Who's Afraid of the Zero Lower Bound? Experimental Evidence on Expectation Formation and Monetary Policy Literacy

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Abstract

We investigate by means of an online learning-to-forecast experiment (LtFE) the impact of interest rate information on expectation formation in normal times and in periods where the zero lower bound (ZLB) is binding. Through the variation of information about the monetary policy stance (i.e. the nominal interest rate and the hypothetical Taylor rate that would prevail if the ZLB would not exist), we investigate the role of central bank communication for expectation formation. Our results can be summarized as follows. First and foremost, at the ZLB, subjects tend to have less pessimistic expectations concerning output and inflation if they do not observe the nominal interest rate. This effect is driven by subjects who, on the one hand, know what a liquidity trap is but, on the other hand, do not have that much general macroeconomic knowledge. Subjects, who do not know what a liquidity trap is, form the same expectations at the ZLB than in normal times, no matter what information they observe. At the same time, for subjects who can be considered macroeconomic experts, the value of interest rate information also is not statistically significant.

Keywords: Behavioral Macroeconomics, Monetary Policy, Zero Lower Bound, Bounded Rationality

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1 Introduction

As widely known, the effectiveness of monetary policy communication hinges on both the sending and the receiving end: on the informational content and clarity of the central bank's announcements, as well as on public's capability to understand those announcements and correctly process that information (see Blinder et al., 2008 for an extensive survey of the literature). This is by no means trivial: While the assumption of rational expectations implies that agents fully understand the economy's structure and therefore monetary policy communication functions effectively, with boundedly rational agents, the effectiveness of communication may be much lower, as they may not understand it properly.

These issues are even more pressing at the zero lower bound (ZLB): While in normal times the policy rate provides valuable information about the current monetary policy stance, at the zero lower bound (ZLB) the policy rate looses its informational content, as it cannot become negative. This makes central bank communication, in particular towards the management of expectations, even more important: As shown by Eggertsson and Woodford (2003), the announcement of planned actions like the planned path of future policy rates (what is known as "forward guidance") is particularly powerful under rational expectations.[1] By contrast, a growing body of research has highlighted the many caveats of monetary policy at the ZLB under behavioral expectations. For instance, Hommes and Lustenhouwer (2019*a*) illustrate in a New Keynesian model with heterogenous behavioral expectations that, depending on the central bank's credibility, an expectations-driven deflationary spiral can occur when the ZLB is binding, see also Hommes and Lustenhouwer (2019*b*). Further, following Reifschneider and Williams (2000), Coibion et al. (2012), Bernanke (2017) and Kiley and Roberts (2017), who consider the difference between the shadow rate (i.e., the policy rate that would have prevailed if the ZLB was not binding) and the actual (ZLB-constrained) policy rate as a measure of foregone monetary policy accommodation, Proaño and Lojak (2020, 2021) assume that the risk premium in their behavioral model depends on this "ZLB policy rate gap", and illustrate how this feeback mechanism may affect the effectiveness of monetary policy.

Recent experiment evidence highlights the importance of bounded rationality in expectation formation at the ZLB. Using the Learning-to-Forecast experiment (LtFE) approach of Marimon and Sunder (1993), Arifovic and Petersen (2017) find that subjects' expectations

[1] Empirical studies such Del Negro et al. (2015) and McKay et al. (2016) document a "lower-than-expected" power of forward guidance (the "forward-guidance puzzle") that they attribute to the the excessive sensitivity of private consumption to interest rate changes implied by the standard Euler consumption equation, as well as from the (empirically widely criticized) front-loading character of the New Keynesian Phillips curve, see also Gürkaynak et al. (2005) and Campbell et al. (2012).

significantly overreact to aggregate demand shocks and historical information, leading very often to severe deflationary traps. In a similar vein, Kryvtsov and Petersen (2019) conduct a laboratory experiment and find that expectations consistently depart from the rational expectations and seem to rely significantly on past realization of inflation an output gap. Further, Kryvtsov and Petersen (2021) find also in an LtFE a differentiated effect of monetary policy announcements on subjects' expectations: While forward-looking announcements of future policy changes are found to have little impact on individual forecasts, backward-looking announcements exert a strong influence particularly among less-accurate forecasters.

Against this background, our paper aims at sheding some light on the following questions: Does the experience of ZLB periods influence the subjects' expectations formation? What is the role of knowledge about the monetary policy stance, and in general terms, of monetary policy and macroeconomic literacy for expectation formation? Would the communication of the hypothetical monetary policy stance (approximated by the Taylor rule rate) change the subjects' expectations concerning future output and inflation at the ZLB?

In a nutshell, our results can be summarized as follows: First, we find that subjects in our experiment (nearly 400 from all around the world and with a heterogeneous economic literacy) do not form structurally and statistically significantly different expectations at the ZLB than in normal times when the ZLB is not binding. Second, people at the ZLB are more optimistic if they *don't observe* the nominal interest rate, being this effect larger for people who know about the liquidity trap. In the same context, subjects without knowledge about the liquidity trap do not have significantly different expectations than when do not interest rate information. Finally, no significant difference in the expectations formation at the ZLB of additionally observing the theoretical Taylor rate can be found.

The remainder of the paper is organized is follows. In section 2 we describe our experiment design in detail. In section 3 we discuss the results of our experiment in detail. Robustness checks are presented in section 4, while section 5 draws some conclusions from this study.

2 Experiment Design

2.1 Setup and Preliminaries

While our original plan was to conduct our learning-to-forecast macro-experiment in a laboratory setup as it is standard in this strain of the literature, the outbreak of the COVID-19 pandemic made this option impossible to pursue. Therefore, we chose to conduct the experiment in an online-setup, where participants did not interact with each other, but had only

to provide now- and one-period ahead forecasts of particular macroeconomic variables on the basis of information supplied to them (as we will discuss in detail below).

