



Who's Afraid of the Zero Lower Bound?

Experimental Evidence on Expectation Formation and Monetary Policy Communication

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Our Paper in a Nutshell

Using an online macro-experiment, we investigate the following questions:

1. Are agents' expectations systematically different at the ZLB?
 2. What is the role of monetary policy communication/understanding for expectation formation at the ZLB?
- ⇒ Using different treatments (with different info sets) we can reveal the role of monetary policy communication/understanding in expectation formation.



Key Results

- ▶ Monetary policy communication (info about policy rate) leads to *lower* output and inflation expectations at the ZLB in the overall sample.
- ▶ This does not hold for people who *do not understand* what a liquidity trap is.
- ▶ For subjects with high general macroeconomics literacy, policy communication at the ZLB is without effect (/is redundant).
- ▶ Communication about the extent of the ZLB constraint has *on average* no different effect than simple interest rate information, but there are different *time effects*.



Related Literature: Monetary Policy Communication and Learning-to-Forecast Experiments at the ZLB

- ▶ Liquidity trap and forward-guidance at the ZLB (Krugman 1998, Eggertson Woodford, 2003)
- ▶ Reifschneider and Williams (2000), Coibion et al. (2012), Bernanke (2017), Kiley and Roberts (2017), Proaño and Lojak (2020,2021), Marinkov (2020): Shadow rate/ZLB policy gap as measure of current shortfall of monetary policy accomodation.

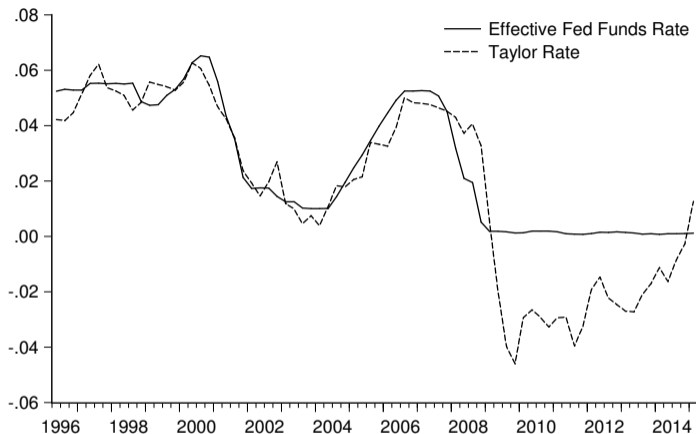


Figure: The U.S. effective federal funds rate, and the Taylor rate as computed by Bernanke (2015). Source: Proaño Lojak (2020, JEBO).



3. Experiment Setup



Experiment Setup

- ▶ Full online setup due to the COVID-19 pandemic
- ▶ Subjects are atomistic \implies **No interaction** whatsoever, and decisions have **no impact** on aggregate outcomes.
- ▶ Sole task: Compute **nowcasts** and **one-period-ahead forecasts** of output and inflation expectations.
- ▶ Alternative treatments vary in terms of the information available to the subjects.



Treatments

- ▶ Treatment 1 (T1): Expectation formation in normal and ZLB times **without nominal interest rate** information
- ▶ Treatment 2 (T2): Expectation formation in normal and ZLB times **with nominal interest rate** information
- ▶ Treatment 3 (T3): Expectation formation in normal and ZLB times **with nominal interest rate** information and **hypothetical Taylor interest rate if ZLB was/were not binding**



Sequence of Events

1. Provision of personal information
2. Preliminary Multiple-Choice questionnaire (to assess “macroeconomic illiteracy” in particular w.r.t. ZLB, incentivized)
3. Instructions
4. Participation in proper experiment (incentivized)



1. Subject Pool: Descriptive Statistics

Table: Descriptive Statistics (Total Nr.: 393 subjects)

	T1	T2	T3				
Treatment	136	124	133				
	Male	Female	Other				
Gender	233	156	4				
	None	BSc	BA	MSc	MA	PhD	
Title	58	89	37	74	29	98	
	Mean	Std. Dev.	Median	25 pct.	75 pct.	mix	max
Age	29	8	27	24	32	18	68
	Econ.	Close Econ.	Business	Nat. Sci.	Soc. Sci.	Hum.	Other
Field of study	236	23	18	42	22	29	23

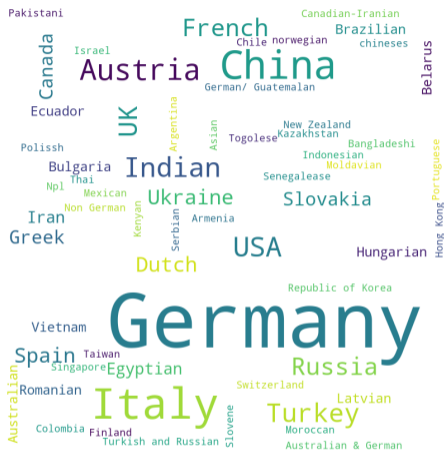


Figure: Subjects' nationalities



2. Preliminary Multiple-Choice Questionnaire

Before entering into the proper experiment, please choose the correct answer in the following multiple choice questions to demonstrate your knowledge of macroeconomics. For each question that you answer correctly you will earn 0.25 Euro. **Only one answer** is correct.

