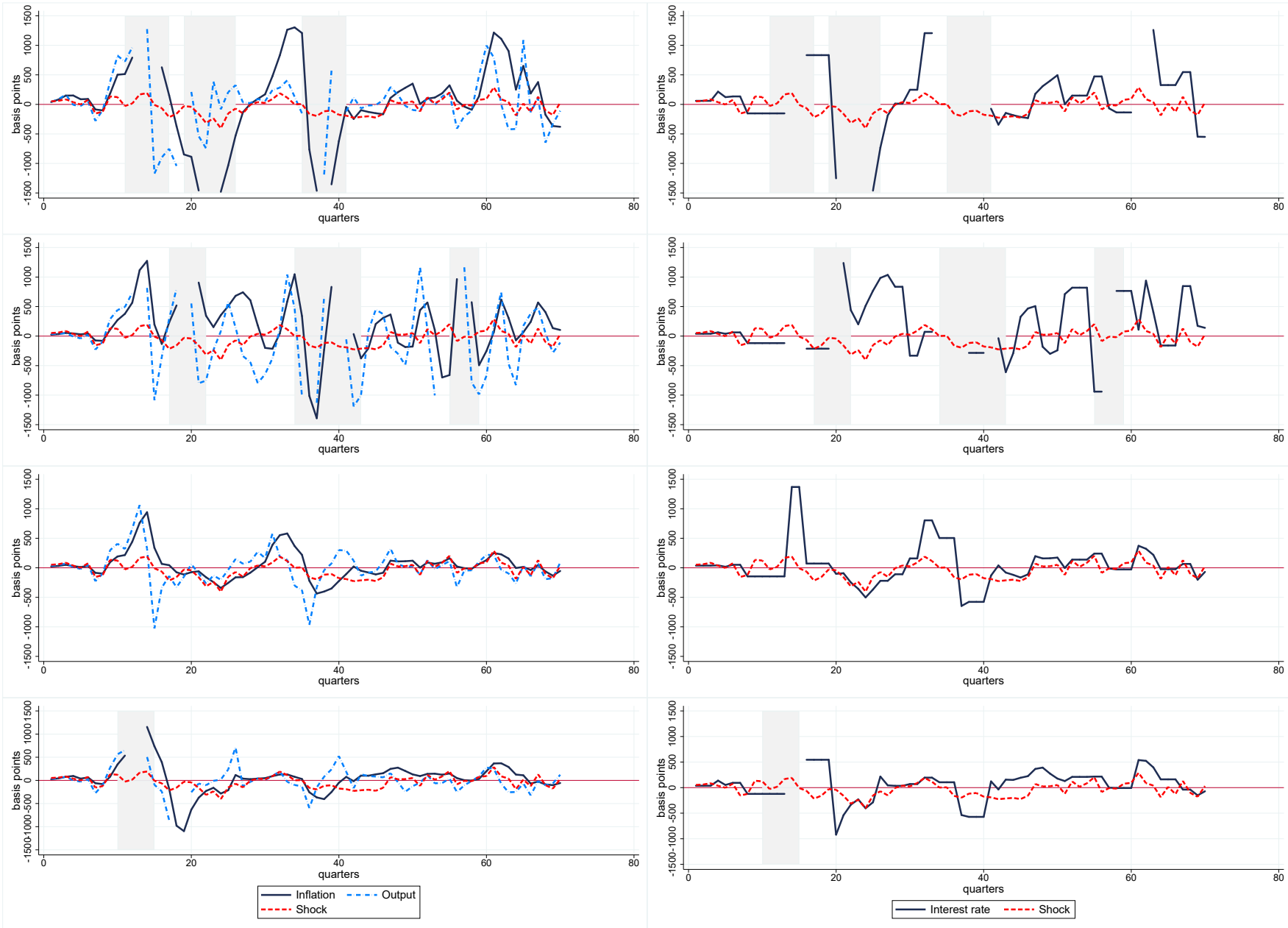
Session 2 (NoCOM, BACK, FWD, COMMIT)



Session 6 (NoCOM, BACK, FWD, COMMIT)



Session 8 (NoCOM, BACK, FWD, COMMIT)



Econometrics of stable dynamics

Explosive episode defined as periods for which the absolute value of inflation or interest rate exceeds 10 times the standard deviation of the demand shock (1344 bps), or the absolute value of output gap exceeds 20 standard deviations of the shock (2688 bps).

Exclude explosive episodes and two periods before and after each episode to dismiss transition to and from explosive episodes.