We recruited our participants through various channels: While in the first sessions participants were recruited from the pool of potential subjects of the Bamberg Laboratory for Experiment Research (BLER) and of Heidelberg University. For the next sessions we recruited more participants by advertising new sessions through various mailing lists such as scelist (`scelist-bounces@lists.repec.org`), as well as through Twitter using as the originating account the personal account of one of the coauthors of this paper @CR_Proano.

A total number of 393 participants from many countries around the world participated in our experiment. Figure 1 illustrates the relative distribution of the participants' nationalities (as provided by them) graphically.

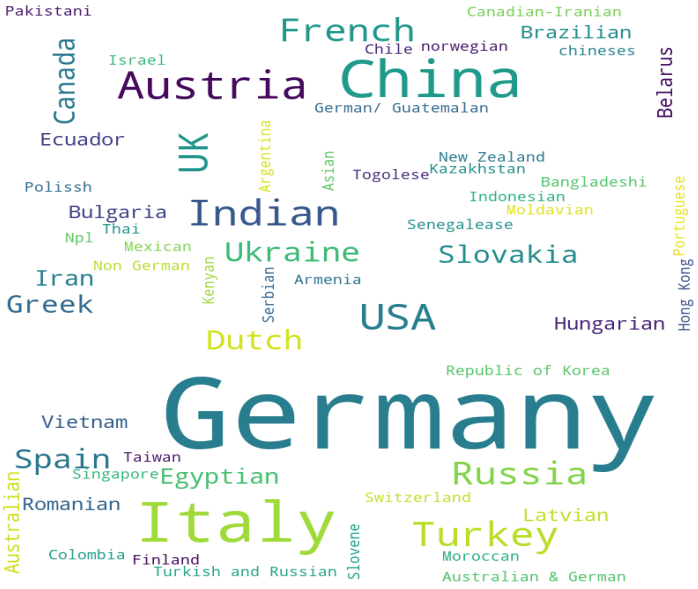

Figure 1: Nationalities of subjected pool.

After providing basic personal information (summarized in Table 1), the subjects were required to answer a multiple choice questionnaire with 10 questions aimed at assessing their macroeconomic (il)literacy. Four possible answers stood up for choice out of which only one was correct. The difficulty of the questions was of a second-year economics bachelor level, so that master or PhD students (or even professionals with a PhD) could answer them easily. All ten questions are reported in the Appendix.

As we will discuss below, a particular question referred to the understanding of the concept of the liquidity trap. Answering this question correctly thus showed that a subject would

Table 1: Descriptive Statistics

	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
Field of study	Econ.	Close Econ.	Business	Nat. Sci.	Soc. Sci.	Hum.	Other
	236	23	18	42	22	29	23

properly understand the macroeconomic implications of the ZLB, at least superficially.

After completing the multiple choice questionnaire, the subjects could then proceed to the proper experiment.

2.2 The Experiment

Before the experiment, the participants were informed about the basic mechanisms of the standard model of the New Neoclassical Synthesis (see Clarida et al., 1999, Woodford, 2003 and Galí, 2008). In particular, the participants obtain a brief explanation of following transmission channels:

- Aggregate output depends positively on aggregate expectations of the future output, and negatively on the real expected interest rate.
- Price inflation depends positively on current output, as well as on the aggregate expectations of future price inflation.
- The policy rate of the central bank is a positive function of the current inflation rate and output gap.
- Subjects are also informed that the policy rate cannot become negative.

Finally, participants were informed that they were atomistic agents, so that their particular, subjective expectations did not exert any impact on the aggregate expectations, which are determined by the data generating process (DGP) discussed below. This assumption allowed

us to perform a web-based experiment (or a survey) which can be responded individually and from all over the world without having to interact with the other experiment participants.

The exact values of aggregate output, aggregate price inflation as well as of the short-term nominal interest rate are not observable within the current period but are instead revealed to the public at the beginning of the next period. Accordingly, only past values of these variables up to period $t-1$ are included in your information set.

The data generating process (DGP) (controlled by the experimenters) is given by

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

$$\pi_t = \tilde{E}_t \pi_{t+1} + \kappa y_t \quad (2)$$

where E_t represents the (model consistent) expected value of output and inflation in the next period (which corresponds to the rational expectations (RE) solution) and ε_t^y is a stochastic AR(1) shock.

Monetary policy is determined in normal times (i.e. when the ZLB is not binding) by a standard Taylor rule. Accordingly, the nominal policy rate i_t is set equal to the Taylor rule interest rate i_t^{T} which is a function of the gap of (last period's) price inflation from the central bank's inflation target π_t^*, and the (last period's) output gap (as the current output gap and inflation rate are determined within a period and are therefore not observable to the central bank until the period is finalized), i.e.

$$i_t = i_t^{\mathrm{T}} = \phi_i i_{t-1}^{\mathrm{T}} + (1-\phi_i)\left(i^* + \phi_\pi(\pi_{t-1} - \pi^*) + \phi_y y_{t-1}\right) + \varepsilon_t^i, \qquad \forall\ i_t \geq 0. \quad (3)$$

where i^* is the steady-state short-term nominal interest rate, $\phi_\pi > 1$ the coefficient measuring how the policy responds quantitatively to changes in inflation (as deviations from its target rate), $\phi_y > 0$ the central bank's responsiveness to output gap fluctuations, ϕ_i the degree of smoothing in the interest rate setting and ε_t^i is a i.i.d. normally distributed stochastic shock with zero mean and variance σ_{ε^i}. In times when the ZLB becomes binding, the short-term policy interest rate i_t cannot become negative ($i_t \geq 0$), even though, theoretically, the Taylor rate i_t^{T} may be negative.

The DGP is driven by two exogenous stochastic processes which follow a covariance stationary AR(1) process with a significant level of persistence. Following the findings by Chung et al. (2012) we can calibrate the variances of the model to generate ZLB periods in more than 5% of cases. For the scenarios with ZLB periods we can of course generate shocks which will lead to ZLB periods of our desired duration.