1. The primary objective of the Eurosystem is
 - a) to guarantee a close but below 2% average growth in economic activity in the euro area.
 - b) to maintain price stability in every single country of the euro area.
 - c) to maintain price stability in the euro area as a whole.
 - d) to keep interest rates low enough to boost aggregate investment.



2. Which function is **not** one of the three main functions of money
 - a) Medium of exchange.
 - b) Unit of account.
 - c) Speculation tool.
 - d) Store of value.
3. How does an increase in the money supply impact economic output within the economy?
 - a) It leads to lower interest rates which encourage additional borrowing and investment and lead to higher aggregate demand.
 - b) It leads to higher interest rates which encourage additional borrowing and investment and lead to higher aggregate demand.
 - c) It leads to lower interest rates which imply lower tax rates, which then lead to the creation of new jobs.
 - d) It leads to higher interest rates which are not tied to tax rates and would have no impact on the creation of new jobs.



4. The loan creation process by the commercial banking sector
 - a) is fully dependent on the development of the monetary base.
 - b) is perfectly described by the causality implied in the money multiplier framework.
 - c) is unrelated to the financial regulatory framework.
 - d) is indirectly controlled through the refinancing conditions set by the central bank.

5. The Taylor rule
 - a) describes how the long-term interest rate reacts to the current inflation rate.
 - b) describes how monetary policy should set the monetary base optimally.
 - c) describes how the short-term interest rate is related to deviations of price inflation and output from their respective target levels.
 - d) says that the nominal interest rate should always be set to zero.



6. The ECB began with the implementation of unconventional monetary policy measures in 2008
 - a) because the government debt levels in the euro area were too high and countercyclical fiscal policy is no longer possible.
 - b) conventional monetary policy was no longer effective due to the zero-lower-bound on nominal interest rates.
 - c) the monetary base in the euro area had reached already excessively high levels.
 - d) the persistent inflation differentials among euro area members made conventional interest rate policy inefficient.
7. Price inflation and aggregate output are assumed often to be
 - a) positively linked as described by the Philipps Curve.
 - b) negatively related.
 - c) not related to each other in a systematic manner.
 - d) are related to each other only when the unemployment rate is zero.



8. When aggregate output increases, the unemployment rate tends to
- a) increase.
 - b) decrease.
 - c) remain always constant.
 - d) decrease only if the unemployment rate was above 10%.
9. An economy is in a liquidity trap,
- a) when there is too much money in the economy and prices are increasing.
 - b) when there is too much money in the economy and prices are decreasing.
 - c) when the nominal interest rate cannot decrease anymore and conventional monetary policy is no longer available.
 - d) when, because of the excessive liquidity offered by banks to the private sector, bankruptcy rates are increasing.



10. The output gap is usually defined as

- a) the percent deviation of the actual aggregate production of an economy from the aggregate production of the rest of the world.
- b) the percent deviation of the actual aggregate production of an economy from the level observed during the most recent recession.
- c) the percent deviation of the actual aggregate production of an economy from the level observed during the most recent boom.
- d) the percent deviation of the actual aggregate production of an economy from the potential level which would be achieved if all factors of production would be used efficiently.



3. The Subject's Tasks

1. the numerical value of aggregate output *in the current period*, i.e. to compute a *nowcast of Y_t* to be denoted as $Y_{t|t}^e$,
2. the numerical value of aggregate output *for the next period*, i.e. the *one-period ahead forecast $Y_{t+1|t}^e$* ,
3. the numerical value of aggregate price inflation *in the current period*, i.e. a *nowcast of π_t* to be denoted $\pi_{t|t}^e$,
4. the numerical value of the aggregate price inflation *for the next period*, i.e. the *one-period ahead forecast $\pi_{t+1|t}^e$* .

The subjects' now- and forecasts do not have any impact on the economy's dynamics!



The Data Generating Process (DGP)

The DGP (controlled by the experimenters) is given by a standard New Keynesian framework (with E_t being the RE operator)

$$y_t = E_t y_{t+1} - \sigma(i_t - E_t \pi_{t+1} - r_t^n) + \varepsilon_t^y \quad (1)$$

$$\pi_t = E_t \pi_{t+1} + \kappa y_t + \varepsilon_t^\pi \quad (2)$$

$$\varepsilon_t^y = \rho \varepsilon_{t-1}^y + \nu_t^y \quad (3)$$

with ε_t^π and ε_t^i white noise processes.