Estimation of conditional responses

Dynamics of individual i's forecasts for variable X_{it+1} are estimated with the following empirical specification:

$$\begin{aligned} E_{it}X_{it+1} &= c_0 + c_{01}\mathcal{I}_{t-1} + (c_1 + c_{11}\mathcal{I}_{t-1})\, E_{it-1}X_{it} + (c_2 + c_{21}\mathcal{I}_{t-1})\, E_{it-2}X_{it-1} \\ &+ (c_3 + c_{31}\mathcal{I}_{t-1})\, \epsilon_t + (c_4 + c_{41}\mathcal{I}_{t-1})\, \epsilon_{t-1} + (c_5 + c_{51}\mathcal{I}_{t-1})\, r^n_{t-2} + D_s + e_{it} \end{aligned}$$

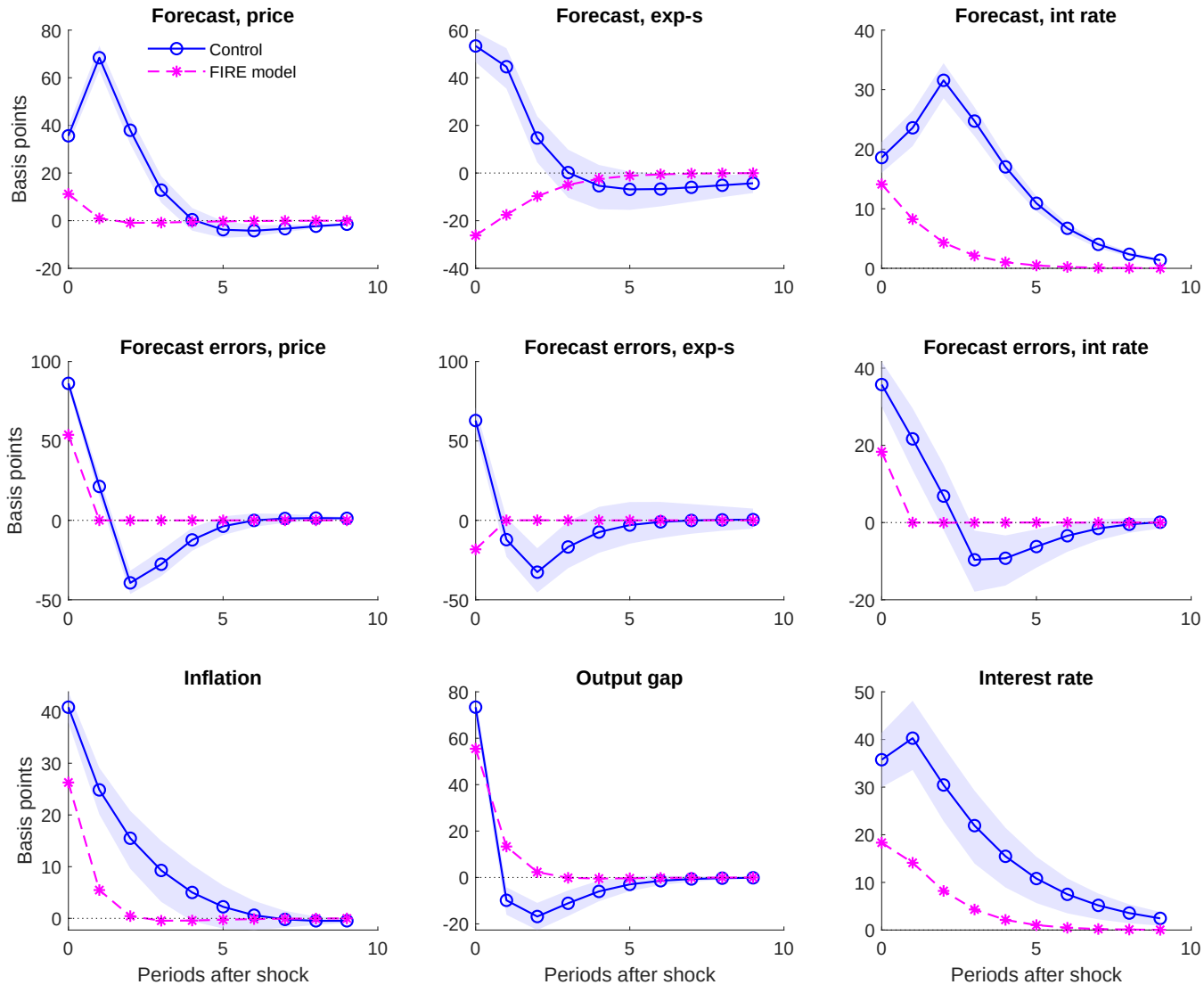
Dynamics of individual variables X_{it} use the same specification, except $\mathcal{I}_{t-1}$ is replaced with $\mathcal{I}_t$ to reflect the fact that they are determined upon realization of monetary policy inaction variable in period t:

$$\begin{aligned} X_{it} &= c_0 + c_{01}\mathcal{I}_t + (c_1 + c_{11}\mathcal{I}_t)\, X_{it-1} + (c_2 + c_{21}\mathcal{I}_t)\, X_{it-2} \\ &+ (c_3 + c_{31}\mathcal{I}_t)\, \epsilon_t + (c_4 + c_{41}\mathcal{I}_t)\, \epsilon_{t-1} + (c_5 + c_{51}\mathcal{I}_t)\, r^n_{t-2} + D_s + e_{it} \end{aligned}$$

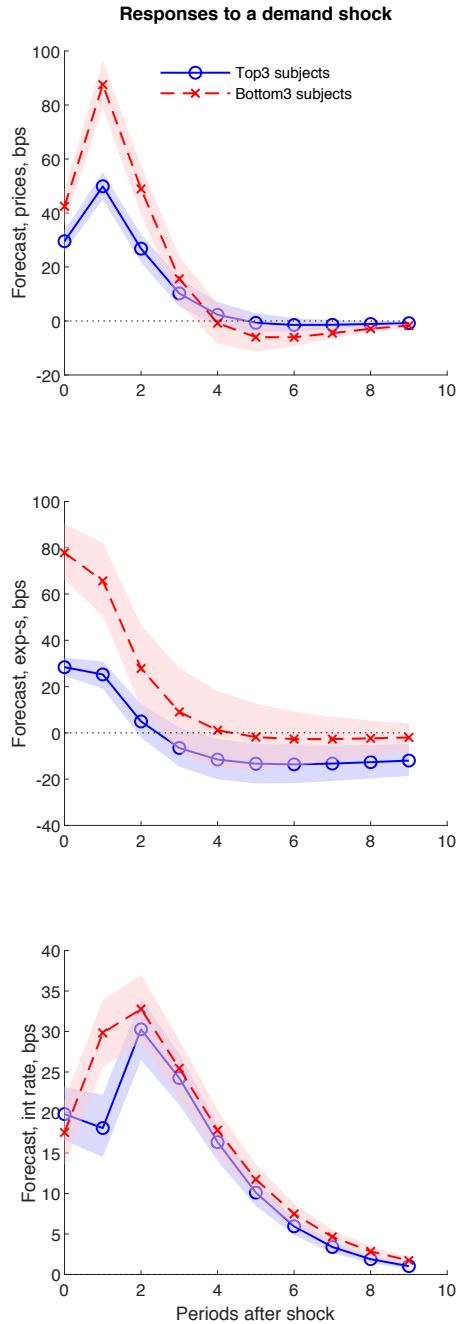
To estimate the effects of communication, we expand the baseline specification with additional terms that include communication dummy Γ_T, with $T \in \{\text{COM-BACK, COM-FWD, COM-COMMIT}\}$:

$$\begin{aligned} E_{it}X_{it+1} &= [1, E_{it-1}X_{it}, E_{it-2}X_{it-1}, \epsilon_t, \epsilon_{t-1}, r^n_{t-2}]\, (\mathbf{c_r} + \mathbf{c_{r1}}\mathcal{I}_{t-1}) \\ &+ [1, E_{it-1}X_{it}, E_{it-2}X_{it-1}, \epsilon_t, \epsilon_{t-1}, r^n_{t-2}]\, (\mathbf{c_{r2}} + \mathbf{c_{r3}}\mathcal{I}_{t-1})\, \Gamma_T + D_s + e_{it}. \end{aligned}$$