3 Results

3.1 Observing nominal interest rates and shadow rates at the ZLB

In order to estimate and quantify the effects of observing nominal interest rates on subjects' inflation and output nowcasts and forecasts at the ZLB, we ran various panel regression models. For nowcasts (of inflation and output) we estimated the following model:

$$\begin{aligned} E_{i,t}x_t =& \alpha_i + \beta_1 ZLB_{i,t} + \beta_2 ZLB_{i,t-1}T1_i + \beta_3 ZLB_{i,t}T3_i + \beta_4 E_{i,t-1}x_{t-1} + \beta_5 E_{i,t-1}x_t \\ &+ \beta_6 \pi_{i,t-1} + \beta_7 \pi_{i,t-2} + \beta_8 y_{i,t-1} + \beta_9 y_{i,t-2} + \gamma\, t + e_{i,t}. \end{aligned} \tag{4}$$

with $x = \pi, y$. $ZLB_{i,t-1}$ is a dummy variable that takes on the value 1 when the zero lower bound was binding in period $t-1$ of the time series shown to subject i (i.e. in the most recent period that the subject observes) and the value 0 otherwise. Moreover $T1_i$ and $T3_i$ are individual specific dummy variables that take on the value 1 if and only if subject i was, respectively, in Treatment 1 or in Treatment 3. When both these dummies are zero, subject i was in Treatment 2, which hence can be interpreted as the benchmark treatment in the above regression, also as it represents the scenario closest to the real world. The interaction terms between $T1_i$ and $T3_i$ and the zero lower bound dummy are our main variables of interest, as motivated below. The remaining variables in Equation (4) are control variables: the most recent nowcast and forecast of subject i and the two most recent values of output and inflation that the subject observes, as well as a time trend.

Note that we estimate the model with fixed effects, as indicated by the individual coefficients α_i. For all specifications we consider, the fixed effects are highly significant, and the Hausman test clearly favors the fixed effects model over the random effects model. We will therefore continue with fixed effects estimation results throughout the main body of the paper.[2] One consequence of this is that any time invariant individual specific variables are fully absorbed by the fixed effects and cannot be estimated. For this reason we do not include the levels of the Treatment dummies $T1_i$ and $T3_i$ in the above regressions specification. However, since we are mainly interested in forecast and nowcasts when the zero lower bound is binding, and since this changes dynamically, our main variables of interest, $ZLB_{i,t-1}T1_i$ and $ZLB_{i,t}T3_i$ are not affected by this restriction of fixed effects estimation.

Now, we turn to the interpretation of the coefficients on these two variables. When $ZLB_{i,t-1}T1_i$ is estimated to have a significant positive coefficient, this implies that subjects

[2]However, we will also show robustness of our results to estimating our models with panel OLS or random effects.

in Treatment 1 have, on average, higher nowcasts during periods where a binding zero lower bound could be observed than subjects in treatment 2 (the benchmark treatment). Since the only difference between these two treatments is whether the interest rate is shown on the screen or not, this would mean that explicit interest rate information at the ZLB leads to lower nowcasts. Conversely, if the coefficient on $ZLB_{i,t-1}T1_i$ is estimated to be significantly negative, then explicit interest rate information at the zero lower bound implies higher nowcasts. Similarly, if $ZLB_{i,t-1}T3_i$ is estimated to have a positive coefficient then predictions at the ZLB in Treatment 3 are, on average, larger than in treatment 2. The interpretation of that would be that additionally providing subjects with information about the hypothetical interest rate leads to higher predictions at the ZLB than only showing the actual nominal interest rate.

Analogously to the case of nowcasts, the estimation model for subjects' forecasts is

$$\begin{aligned} E_{i,t}x_{t+1} =& \alpha_i + \beta_1 ZLB_{i,t} + \beta_2 ZLB_{i,t}T2_i + \beta_3 ZLB_{i,t}T3_i + \beta_4 E_{i,t-1}x_{t-1} + \beta_5 E_{i,t-1}x_t \\ &+ \beta_6 \pi_{i,t-1} + \beta_7 \pi_{i,t-2} + \beta_8 y_{i,t-1} + \beta_9 y_{i,t-2} + \gamma\, te_{i,t}. \end{aligned} \tag{5}$$

The first two columns of Table 2 show the estimation results of, respectively, Equations (4) and (5) for the case of inflation expectations. Similarly, the first two columns of Table 3 present the case of output nowcasts and forecasts. The models seem to fit the data well, and subjects are found to engage in trend following behavior. This can be seen from the large and positive coefficient on the first lag of the variable being forecast and the negative coefficient on its second lag. That is, for predicting current and future inflation, subjects extrapolate the recent trend in observed inflation and for predicting current and future output they extrapolate the observed trend in output. This is in line with findings in the related experimental literature. There further is some evidence that subjects also use the trend in observed inflation to predict output and the recent trend in output to predict inflation. The extend to which they use the 'other' variable in their prediction is, however, considerably smaller, as can be seen from the lower magnitude of the estimated coefficients. Finally, subjects expectations are positively affected by their previous forecast and nowcast of the same variable.