When the ZLB is not binding, the policy rate is determined by a standard Taylor rule:

$$i_t = i_t^\top = i^* + \phi_\pi(\pi_t - \pi^*) + \phi_y y_t + \varepsilon_t^i, \quad \forall i_t \geq 0. \quad (4)$$



ZLB Periods

In each session, two “recessionary” episodes were included to generate recessions that were

- ▶ severe enough i.e. the ZLB became binding (about -4% output gap)
- ▶ long-enough so that agents could observe and react to them (about 4-6 periods)
- ▶ implemented by student assistant according to predefined rules (and quality-controlled by us)



Figure: Screenshot (Treatment 3: Expectation formation in normal and ZLB times with nominal interest rate information and hypothetical interest rate if ZLB was/were not binding)



Econometric Analysis

$$\begin{aligned}
 E_{i,t}x_t &= \alpha_i + \beta_1 ZLB_{i,t} + \beta_2 ZLB_{i,t-1}T1_i + \beta_3 ZLB_{i,t}T3_i + \beta_4 E_{i,t-1}x_{t-1} \\
 &+ \beta_5 E_{i,t-1}x_t + \beta_6 \pi_{i,t-1} + \beta_6 \pi_{i,t-2} + \beta_8 y_{i,t-1} + \beta_9 y_{i,t-2} + \gamma t + e_{i,t}. \quad (5)
 \end{aligned}$$

$$\begin{aligned}
 E_{i,t}x_{t+1} &= \alpha_i + \beta_1 ZLB_{i,t} + \beta_2 ZLB_{i,t}T1_i + \beta_3 ZLB_{i,t}T3_i + \beta_4 E_{i,t-1}x_{t-1} \\
 &+ \beta_5 E_{i,t-1}x_t + \beta_6 \pi_{i,t-1} + \beta_6 \pi_{i,t-2} + \beta_8 y_{i,t-1} + \beta_9 y_{i,t-2} + \gamma t + e_{i,t} \quad (6)
 \end{aligned}$$



Econometric Analysis: MIS

$$\begin{aligned}
 E_{i,t}x_t &= \alpha_i + \beta_1 ZLB_{i,t} + \beta_2 ZLB_{i,t-1} MIS_i + \beta_3 ZLB_{i,t} T1_i + \beta_4 ZLB_{i,t} T1_i MIS_i \\
 &+ \beta_5 E_{i,t-1}x_{t-1} + \beta_6 E_{i,t-1}x_t + \beta_7 \pi_{i,t-1} + \beta_8 \pi_{i,t-2} + \beta_9 y_{i,t-1} \\
 &+ \beta_{10} y_{i,t-2} + \gamma t + e_{i,t}.
 \end{aligned} \tag{7}$$

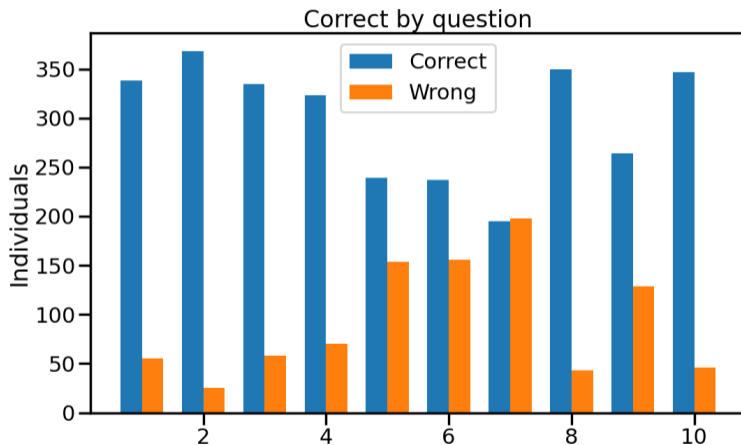
$$\begin{aligned}
 E_{i,t}x_{t+1} &= \alpha_i + \beta_1 ZLB_{i,t} + \beta_2 ZLB_{i,t} MIS_i + \beta_3 ZLB_{i,t} T1_i + \beta_4 ZLB_{i,t} T1_i MIS_i \\
 &+ \beta_5 E_{i,t-1}x_{t-1} + \beta_6 E_{i,t-1}x_t + \beta_7 \pi_{i,t-1} + \beta_8 \pi_{i,t-2} + \beta_9 y_{i,t-1} \\
 &+ \beta_{10} y_{i,t-2} + \gamma t + e_{i,t}.
 \end{aligned} \tag{8}$$



4. Results (So Far)

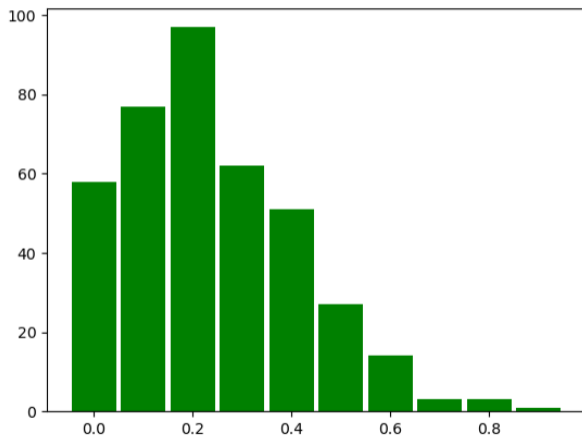


Preliminary Multiple Choice Questionnaire





Macroeconomic Illiteracy Score (MIS)





Inflation: Now- and Forecasts (Baseline: T2)