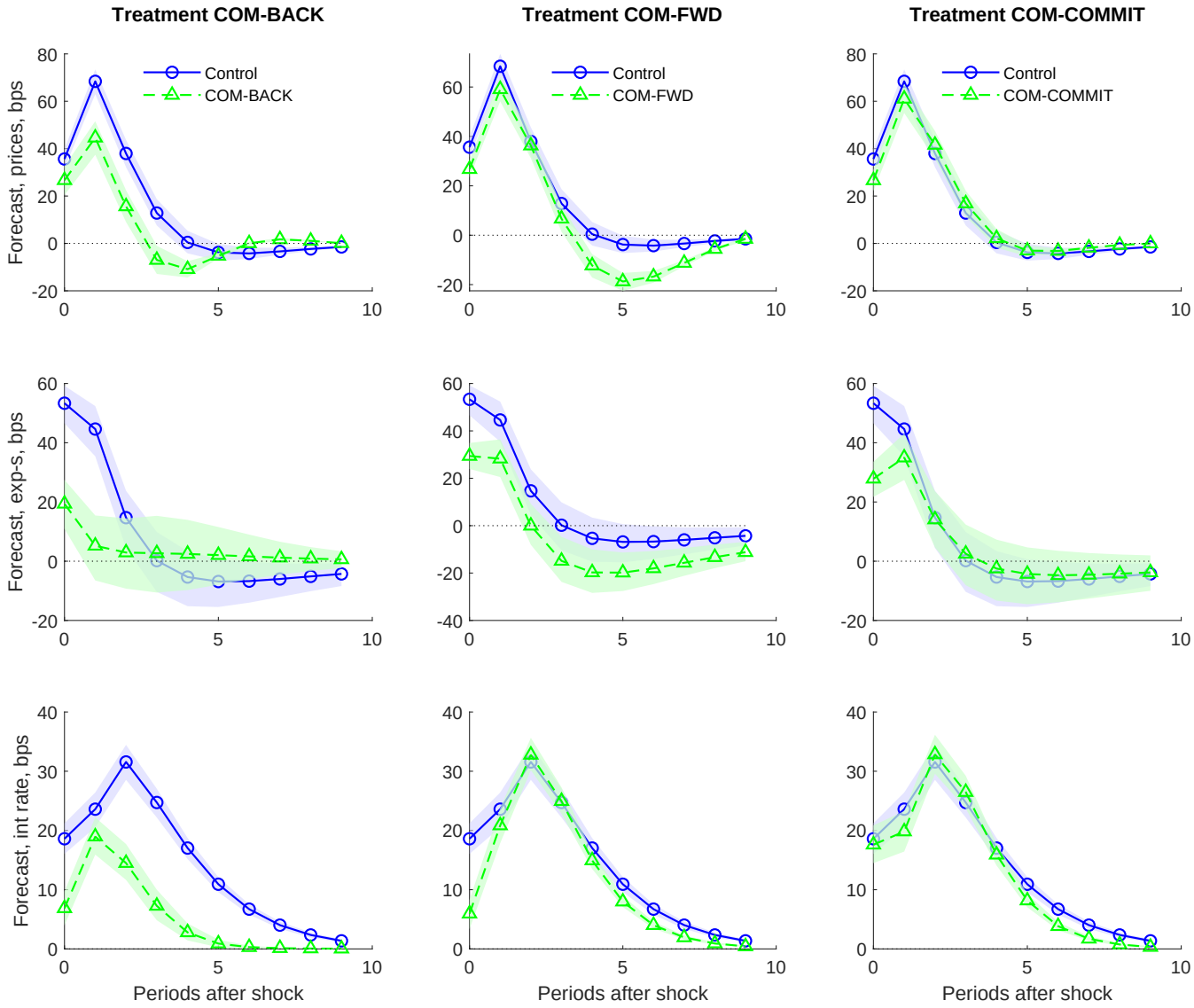
IRF, demand shock, control treatment



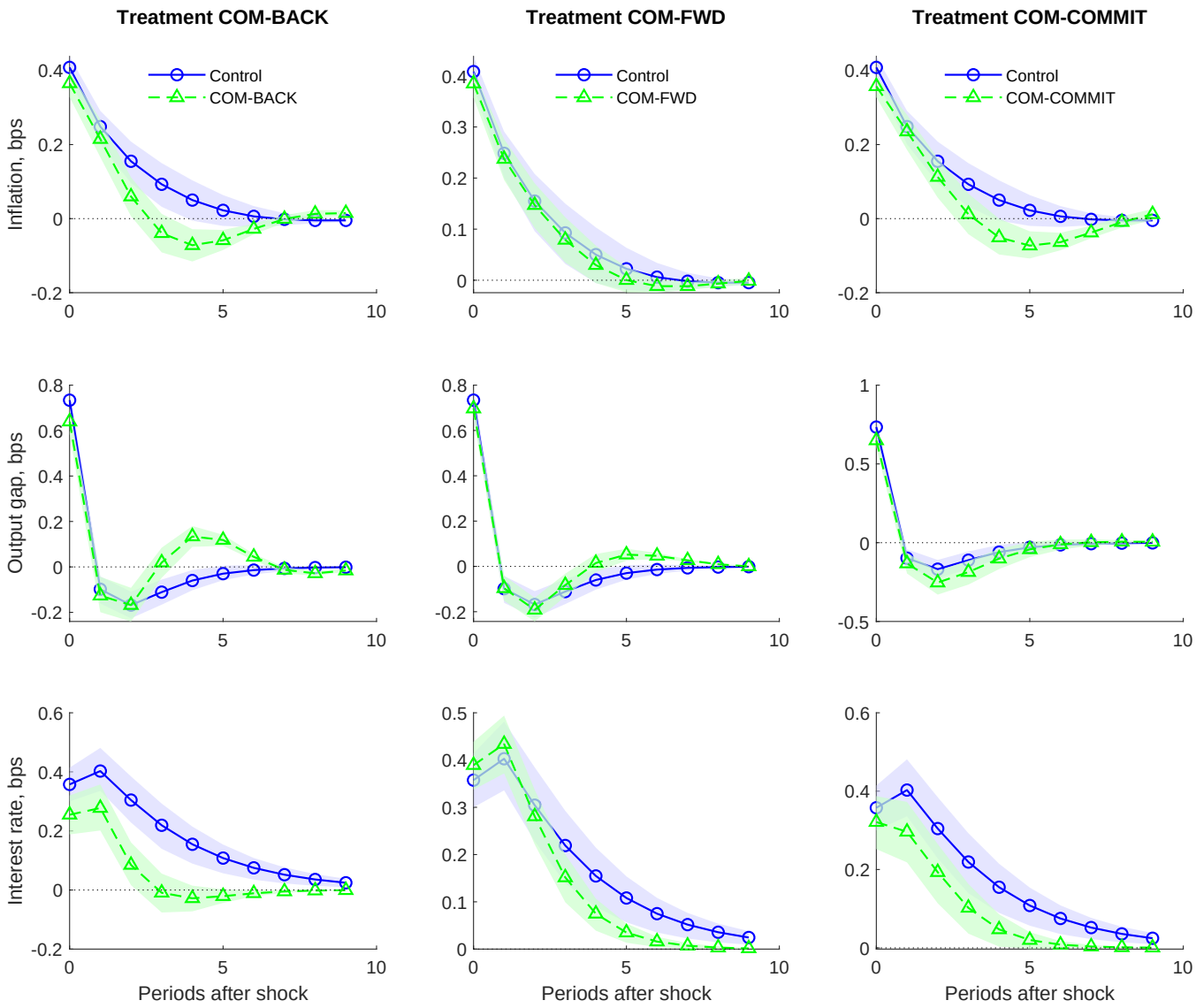