Next, we turn to our main variables of interest, $ZLB_{i,t}T1_i$ and $ZLB_{i,t}T3_i$. All four coefficients on $ZLB_{i,t}T1_i$ are positive and statistically significantly different from zero at the 1% level. As discussed above, this implies that, all else equal, subjects in Treatment 1 have higher expectations following periods where the ZLB was binding than subjects in Treatment 2. We therefore conclude that providing subjects with explicit information about the nominal interest rate during periods of a binding ZLB significantly reduces there inflation nowcasts

Table 2: Inflation nowcasts and forecasts

	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***	0.244***	0.142***	0.226***	0.196***	0.287***
	(0.036)	(0.048)	(0.032)	(0.044)	(0.050)	(0.067)
ZLB	-0.129**	-0.101	-0.103**	-0.087	-0.186***	-0.116
	(0.052)	(0.068)	(0.051)	(0.070)	(0.064)	(0.080)
ZLB*T1	0.099***	0.114***	0.136***	0.172***	0.003	-0.048
	(0.025)	(0.023)	(0.025)	(0.026)	(0.041)	(0.040)
ZLB*T3	0.025	0.021	-0.010	0.002	0.074	0.020
	(0.021)	(0.033)	(0.017)	(0.037)	(0.051)	(0.066)
E(t-1)pi(t-1)	0.164***	0.089***	0.178***	0.120***	0.136***	0.031
	(0.042)	(0.023)	(0.047)	(0.024)	(0.050)	(0.034)
E(t-1)pi(t)	0.164***	0.271***	0.163***	0.272***	0.165***	0.267***
	(0.025)	(0.021)	(0.032)	(0.019)	(0.027)	(0.031)
pi(t-1)	0.891***	0.887***	0.889***	0.874***	0.893***	0.915***
	(0.015)	(0.017)	(0.016)	(0.019)	(0.024)	(0.025)
pi(t-2)	-0.344***	-0.417***	-0.338***	-0.424***	-0.354***	-0.405***
	(0.029)	(0.027)	(0.028)	(0.031)	(0.045)	(0.036)
y(t-1)	0.056***	0.143***	0.056***	0.163***	0.056*	0.102***
	(0.019)	(0.022)	(0.016)	(0.020)	(0.034)	(0.033)
y(t-2)	0.017	-0.042*	0.010	-0.055**	0.031	-0.017
	(0.016)	(0.022)	(0.017)	(0.025)	(0.027)	(0.028)
t	-0.003***	-0.004***	-0.002**	-0.003**	-0.005***	-0.006***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(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.

and forecasts. The estimated coefficient sizes of around -0.1 are economically significant given that, in the experiment, output mainly fluctuated between -1 and 1 and inflation mainly between -2 and 2 percent.

In order to see the effect of providing subjects additionally with explicit information about the hypothetical interest rate according to the Taylor rule, we turn to the estimated coefficients on $ZLB_{i,t}T1_i$. As can be seen in Tables 2 and 3, these coefficients are, in all four cases, close to zero and statistically insignificant. This means that, on average, subjects in

Table 3: Output nowcasts and forecasts

	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***	0.141***	0.077***	0.130***	0.109***	0.165***
	(0.028)	(0.031)	(0.029)	(0.031)	(0.034)	(0.040)
ZLB	-0.104***	-0.066	-0.082**	-0.061	-0.152***	-0.060
	(0.039)	(0.057)	(0.038)	(0.067)	(0.051)	(0.054)
ZLB*T1	0.129***	0.095***	0.156***	0.146***	0.045*	-0.051
	(0.016)	(0.019)	(0.021)	(0.024)	(0.027)	(0.039)
ZLB*T3	0.021	0.012	-0.002	-0.024	0.048	0.034
	(0.014)	(0.023)	(0.023)	(0.036)	(0.045)	(0.048)
E(t-1)y(t-1)	0.176***	0.071**	0.229***	0.070**	0.077	0.071
	(0.052)	(0.033)	(0.062)	(0.029)	(0.068)	(0.064)
E(t-1)y(t)	0.173***	0.299***	0.161***	0.321***	0.190***	0.250***
	(0.024)	(0.024)	(0.029)	(0.028)	(0.036)	(0.032)
y(t-1)	0.870***	0.917***	0.867***	0.925***	0.877***	0.898***
	(0.020)	(0.020)	(0.016)	(0.019)	(0.038)	(0.032)
y(t-2)	-0.244***	-0.335***	-0.283***	-0.352***	-0.164***	-0.294***
	(0.037)	(0.034)	(0.042)	(0.036)	(0.045)	(0.045)
pi(t-1)	0.048***	0.080***	0.056***	0.073***	0.032	0.093***
	(0.010)	(0.012)	(0.010)	(0.013)	(0.019)	(0.019)
pi(t-2)	-0.070***	-0.103***	-0.064***	-0.093***	-0.084***	-0.122***
	(0.012)	(0.018)	(0.012)	(0.020)	(0.017)	(0.023)
t	-0.002***	-0.003***	-0.002**	-0.003**	-0.004***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(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.

Treatment 3 did not make higher or lower predictions at the ZLB than subjects in Treatment 2.

In conclusion, we find that that providing subjects with explicit information about the nominal interest rate reduces their output and inflation expectations at the zero lower bound, but that additionally providing them with information about the hypothetical interest rate that would have occurred without a zero lower bound neither increases nor weakens this effect.

Finally, note the estimated coefficient on the linear time trend are statistically significant and negative. This means that, controlling for whether the ZLB was binding or not, subjects tended to give lower predictions as the experiment progressed. This might be explained with large recessionary episodes that they experienced. These experiences may have made them, all else equal, more pessimistic about the future. In Section **??** we will study how expectations at the ZLB may have evolved differently over time in the different treatments.

3.2 Knowing what a liquidity trap is

After having established that subjects who are shown realizations of the nominal interest rate have lower inflation and output expectations at the zero lower bound on average, we now turn to the subject characteristics that drive this result. In particular, we first study how this treatment effects depends on subjects' understanding of what a liquidity trap is.

As discussed in Section 2, at the beginning of the experiment, we asked subjects to answer ten incentivized multiple choice questions about macroeconomics. One of these questions (question 9) was:

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.

Subjects that are very familiar with the consequences of a zero lower bound on the nominal interest rate would have had no problems answering this question. On the other hand,

subjects that may just have heard occasionally about terms like liquidity traps and zero lower bound but do not have a deep understanding of these concepts, may easily fall for one of the other choice alternatives. This question hence offers us the opportunity to make a separation between subjects that (mostly) have a good understanding of the potential effects of a binding ZLB on future output and inflation on the one hand, and those that have a considerably lesser understanding of this on the other hand. It turns out that about two thirds of the subjects in our sample answered the above question correctly, whereas the other third did not. This means that we can split our sample based on whether subjects answered the liquidity trap question correctly or not and still end up with a relatively large amount of observations in each subsample.