	Full sample		Liq. trap question correct		Liq. trap question wrong	
	E(t)pi(t)	E(t)pi(t+1)	E(t)pi(t)	E(t)pi(t+1)	E(t)pi(t)	E(t)pi(t+1)
Intercept	0.158*** (0.036)	0.244*** (0.048)	0.142*** (0.032)	0.226*** (0.044)	0.196*** (0.050)	0.287*** (0.067)
ZLB	-0.129** (0.052)	-0.101 (0.068)	-0.103** (0.051)	-0.087 (0.070)	-0.186*** (0.064)	-0.116 (0.080)
ZLB*T1	0.099*** (0.025)	0.114*** (0.023)	0.136*** (0.025)	0.172*** (0.026)	0.003 (0.041)	-0.048 (0.040)
ZLB*T3	0.025 (0.021)	0.021 (0.033)	-0.010 (0.017)	0.002 (0.037)	0.074 (0.051)	0.020 (0.066)
E(t-1)pi(t-1)	0.164*** (0.042)	0.089*** (0.023)	0.178*** (0.047)	0.120*** (0.024)	0.136*** (0.050)	0.031 (0.034)
E(t-1)pi(t)	0.164*** (0.025)	0.271*** (0.021)	0.163*** (0.032)	0.272*** (0.019)	0.165*** (0.027)	0.267*** (0.031)
pi(t-1)	0.891*** (0.015)	0.887*** (0.017)	0.889*** (0.016)	0.874*** (0.019)	0.893*** (0.024)	0.915*** (0.025)
pi(t-2)	-0.344*** (0.029)	-0.417*** (0.027)	-0.338*** (0.028)	-0.424*** (0.031)	-0.354*** (0.045)	-0.405*** (0.036)
y(t-1)	0.056*** (0.019)	0.143*** (0.022)	0.056*** (0.016)	0.163*** (0.020)	0.056* (0.034)	0.102*** (0.033)
y(t-2)	0.017 (0.016)	-0.042* (0.022)	0.010 (0.017)	-0.055** (0.025)	0.031 (0.027)	-0.017 (0.028)
t	-0.003*** (0.001)	-0.004*** (0.002)	-0.002** (0.001)	-0.003** (0.002)	-0.005*** (0.001)	-0.006*** (0.002)
Obs	17534	17475	11812	11783	5722	5692
R ²	0.807	0.746	0.818	0.766	0.787	0.707
F-stat	7170.615	5003.755	5173.470	3769.144	2067.084	1341.081

* $p < .1$, ** $p < .05$, *** $p < .01$. Panel estimation with fixed effects and Driscoll-Kraay standard errors.

- ▶ Trend-chasing
- ▶ Expectations persistence (now- and forecasts)
- ▶ Time effect
- ▶ Higher expectations in T1 vs. T2/T3
- ▶ Right-Q9 effect in T1



Taking Stock

- ▶ People at the ZLB are more optimistic if they *don't* observe the nominal interest rate (higher expectations in T1 vs. T2/T3)
- ▶ This effect is larger for people who know about the liquidity trap (Q9 right)
- ▶ No significant difference at the ZLB of additionally observing the theoretical Taylor rate (ZLB*T3 insignificant)
- ▶ Subjects without knowledge about the liquidity trap (Q9 wrong), do not have significantly different expectations with than without interest rate information (no treatment effects of ZLB*T3 observable).



Macroeconomic Illiteracy Score

	Full sample		Liq. trap question correct		Liq. trap question wrong	
	E(t)pi(t)	E(t)pi(t+1)	E(t)pi(t)	E(t)pi(t+1)	E(t)pi(t)	E(t)pi(t+1)
Intercept	0.159*** (0.037)	0.245*** (0.048)	0.143*** (0.032)	0.227*** (0.043)	0.196*** (0.050)	0.288*** (0.067)
ZLB	-0.180*** (0.059)	-0.180** (0.077)	-0.155*** (0.058)	-0.134* (0.078)	-0.195** (0.081)	-0.218* (0.115)
ZLB*MIS	0.261*** (0.063)	0.371*** (0.079)	0.261*** (0.070)	0.258*** (0.095)	0.160 (0.101)	0.327* (0.194)
ZLB*T1	0.101*** (0.029)	0.146*** (0.032)	-0.015 (0.033)	0.041 (0.042)	0.113** (0.052)	0.119 (0.074)
ZLB*T1*MIS	-0.040 (0.103)	-0.151 (0.128)	0.983*** (0.193)	0.835*** (0.227)	-0.447*** (0.140)	-0.514** (0.238)
E(t-1)pi(t-1)	0.164*** (0.042)	0.088*** (0.023)	0.173*** (0.047)	0.116*** (0.024)	0.136*** (0.050)	0.031 (0.034)
E(t-1)pi(t)	0.163*** (0.025)	0.270*** (0.021)	0.161*** (0.032)	0.270*** (0.019)	0.164*** (0.027)	0.266*** (0.030)
pi(t-1)	0.891*** (0.015)	0.887*** (0.017)	0.889*** (0.016)	0.873*** (0.019)	0.892*** (0.024)	0.914*** (0.025)
pi(t-2)	-0.343*** (0.029)	-0.416*** (0.027)	-0.333*** (0.028)	-0.420*** (0.032)	-0.354*** (0.045)	-0.404*** (0.036)
y(t-1)	0.056*** (0.019)	0.143*** (0.022)	0.057*** (0.016)	0.164*** (0.020)	0.057* (0.034)	0.102*** (0.033)
y(t-2)	0.017 (0.016)	-0.042* (0.022)	0.011 (0.017)	-0.053** (0.025)	0.032 (0.027)	-0.017 (0.028)
t	-0.003*** (0.001)	-0.004*** (0.002)	-0.003** (0.001)	-0.003** (0.002)	-0.005*** (0.001)	-0.006*** (0.002)
Obs	17534	17475	11812	11783	5722	5692
R ²	0.807	0.746	0.819	0.767	0.787	0.707
F-stat	6525.123	4555.121	4731.072	3438.828	1879.326	1220.047