IRF expectations, demand shock, control treatment



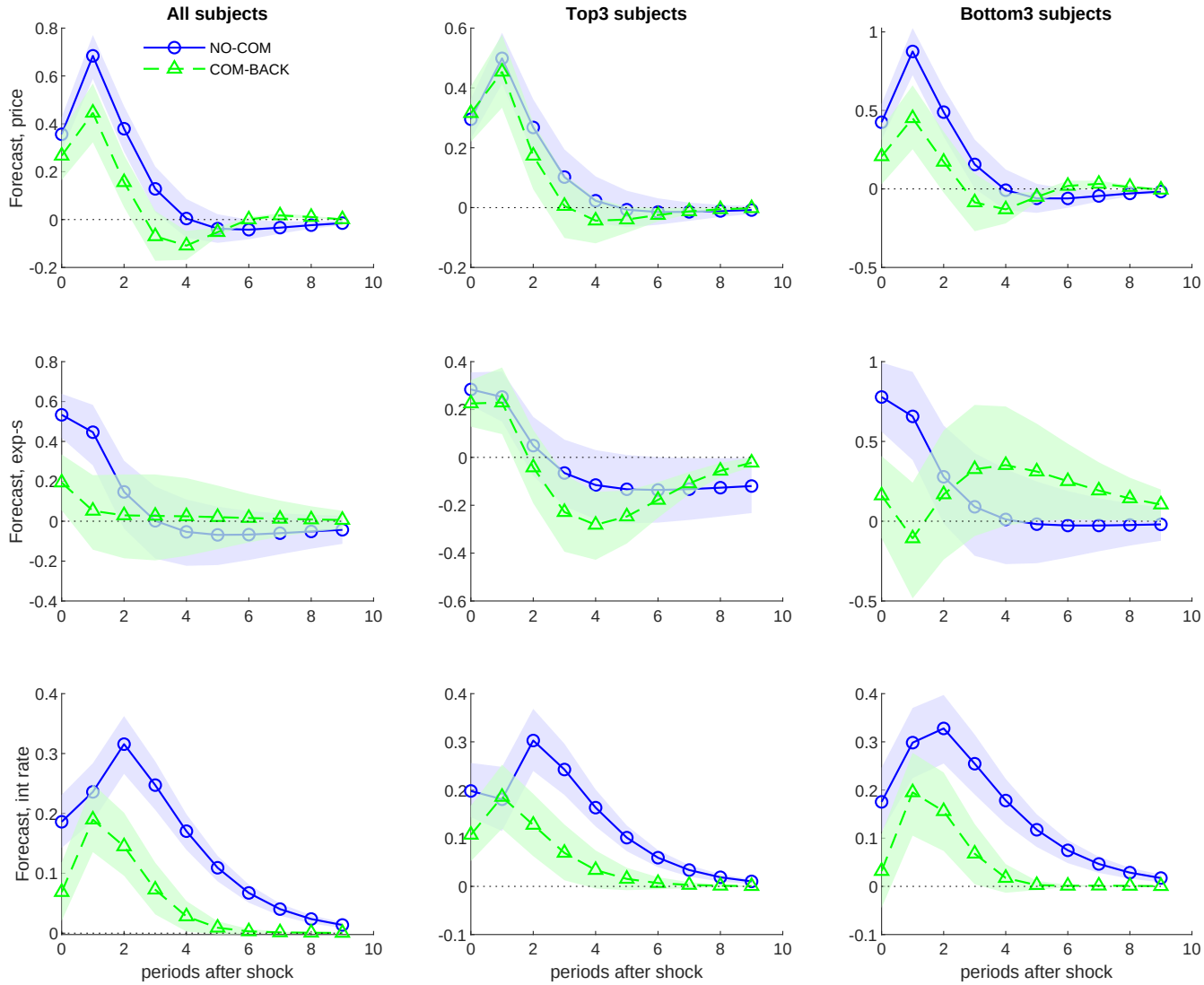
IRF expectations to demand shock, COM treatments