In the middle two columns of Tables 2 and 3 we present the results of the panel regressions of the previous section for the subsample of subjects that correctly answer the liquidity trap question. Here, it can be seen that the estimated coefficients on $ZLB_{i,t}T1_i$ are almost 1.5 times as large as in the full sample. At the same time, the estimated coefficients on all other variables change only marginally. This implies that subjects who have good understanding of liquidity traps do not build their forecasts in a fundamentally different way, but that they do have considerably lower output and inflation expectations than the full population when they observe a binding zero lower bound.

The estimation results of the other subsample – subjects that did not answer the liquidity trap correctly – are presented in the final two columns of Tables 2 and 3. Interestingly the estimated coefficients on $ZLB_{i,t}T1_i$ now are mostly insignificantly different from zero. Moreover, the estimated coefficients are more often positive than negative. This means that the treatment effects at the zero lower bound discussed above completely disappear when we only consider subjects that answered the question about the liquidity trap wrongly.

This result is striking yet intuitive. Subjects that do not have a deep understanding of what a liquidity trap is, and hence what the consequences of a binding ZLB are for output and inflation, do not have an obvious channel to use interest rate information for their output and inflation forecasts. Therefore, they largely ignore this information and make predictions in the same way in the treatment with nominal interest rate information as in the treatment without such information. Subjects with a deeper understanding of liquidity traps and the zero lower bound on the other hand, on average, are more pessimistic about future output and inflation when they observe a binding zero lower bound compared to the case where they do not observe the value of the nominal interest rate. This is because they know that the binding zero lower bound prevents the central bank from stimulating the economy. As a consequence, they expect a slower recovery than they would have expected if they would not

have realized that the zero lower bound was binding.

3.3 The role of general macroeconomic (il)literacy

Next, we turn to subjects' overall knowledge about macroeconomics. For this, we combine subject's answers to all ten incentivized questions that they answered at the beginning of the experiment. In particular, we calculate a macroeconomic illiteracy score (MIS) as the fraction of incorrectly answered macroeconomic questions. This variable hence can take teh values 0,0.1,0.2,...0.9,1. A value of $MIS_i = 0$ means that subject i answered all ten questions correctly whereas a value of $MIS_i = 1$ means that the subject did not answer any question correctly. [3]

We are now interested in whether the estimated magnitude of the interaction terms between treatment and zlb depend on subjects' MIS. We, therefore add additional variables to the regressions of the form of (4) and (4) that allow for interaction between MIS_i and these dummies. Since we found no significant differences between Treatment 2 and Treatment 3, we will focus in this section on the differences between treatment 1 on the one hand and the other two treatments on the other hand. This will limit the number of (interacting) variables in the regression and allow for more parsimonious and intuitive regression tables. We note however, that results of this section are robust to having additional treatment dummies for Treatment 3.[4] We thus estimate the following models

$$\begin{aligned} E_{i,t}x_t &= \alpha_i + \beta_1 ZLB_{i,t} + \beta_2 ZLB_{i,t-1}MIS_i + \beta_3 ZLB_{i,t}T1_i + \beta_4 ZLB_{i,t}T1_i MIS_i \\ &\quad + \beta_5 E_{i,t-1}x_{t-1} + \beta_6 E_{i,t-1}x_t + \beta_7 \pi_{i,t-1} + \beta_8 \pi_{i,t-2} + \beta_9 y_{i,t-1} + \beta_10 y_{i,t-2} + e_{i,t} \quad (6) \\ E_{i,t}x_{t+1} &= \alpha_i + \beta_1 ZLB_{i,t} + \beta_2 ZLB_{i,t}MIS_i + \beta_3 ZLB_{i,t}T1_i + \beta_4 ZLB_{i,t}T1_i MIS_i \\ &\quad + \beta_5 E_{i,t-1}x_{t-1} + \beta_6 E_{i,t-1}x_t + \beta_7 \pi_{i,t-1} + \beta_8 \pi_{i,t-2} + \beta_9 y_{i,t-1} + \beta_10 y_{i,t-2} + e_{i,t} \quad (7) \end{aligned}$$

Since $T1_i$ is the only treatment dummy in these models the interpretation of $ZLB_{i,t}T1_i$ becomes the difference in expectations at the ZLB between treatment 1 and the other two treatments. However, we now additionally have the interaction term $ZLB_{i,t}T1_i MIS_i$ included in the regression model. Therefore, the above interpretation of $ZLB_{i,t}T1_i$ only holds when $MIS_i = 0$. That is, the estimated coefficient on $ZLB_{i,t}T1_i$ (β_3) tells us how much

[3] It would be equivalent to work with a macroeconomic literacy score that is defined in exactly the opposite manner as MIS (1 when all answers are correct and 0 when all answers are wrong). However, with the MIS as we defined it, the regression results presented in this section are more easy to interpret.

[4] Results are available on request.

higher expectations at the ZLB are in treatment T1 compared to T2 and T3 *for individuals that have a macro score of* $MIS_i = 0$. At the same time, the estimated coefficient on $ZLB_{i,t}T1_iMIS_i$ (β_4) gives the marginal effect of MIS_i on that treatment difference at the ZLB. Therefore, somebody with $MIS_i = 0.3$ the difference in expectations at the ZLB between T1 and the other two treatments is given by $\beta_3 + 0.3 \cdot \beta_4$ and for somebody that answered all questions incorrectly it is given by $\beta_3 + 0.5 \cdot \beta_4$.