* $p < .1$, ** $p < .05$, *** $p < .01$. Panel estimation with fixed effects and Driscoll-Kraay standard errors.

- ▶ T1 vs. T2/T3 perspective
- ▶ ZLB*T1 (β_3) applies for MIS = 0
- ▶ ZLB*T1*MIS (β_4): marginal effect of MIS
- ▶ For MIS = 0.3:
 $\beta_3 + \beta_4 \cdot 0.3$



Who's Afraid of the ZLB?

Significant but ambiguous value of interest rate info (T2/T3):

- ▶ Observing a ZLB leads in general to lower expectations
- ▶ Higher macro illiteracy leads to more optimistic views
- ▶ Interest rate info at the ZLB leads to lower inflation expectations (ZLB*T1)
- ▶ unless they are “macro-experts” (no difference between T1 and T2/T3)
- ▶ For “non-experts” who however understand the ZLB (Q9 right), knowing the interest rate in general makes them less optimistic, . . .
- ▶ People who do not understand the ZLB (Q9 wrong) have lower expectations when they do not have interest rate info (different mental model?)



Policy Implications

- ▶ “15% of the US Americans believe that the Federal Reserve is a National Park” - Twitter ;)
- ▶ Understanding of economics and monetary policy may vary significantly across the population (inflation debate!)
- ▶ Forward-guidance and CB communication may not be as effective because people may not understand their functioning.
- ▶ On the other hand: “wrong” optimism may be just what is needed!



Thank you for your attention



Appendix

LtFE



- ▶ Learning to forecast laboratory experiments (LtFE, Marimon Sunder 1993) have become increasingly popular, see e.g. Hommes et al. (2005), Bao and Ding (2016), Bao et al. (2013), Assenza et al. (2011), Anufriev et al. (2013).
- ▶ LtFE with ZLB: Arifovic and Petersen (2017), Hommes et al. (2019), Kryvtsov and Petersen (2019, 2021), Ahrens et al. (2021).

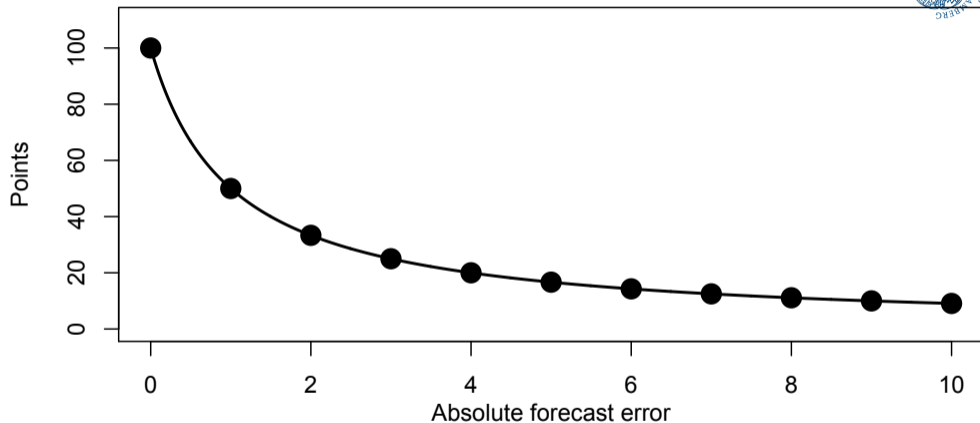


Figure: Relation between forecast errors and the points earned.