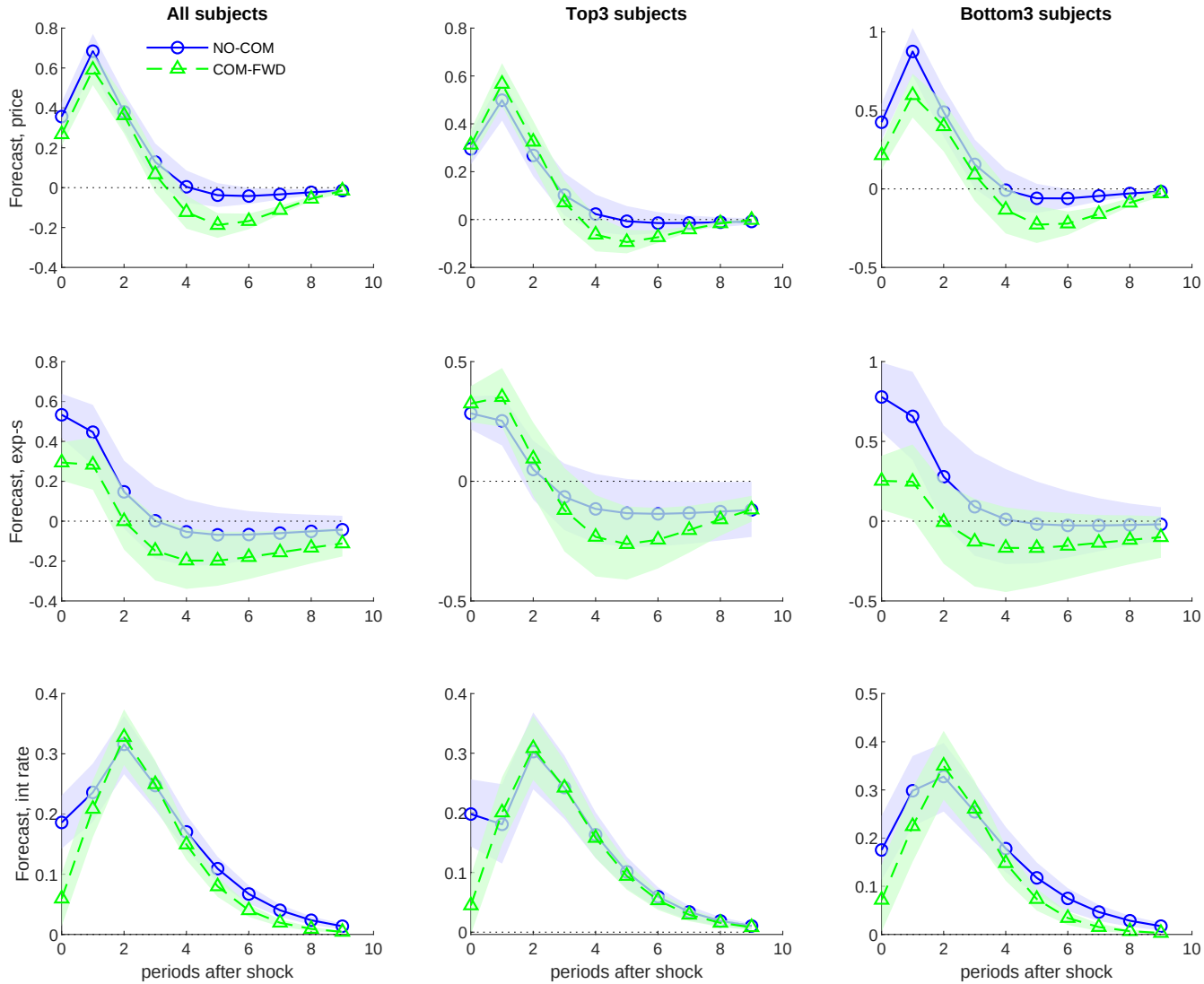
IRF aggregate to demand shock, COM treatments