Table 4: Inflation nowcasts and forecasts

	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***	0.245***	0.143***	0.227***	0.196***	0.288***
	(0.037)	(0.048)	(0.032)	(0.043)	(0.050)	(0.067)
ZLB	-0.180***	-0.180**	-0.155***	-0.134*	-0.195**	-0.218*
	(0.059)	(0.077)	(0.058)	(0.078)	(0.081)	(0.115)
ZLB*MIS	0.261***	0.371***	0.261***	0.258***	0.160	0.327*
	(0.063)	(0.079)	(0.070)	(0.095)	(0.101)	(0.194)
ZLB*T1	0.101***	0.146***	-0.015	0.041	0.113**	0.119
	(0.029)	(0.032)	(0.033)	(0.042)	(0.052)	(0.074)
ZLB*T1*MIS	-0.040	-0.151	0.983***	0.835***	-0.447***	-0.514**
	(0.103)	(0.128)	(0.193)	(0.227)	(0.140)	(0.238)
E(t-1)pi(t-1)	0.164***	0.088***	0.173***	0.116***	0.136***	0.031
	(0.042)	(0.023)	(0.047)	(0.024)	(0.050)	(0.034)
E(t-1)pi(t)	0.163***	0.270***	0.161***	0.270***	0.164***	0.266***
	(0.025)	(0.021)	(0.032)	(0.019)	(0.027)	(0.030)
pi(t-1)	0.891***	0.887***	0.889***	0.873***	0.892***	0.914***
	(0.015)	(0.017)	(0.016)	(0.019)	(0.024)	(0.025)
pi(t-2)	-0.343***	-0.416***	-0.333***	-0.420***	-0.354***	-0.404***
	(0.029)	(0.027)	(0.028)	(0.032)	(0.045)	(0.036)
y(t-1)	0.056***	0.143***	0.057***	0.164***	0.057*	0.102***
	(0.019)	(0.022)	(0.016)	(0.020)	(0.034)	(0.033)
y(t-2)	0.017	-0.042*	0.011	-0.053**	0.032	-0.017
	(0.016)	(0.022)	(0.017)	(0.025)	(0.027)	(0.028)
t	-0.003***	-0.004***	-0.003**	-0.003**	-0.005***	-0.006***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(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.

We present the regression results in Tables 4 and 5 for inflation and output, respectively.

Table 5: Output nowcasts and forecasts

	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***	0.142***	0.079***	0.132***	0.109***	0.166***
	(0.028)	(0.032)	(0.029)	(0.031)	(0.034)	(0.040)
ZLB	-0.148***	-0.150**	-0.122***	-0.098	-0.166**	-0.220**
	(0.041)	(0.065)	(0.038)	(0.069)	(0.067)	(0.087)
ZLB*MIS	0.226***	0.375***	0.218***	0.148*	0.124	0.513***
	(0.057)	(0.080)	(0.061)	(0.082)	(0.113)	(0.148)
ZLB*T1	0.061***	0.085***	-0.081***	-0.071**	0.167***	0.209***
	(0.021)	(0.025)	(0.026)	(0.030)	(0.046)	(0.065)
ZLB*T1*MIS	0.283***	0.053	1.448***	1.376***	-0.437***	-0.806***
	(0.079)	(0.091)	(0.179)	(0.248)	(0.158)	(0.185)
E(t-1)y(t-1)	0.175***	0.070**	0.217***	0.059**	0.077	0.073
	(0.051)	(0.032)	(0.060)	(0.028)	(0.069)	(0.065)
E(t-1)y(t)	0.171***	0.296***	0.156***	0.317***	0.188***	0.246***
	(0.025)	(0.024)	(0.029)	(0.027)	(0.036)	(0.032)
y(t-1)	0.870***	0.917***	0.868***	0.927***	0.878***	0.899***
	(0.020)	(0.020)	(0.016)	(0.019)	(0.038)	(0.032)
y(t-2)	-0.240***	-0.331***	-0.266***	-0.337***	-0.163***	-0.291***
	(0.037)	(0.033)	(0.041)	(0.035)	(0.045)	(0.044)
pi(t-1)	0.048***	0.080***	0.055***	0.072***	0.031	0.092***
	(0.010)	(0.012)	(0.010)	(0.013)	(0.019)	(0.019)
pi(t-2)	-0.070***	-0.103***	-0.064***	-0.094***	-0.084***	-0.122***
	(0.012)	(0.018)	(0.013)	(0.020)	(0.017)	(0.023)
t	-0.002***	-0.003***	-0.002**	-0.003**	-0.004***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(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.

Focusing first on the first two columns, which correspond to the full sample, it can be seen that the estimated coefficients on $ZLB_{i,t}T1_i$ are highly significant and comparable in magnitude with the estimates of Section 3.1. Moreover, in three of the four cases, the estimated coefficient on $ZLB_{i,t}T1_iMIS_i$ is not statistically significant. Therefore, with the exception of output nowcasts, there is no significant role for MIS when it comes to our main treatment effect. For the full sample, the effects of explicitly providing subjects with nominal interest rate information, hence, remains as in Section 3.1, independently of their MIS.

This completely changes when we consider the two subsamples discussed in the Section 3.2. In the subsample of subjects that answered the question about liquidity traps correctly, the estimated coefficients on $ZLB_{i,t}T1_i$ become insignificantly different from zero or even negative. This implies that subjects who know what a liquidity trap is but also answered all other macroeconomic questions correctly do not have higher expectations at the ZLB in Treatment 1 than in the treatments with nominal interest rate information.

However, the estimated coefficients on $ZLB_{i,t}T1_iMIS_i$ are large and highly significant. This means that subjects answered the liquidity trap correctly but actually answered most other macroeconomic questions wrongly, have considerably higher expectations at the ZLB in Treatment 1 than in the other two treatments. And more precisely, the more macroeconomic questions a subject did not answer correctly, the higher the treatment effect in this subsample.