Forecast Errors (Coibion Gorodnichenko, 2015)

	Full sample		Liq. trap question correct		Liq. trap question wrong	
	$\pi(t) - E(t)\pi(t)$	$\pi(t) - E(t)\pi(t)$	$\pi(t) - E(t)\pi(t)$	$\pi(t) - E(t)\pi(t)$	$\pi(t) - E(t)\pi(t)$	$\pi(t) - E(t)\pi(t)$
$E(t)\pi(t) - E(t-1)\pi(t)$	-0.350*** (0.034)	-0.351*** (0.039)	-0.350*** (0.036)	-0.350*** (0.041)	-0.350*** (0.032)	-0.351*** (0.036)
Intercept	-0.392*** (0.133)	-0.388*** (0.107)	-0.393*** (0.134)	-0.397*** (0.108)	-0.390*** (0.133)	-0.370*** (0.106)
ZLB		0.131 (0.192)		0.146 (0.194)		0.005 (0.200)
ZLB*MIS		-0.391*** (0.116)		-0.320*** (0.123)		-0.181 (0.221)
ZLB*T1		-0.110*** (0.034)		0.044* (0.025)		-0.019 (0.103)
ZLB*T1*MIS		-0.138 (0.146)		-1.680*** (0.204)		0.274 (0.314)
Obs	17555	17555	11829	11829	5726	5726
R ²	0.152	0.153	0.148	0.153	0.159	0.160
F-stat	3067.146	619.973	2002.695	417.341	1060.754	212.683

* $p < .1$, ** $p < .05$, *** $p < .01$. Panel estimation with fixed effects and Driscoll-Kraay standard errors.



Forecast Errors: Take-Aways

- ▶ General rejection of rational expectations hypothesis
- ▶ Upward revisions lead to upward-biased expectations
- ▶ People without interest info (T1) have more positive forecast errors (higher expectations) at the ZLB
- ▶ Right-Q9-people have higher expectations in T1
- ▶ Wrong-Q9-people do not have statistically significant forecast errors between T1 vs. T2/T3.



Dynamic Treatment Effects

	Full sample		Liq. trap question correct		Liq. trap question wrong	
	E(t)pi(t)	E(t)pi(t+1)	E(t)pi(t)	E(t)pi(t+1)	E(t)pi(t)	E(t)pi(t+1)
Intercept	0.096*** (0.032)	0.198*** (0.044)	0.093*** (0.032)	0.186*** (0.042)	0.100** (0.042)	0.222*** (0.062)
ZLB	-0.043 (0.062)	0.002 (0.077)	-0.018 (0.061)	0.019 (0.071)	-0.094 (0.086)	-0.018 (0.123)
ZLB*T1	0.093** (0.036)	0.076*** (0.028)	0.130*** (0.038)	0.131*** (0.031)	-0.005 (0.057)	-0.073 (0.056)
ZLB*T3	0.045 (0.037)	-0.047 (0.041)	-0.049** (0.025)	-0.109*** (0.042)	0.181** (0.087)	0.025 (0.105)
E(t-1)pi(t-1)	0.163*** (0.042)	0.088*** (0.023)	0.177*** (0.047)	0.120*** (0.024)	0.133*** (0.049)	0.030 (0.034)
E(t-1)pi(t)	0.164*** (0.025)	0.271*** (0.022)	0.163*** (0.032)	0.271*** (0.019)	0.165*** (0.027)	0.267*** (0.031)
pi(t-1)	0.893*** (0.015)	0.889*** (0.016)	0.891*** (0.016)	0.875*** (0.018)	0.896*** (0.022)	0.917*** (0.026)
pi(t-2)	-0.339*** (0.027)	-0.414*** (0.025)	-0.334*** (0.026)	-0.421*** (0.030)	-0.348*** (0.042)	-0.401*** (0.035)
y(t-1)	0.055*** (0.017)	0.142*** (0.021)	0.055*** (0.015)	0.162*** (0.019)	0.055* (0.031)	0.100*** (0.032)
y(t-2)	0.014 (0.018)	-0.044* (0.024)	0.007 (0.018)	-0.057** (0.026)	0.027 (0.029)	-0.020 (0.030)
tt	-0.001* (0.001)	-0.003** (0.001)	-0.001 (0.001)	-0.002* (0.001)	-0.002** (0.001)	-0.004*** (0.002)
zlb	-0.003** (0.001)	-0.004** (0.002)	-0.003** (0.001)	-0.004** (0.002)	-0.002 (0.002)	-0.003 (0.003)
zlbT3t	-0.001 (0.001)	0.003 (0.002)	0.002** (0.001)	0.005*** (0.001)	-0.005* (0.003)	-0.000 (0.004)
zlbT1t	0.000 (0.001)	0.002* (0.001)	0.000 (0.001)	0.002 (0.001)	0.000 (0.002)	0.001 (0.002)
Obs	17534	17475	11812	11783	5722	5692
R ²	0.807	0.746	0.818	0.766	0.788	0.707
F-stat	5518.733	3850.383	3980.709	2901.343	1593.329	1031.565

* $p < .1$, ** $p < .05$, *** $p < .01$. Panel estimation with fixed effects and Driscoll-Kraay standard errors.



Dynamic Treatment Effects: Take-Aways

- ▶ Negative time effect during ZLB periods
- ▶ ... driven by T2 treatment
- ▶ T1 treatment not significant
- ▶ In words: people in T2 become more pessimistic as experiment progresses, while
- ▶ T3 subjects become more optimistic
- ▶ net effect over all treatments is negative.