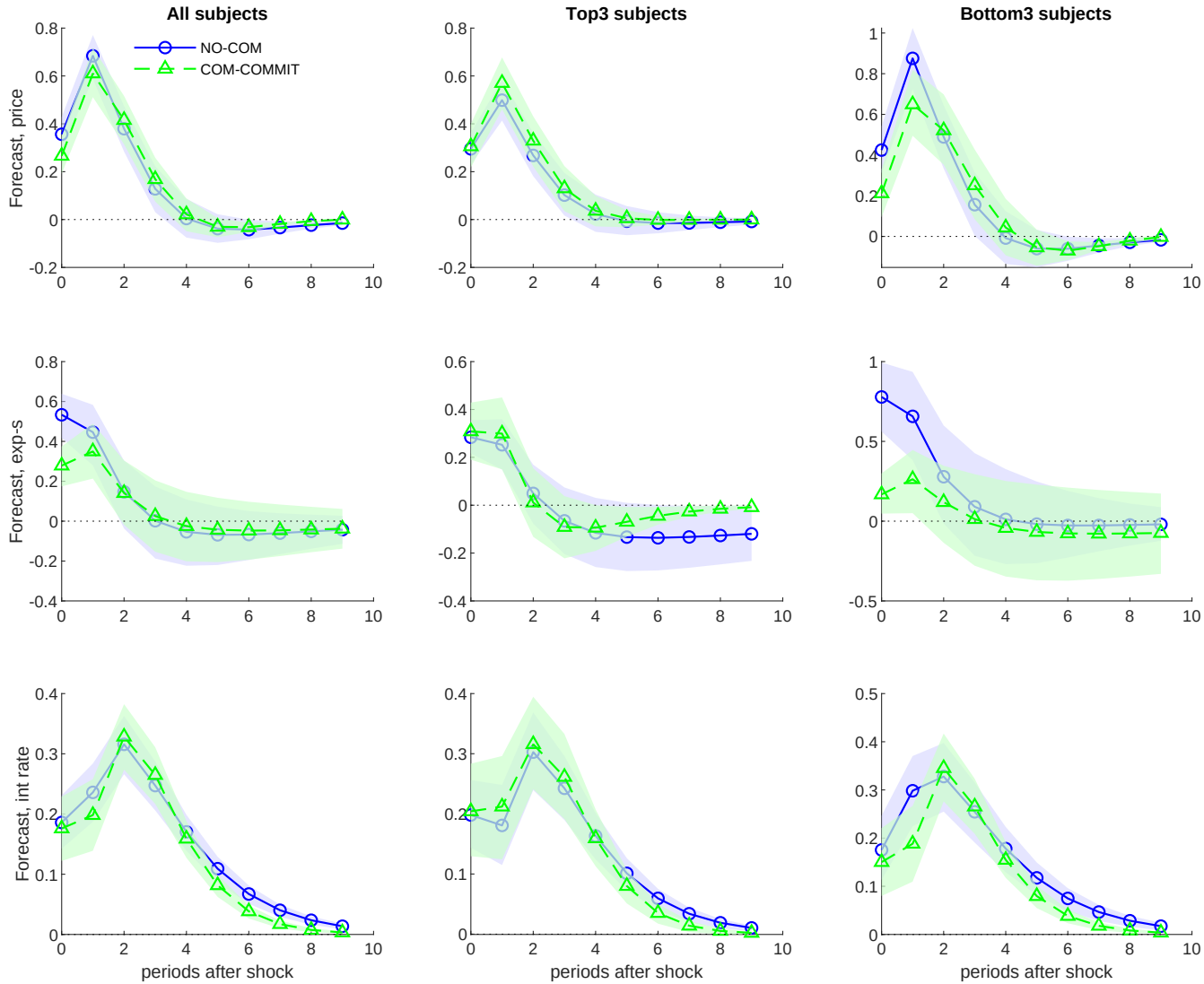
IRF expectations to demand shock, heterogeneity, COM-BACK



IRF expectations to demand shock, heterogeneity, COM-FWD



IRF expectations to demand shock, heterogeneity, COM-COMMIT



Anchoring of interest rate expectations

Why does COM-FWD and COM-COMMIT not work better to manage interest rate expectations?