The exact opposite picture arises when we consider the subsample of subjects that answered the liquidity trap question incorrectly, in the final two columns of Tables 4 and 5. Here, the estimated coefficients on $ZLB_{i,t}T1_i$ are positive whereas estimated coefficients on $ZLB_{i,t}T1_iMIS_i$ are *negative*. Moreover, the latter coefficients are considerably larger in absolute value than the former This implies that subjects who do not know what a liquidity trap is and additionally had a considerable number of mistakes in the other macroeconomic questions (high MIS) actually have lower expectations at the zero lower bound in treatment 1 than in the other two treatments. For them, explicitly seeing information about the nominal interest rate at its zero lower bound was no reason to have more negative output and inflation expectations but rather even the opposite.

Most of these results are intuitive, although not immediately obviously so. What may seem puzzling is that subjects that know a lot about macroeconomics (low MIS) and know what a liquidity trap is do not have lower output and inflation expectations when they are presented with the nominal interest rate. The intuition for this result, however, is that these macroeconomic experts do not need to see nominal interest rate information in order to recognize a liquidity trap. Instead, they could already recognize from the output and inflation time series that the ZLB may be binding and adjusted their expectations accordingly also in treatment 1. The explicit interest rate information did not offer them much additional informational content over the implicit information that they had in all treatments. Hence, we do not observe a treatment difference for these subjects.

Subjects that understand what a liquidity trap is but are not macroeconomic expert (higher MIS), on the other hand, apparently had a harder time making correct inference about the ZLB from only output and inflation time series. Hence there inflation and output

expectations were considerably lower when they were explicitly shown that the ZLB was binding compared to the case were they had no explicit information about the nominal interest rate (Treatment 1).

Finally, this effect completely disappears (and even partly reverses) when subjects do not understand what a liquidity trap is. If they additionally do not have a too high MIS, they simply largely ignore explicit interest rate information as they do not have a clear economic theory of how a binding ZLB should impact future output and inflation. Interestingly, subjects that hardly know anything about macroeconomics (liquidity trap question wrong and high MIS) react to explicit interest rate information in an intuitive way by having higher output and inflation expectations. This might reflect that these subjects have a completely different model in their mind of how an economy might work. Alternatively, it could reflect that these subjects were simply not properly understanding the experimental environment and tasks and made predictions that are not based on any economic reasoning.

3.4 Forecast Errors

In order to obtain a more robust picture of the above results we now turn to an analysis of nowcast errors. In the spirit of Coibion and Gorodnichenko (2015) we start with a regression of nowcast errors on nowcast revisions, where nowcast revisions are calculated as a subjects current nowcast minus its previous forecast about inflation or output and where nowcast errors are defined as the difference between realized inflation and a subjects nowcast. A negative nowcast error hence implies that the nowcast was too high.

We perform the regressions in a panel at the individual level, as in Bordalo et al. (2019). The first columns of Table 6 and 7 present the results of this panel regression on our full sample of subjects. The negative significant coefficients on forecast revisions indicate overreaction to new information, in line with the individual-level results of Bordalo et al. (2019).

Next, we follow Coibion and Gorodnichenko (2015) by adding additional variables to this regression. These authors find that variables like past inflation and output are not statistically significantly different form zero when added to the forecast revision as an additional explanatory variable. They interpret this as implying that the deviations from rationality that are implied by forecastable forecast errors can be fully explained by inefficient revisions of past expectations. Once one controls for this inefficient updating by including forecast revisions in the regresison, lagged output and inflation no longer hold any predictive power for forecast errors.

However, when we add interactions of ZLB, MIS and treatment dummies to the forecast

Table 6: Inflation nowcast errors

	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***	-0.351***	-0.350***	-0.350***	-0.350***	-0.351***
	(0.034)	(0.039)	(0.036)	(0.041)	(0.032)	(0.036)
Intercept	-0.392***	-0.388***	-0.393***	-0.397***	-0.390***	-0.370***
	(0.133)	(0.107)	(0.134)	(0.108)	(0.133)	(0.106)
ZLB		0.131		0.146		0.005
		(0.192)		(0.194)		(0.200)
ZLB*MIS		-0.391***		-0.320***		-0.181
		(0.116)		(0.123)		(0.221)
ZLB*T1		-0.110***		0.044*		-0.019
		(0.034)		(0.025)		(0.103)
ZLB*T1*MIS		-0.138		-1.680***		0.274
		(0.146)		(0.204)		(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.

error regression on our experimental data, we do obtain statistically significant coefficients, as can be seen in the second columns of Tables 6 and 7. We are, again particularly interested in the estimated coefficients on $ZLB_{i,t-1}T1_i$ and $ZLB_{i,t-1}T1_iMIS_i$. In the full sample, we find that for inflation, forecast errors at the ZLB are more negative (or less positive) in Treatment 1 than in the other two treatments. This implies that subjects had lower (more negative) expectations at the ZLB in treatments where they had explicit information about the nominal interest rate. The influence of MIS on this treatment effect is not statistically significant here. For output, we find, instead, that this treatment effect is larger for subjects with a higher MIS and that there is no significant treatment difference for subjects that answered all macroeconomic questions correctly.

The other four columns of Tables 6 and 7 correspond to the subsamples of subjects that either answered the question about liquidity traps correctly or incorrectly. As in the previous sections, we find large differences across these different samples. In particular, in the subsample of subjects that answered the liquidity trap question correctly, there is a large negative treatment effect for subjects with a high MIS. For subjects with a low MIS this is not the case, and subjects that answered all macroeconomic questions correctly ($MIS_i = 0$) there even is a positive effect of T1 on forecast errors at the ZLB. The latter is however not

Table 7: Output nowcast errors

	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***	-0.354***	-0.349***	-0.351***	-0.357***	-0.361***
	(0.042)	(0.048)	(0.045)	(0.050)	(0.040)	(0.045)
Intercept	-0.167	-0.109*	-0.165	-0.115*	-0.173	-0.099
	(0.128)	(0.063)	(0.128)	(0.063)	(0.128)	(0.064)
ZLB		0.041		0.047		-0.050
		(0.186)		(0.189)		(0.186)
ZLB*MIS		-0.379***		-0.264**		-0.267
		(0.093)		(0.116)		(0.169)
ZLB*T1		-0.049		0.163***		-0.116
		(0.038)		(0.033)		(0.108)
ZLB*T1*MIS		-0.487***		-2.388***		0.463
		(0.111)		(0.275)		(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.

statistically significant at the 5% level for the case of inflation. Moreover, for subjects that do not have a good understanding of what a liquidity trap is, none of our added variables obtain a statistically significant coefficient in the forecast error regression and we find no treatment effects here.