Output: Now- and Forecasts (Baseline: T2)

	Full sample		Liq. trap question correct		Liq. trap question wrong	
	E(t)y(t)	E(t)y(t+1)	E(t)y(t)	E(t)y(t+1)	E(t)y(t)	E(t)y(t+1)
Intercept	0.086*** (0.028)	0.141*** (0.031)	0.077*** (0.029)	0.130*** (0.031)	0.109*** (0.034)	0.165*** (0.040)
ZLB	-0.104*** (0.039)	-0.066 (0.057)	-0.082** (0.038)	-0.061 (0.067)	-0.152*** (0.051)	-0.060 (0.054)
ZLB*T1	0.129*** (0.016)	0.095*** (0.019)	0.156*** (0.021)	0.146*** (0.024)	0.045* (0.027)	-0.051 (0.039)
ZLB*T3	0.021 (0.014)	0.012 (0.023)	-0.002 (0.023)	-0.024 (0.036)	0.048 (0.045)	0.034 (0.048)
E(t-1)y(t-1)	0.176*** (0.052)	0.071** (0.033)	0.229*** (0.062)	0.070** (0.029)	0.077 (0.068)	0.071 (0.064)
E(t-1)y(t)	0.173*** (0.024)	0.299*** (0.024)	0.161*** (0.029)	0.321*** (0.028)	0.190*** (0.036)	0.250*** (0.032)
y(t-1)	0.870*** (0.020)	0.917*** (0.020)	0.867*** (0.016)	0.925*** (0.019)	0.877*** (0.038)	0.898*** (0.032)
y(t-2)	-0.244*** (0.037)	-0.335*** (0.034)	-0.283*** (0.042)	-0.352*** (0.036)	-0.164*** (0.045)	-0.294*** (0.045)
pi(t-1)	0.048*** (0.010)	0.080*** (0.012)	0.056*** (0.010)	0.073*** (0.013)	0.032 (0.019)	0.093*** (0.019)
pi(t-2)	-0.070*** (0.012)	-0.103*** (0.018)	-0.064*** (0.012)	-0.093*** (0.020)	-0.084*** (0.017)	-0.122*** (0.023)
t	-0.002*** (0.001)	-0.003*** (0.001)	-0.002** (0.001)	-0.003** (0.001)	-0.004*** (0.001)	-0.005*** (0.001)
Obs	17568	17511	11863	11832	5705	5679
R ²	0.831	0.792	0.840	0.804	0.816	0.770
F-stat	8464.925	6530.133	6093.573	4728.897	2460.734	1859.553

* $p < .1$, ** $p < .05$, *** $p < .01$. Panel estimation with fixed effects and Driscoll-Kraay standard errors.



Output: Now- and Forecasts - MIS

	Full sample		Liq. trap question correct		Liq. trap question wrong	
	E(t)y(t)	E(t)y(t+1)	E(t)y(t)	E(t)y(t+1)	E(t)y(t)	E(t)y(t+1)
Intercept	0.087*** (0.028)	0.142*** (0.032)	0.079*** (0.029)	0.132*** (0.031)	0.109*** (0.034)	0.166*** (0.040)
ZLB	-0.148*** (0.041)	-0.150** (0.065)	-0.122*** (0.038)	-0.098 (0.069)	-0.166** (0.067)	-0.220** (0.087)
ZLB*MIS	0.226*** (0.057)	0.375*** (0.080)	0.218*** (0.061)	0.148* (0.082)	0.124 (0.113)	0.513*** (0.148)
ZLB*T1	0.061*** (0.021)	0.085*** (0.025)	-0.081*** (0.026)	-0.071** (0.030)	0.167*** (0.046)	0.209*** (0.065)
ZLB*T1*MIS	0.283*** (0.079)	0.053 (0.091)	1.448*** (0.179)	1.376*** (0.248)	-0.437*** (0.158)	-0.806*** (0.185)
E(t-1)y(t-1)	0.175*** (0.051)	0.070** (0.032)	0.217*** (0.060)	0.059** (0.028)	0.077 (0.069)	0.073 (0.065)
E(t-1)y(t)	0.171*** (0.025)	0.296*** (0.024)	0.156*** (0.029)	0.317*** (0.027)	0.188*** (0.036)	0.246*** (0.032)
y(t-1)	0.870*** (0.020)	0.917*** (0.020)	0.868*** (0.016)	0.927*** (0.019)	0.878*** (0.038)	0.899*** (0.032)
y(t-2)	-0.240*** (0.037)	-0.331*** (0.033)	-0.266*** (0.041)	-0.337*** (0.035)	-0.163*** (0.045)	-0.291*** (0.044)
pi(t-1)	0.048*** (0.010)	0.080*** (0.012)	0.055*** (0.010)	0.072*** (0.013)	0.031 (0.019)	0.092*** (0.019)
pi(t-2)	-0.070*** (0.012)	-0.103*** (0.018)	-0.064*** (0.013)	-0.094*** (0.020)	-0.084*** (0.017)	-0.122*** (0.023)
t	-0.002*** (0.001)	-0.003*** (0.001)	-0.002** (0.001)	-0.003** (0.001)	-0.004*** (0.001)	-0.005*** (0.001)
Obs	17568	17511	11863	11832	5705	5679
R ²	0.832	0.793	0.842	0.805	0.816	0.771
F-stat	7716.244	5953.638	5618.858	4339.541	2238.303	1695.838

* $p < .1$, ** $p < .05$, *** $p < .01$. Panel estimation with fixed effects and Driscoll-Kraay standard errors.