- Mis-perceptions of interest rate
- Credibility concerns

Anchoring of interest rate expectations

	COM-BACK (1)	COM-BACK (2)	COM-FWD (3)	COM-COMMIT (4)
$P(Anchored_{i,t} = 1\|X)$				
$Anchored_{i,t-1}$	0.416***	0.399***	0.502***	2.152***
	(0.09)	(0.09)	(0.09)	(0.17)
$Period_t$	0.006**	0.002	-0.006**	0.004**
	(0.00)	(0.00)	(0.00)	(0.00)
$Top3_i$	0.048	-0.047	0.330**	-0.189
	(0.17)	(0.09)	(0.13)	(0.12)
$ExplosiveEpisode_{t-1}$	-0.130	-0.363**	0.086	-2.280***
	(0.19)	(0.16)	(0.19)	(0.65)
$NumPeriodsInactive_{t-1}$			-0.096***	-0.507***
			(0.03)	(0.05)
$NumPeriodsInactive_{t-1}$			0.024	0.444***
$\times ExplosiveEpisode_{t-1}$			(0.06)	(0.08)
$F.G.Horizon_t$				-0.091***
				(0.03)
$F.G.Horizon_t$				0.519***
$\times ExplosiveEpisode_{t-1}$				(0.18)
α	-1.035***	-0.374***	0.421**	-0.689***
	(0.24)	(0.14)	(0.19)	(0.25)
Perc. Anchoring				
Stable Periods	23.4%	41.3%	73.1%	41.9%
Explosive Episodes	13.3%	31.7%	63.7%	52.8%
N	1482	1482	2576	1182
χ^2	32.36	40.92	94.63	296.6

Summary

Simpler, more accessible central bank communication tends to be more effective in influencing participants' forecasts.

- Backward-looking communication benefits the less-informed forecasters
- Works through indirect mechanism of improving attention
- Coibion, Gorodnichenko, Kumar (2018): 'pierce veil of ignorance'
- Bholat, Broughton, Parker, Ter Meer and Walczak (2018) - visual relatable summaries work better to improve trust and comrepehension

Forward-looking types of communication less effective

- Consistent with existing evidence on qualitative communication (Kahn, 2007; Arifovic and Petersen, 2017)
- Effects of forward guidance mixed (Filardo and Hoffman, 2017).

Description of DGP to participants

$$\begin{aligned}\text{Excess spending of your household}_t = 0.99\ &\textbf{Forecast about your household's excess spending}\\ &\textbf{tomorrow}_t + 0.01\,\text{Median excess spending}_t\\ &+ 0.48\,\text{Median price change}_t - 0.99\,\text{Interest rate}_t\end{aligned}$$

$$\begin{aligned}\text{Price change of your firm}_t = 0.51\ &\textbf{Forecast about your firm's price change tomorrow}_t\\ &+ 0.4\,(\,\text{Median excess spending}_t + \text{Shock}_t)\\ &+ 0.3\,\text{Median price change}_t\end{aligned}$$

The central bank's objective is to keep aggregate price changes and excess spending as close to zero as possible.

- It will raise interest rates when the economy is booming (that is, there is a high median price change and median spending)
- It will decrease interest rate when the economy is in recession (that is, low median price change and excess spending)
- The interest rate will respond more aggressively to median price changes, and increase by more than 1% for a 1% increase in the median price.
- Occasionally the interest rate may stay unchanged.

Description of DGP to participants - continued

The households' desire to spend will depend on, among other things, a random economy-wide disturbance which we call "shocks". All households experience the same shock to their spending. Over hundreds of rounds, the mean shock will equal zero. In practice, the shocks will be positive or negative (or very rarely, zero!) from round to round and will range approximately within [–134,134] roughly 2/3 of the time, and within [–268,268] 95% of the time. The shocks may exceed –268 or 268 in magnitude, but such events are relatively rare. The shocks will evolve according to the following process:

$$\text{Shock}_t = 0.45\ \text{Shock}_{t-1} + \text{Random Component}_t$$

Shocks dissipate to 45% of their value after each period. As a shock dissipates, new random events occur that increase or decrease the shock. On average, these random components are equal to zero.

▸ Return