Forecast Errors: Output

	Full sample		Liq. trap question correct		Liq. trap question wrong	
	$y(t)-E(t)y(t)$	$y(t)-E(t)y(t)$	$y(t)-E(t)y(t)$	$y(t)-E(t)y(t)$	$y(t)-E(t)y(t)$	$y(t)-E(t)y(t)$
$E(t)y(t)-E(t-1)y(t)$	-0.352*** (0.042)	-0.354*** (0.048)	-0.349*** (0.045)	-0.351*** (0.050)	-0.357*** (0.040)	-0.361*** (0.045)
Intercept	-0.167 (0.128)	-0.109* (0.063)	-0.165 (0.128)	-0.115* (0.063)	-0.173 (0.128)	-0.099 (0.064)
ZLB		0.041 (0.186)		0.047 (0.189)		-0.050 (0.186)
ZLB*MIS		-0.379*** (0.093)		-0.264** (0.116)		-0.267 (0.169)
ZLB*T1		-0.049 (0.038)		0.163*** (0.033)		-0.116 (0.108)
ZLB*T1*MIS		-0.487*** (0.111)		-2.388*** (0.275)		0.463 (0.331)
Obs	17600	17600	11887	11887	5713	5713
R ²	0.136	0.141	0.131	0.142	0.148	0.151
F-stat	2719.325	563.632	1753.713	385.087	967.089	198.127

* $p < .1$, ** $p < .05$, *** $p < .01$. Panel estimation with fixed effects and Driscoll-Kraay standard errors.



Dynamic Treatment Effects: Output

	Full sample		Liq. trap question correct		Liq. trap question wrong	
	E(t)y(t)	E(t)y(t+1)	E(t)y(t)	E(t)y(t+1)	E(t)y(t)	E(t)y(t+1)
Intercept	0.049*** (0.019)	0.097*** (0.022)	0.053** (0.024)	0.097*** (0.023)	0.042** (0.020)	0.097*** (0.037)
ZLB	-0.046 (0.048)	-0.036 (0.060)	-0.027 (0.046)	0.036 (0.059)	-0.092 (0.073)	-0.012 (0.098)
ZLB*T1	0.115*** (0.038)	0.173*** (0.036)	0.166*** (0.037)	0.130*** (0.041)	0.045 (0.038)	0.018 (0.052)
ZLB*T3	0.019 (0.034)	0.033 (0.048)	-0.082*** (0.025)	-0.163*** (0.036)	0.127* (0.074)	0.098 (0.074)
E(t-1)y(t-1)	0.176*** (0.052)	0.071** (0.033)	0.229*** (0.062)	0.069** (0.029)	0.075 (0.068)	0.071 (0.064)
E(t-1)y(t)	0.173*** (0.024)	0.298*** (0.024)	0.159*** (0.029)	0.319*** (0.028)	0.190*** (0.036)	0.249*** (0.032)
y(t-1)	0.869*** (0.019)	0.916*** (0.019)	0.866*** (0.016)	0.924*** (0.018)	0.876*** (0.036)	0.897*** (0.031)
y(t-2)	-0.245*** (0.038)	-0.336*** (0.035)	-0.283*** (0.043)	-0.352*** (0.038)	-0.165*** (0.045)	-0.296*** (0.045)
pi(t-1)	0.050*** (0.010)	0.081*** (0.011)	0.057*** (0.010)	0.074*** (0.012)	0.034* (0.018)	0.095*** (0.019)
pi(t-2)	-0.068*** (0.012)	-0.101*** (0.018)	-0.063*** (0.012)	-0.091*** (0.019)	-0.081*** (0.017)	-0.119*** (0.022)
tt	-0.001 (0.001)	-0.001 (0.001)	-0.001* (0.001)	-0.002*** (0.001)	-0.002*** (0.001)	-0.003** (0.001)
zlb	-0.002 (0.001)	-0.001 (0.001)	-0.002 (0.001)	-0.004** (0.002)	-0.002 (0.002)	-0.001 (0.003)
zlbT3t	0.000 (0.001)	0.000 (0.002)	0.003*** (0.001)	0.006*** (0.001)	-0.003* (0.002)	-0.003 (0.003)
zlbT1t	0.000 (0.001)	-0.002** (0.001)	-0.000 (0.001)	0.001 (0.002)	-0.000 (0.002)	-0.003 (0.003)
Obs	17568	17511	11863	11832	5705	5679
R ²	0.831	0.793	0.840	0.804	0.816	0.771
F-stat	5643.872	4356.622	4691.096	3643.967	1895.172	1431.301

* $p < .1$, ** $p < .05$, *** $p < .01$. Panel estimation with fixed effects

and Driscoll-Kraay standard errors.