All in all, the results of the forecast error analysis confirm our main findings from the previous sections: explicitly providing subjects with nominal interest rate information reduces their expectations at the zero lower bound, but only if they know what a liquidity trap is and at the same time are not macroeconomic experts.

Finally, note that the estimated coefficient on the forecast revision is highly robust across (sub)samples and across the model specifications with out without the additional regressors.

3.5 Dynamic treatment effects at ZLB

So far, we have focused on the average treatments effect at the ZLB over the whole time sample. In this Section, we will consider whether treatment differences in predictions at the ZLB might have changed over time during the experiment. We do so by adding additional regressors to (4) and (5) that are interactions of a time trend and the terms $ZLB_{i,t}$, $ZLB_{i,t}T1_i$

and $ZLB_{i,t}T3_i$. When these terms are statistically significant, there are changes over time in howmcuh higher or lower expectations at the ZLB are in different treatments.

Table 8: Inflation nowcasts and forecasts

	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***	0.198***	0.093***	0.186***	0.100**	0.222***
	(0.032)	(0.044)	(0.032)	(0.042)	(0.042)	(0.062)
ZLB	-0.043	0.002	-0.018	0.019	-0.094	-0.018
	(0.062)	(0.077)	(0.061)	(0.071)	(0.086)	(0.123)
ZLB*T1	0.093**	0.076***	0.130***	0.131***	-0.005	-0.073
	(0.036)	(0.028)	(0.038)	(0.031)	(0.057)	(0.056)
ZLB*T3	0.045	-0.047	-0.049**	-0.109***	0.181**	0.025
	(0.037)	(0.041)	(0.025)	(0.042)	(0.087)	(0.105)
E(t-1)pi(t-1)	0.163***	0.088***	0.177***	0.120***	0.133***	0.030
	(0.042)	(0.023)	(0.047)	(0.024)	(0.049)	(0.034)
E(t-1)pi(t)	0.164***	0.271***	0.163***	0.271***	0.165***	0.267***
	(0.025)	(0.022)	(0.032)	(0.019)	(0.027)	(0.031)
pi(t-1)	0.893***	0.889***	0.891***	0.875***	0.896***	0.917***
	(0.015)	(0.016)	(0.016)	(0.018)	(0.022)	(0.026)
pi(t-2)	-0.339***	-0.414***	-0.334***	-0.421***	-0.348***	-0.401***
	(0.027)	(0.025)	(0.026)	(0.030)	(0.042)	(0.035)
y(t-1)	0.055***	0.142***	0.055***	0.162***	0.055*	0.100***
	(0.017)	(0.021)	(0.015)	(0.019)	(0.031)	(0.032)
y(t-2)	0.014	-0.044*	0.007	-0.057**	0.027	-0.020
	(0.018)	(0.024)	(0.018)	(0.026)	(0.029)	(0.030)
tt	-0.001*	-0.003**	-0.001	-0.002*	-0.002**	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
zlbt	-0.003**	-0.004**	-0.003**	-0.004**	-0.002	-0.003
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.003)
zlbT3t	-0.001	0.003	0.002**	0.005***	-0.005*	-0.000
	(0.001)	(0.002)	(0.001)	(0.001)	(0.003)	(0.004)
zlbT1t	0.000	0.002*	0.000	0.002	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(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.

The results of the regressions of this extended model are presented in Tables 8 and 9. Focusing, first, on $ZLB_{i,t}T1_i$, we see that for nowcasts the estimated coefficient for all subsam-

Table 9: Output nowcasts and forecasts

	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***	0.097***	0.053**	0.097***	0.042**	0.097***
	(0.019)	(0.022)	(0.024)	(0.023)	(0.020)	(0.037)
ZLB	-0.046	-0.036	-0.027	0.036	-0.092	-0.012
	(0.048)	(0.060)	(0.046)	(0.059)	(0.073)	(0.098)
ZLB*T1	0.115***	0.173***	0.166***	0.130***	0.045	0.018
	(0.038)	(0.036)	(0.037)	(0.041)	(0.038)	(0.052)
ZLB*T3	0.019	0.033	-0.082***	-0.163***	0.127*	0.098
	(0.034)	(0.048)	(0.025)	(0.036)	(0.074)	(0.074)
E(t-1)y(t-1)	0.176***	0.071**	0.229***	0.069**	0.075	0.071
	(0.052)	(0.033)	(0.062)	(0.029)	(0.068)	(0.064)
E(t-1)y(t)	0.173***	0.298***	0.159***	0.319***	0.190***	0.249***
	(0.024)	(0.024)	(0.029)	(0.028)	(0.036)	(0.032)
y(t-1)	0.869***	0.916***	0.866***	0.924***	0.876***	0.897***
	(0.019)	(0.019)	(0.016)	(0.018)	(0.036)	(0.031)
y(t-2)	-0.245***	-0.336***	-0.283***	-0.352***	-0.165***	-0.296***
	(0.038)	(0.035)	(0.043)	(0.038)	(0.045)	(0.045)
pi(t-1)	0.050***	0.081***	0.057***	0.074***	0.034*	0.095***
	(0.010)	(0.011)	(0.010)	(0.012)	(0.018)	(0.019)
pi(t-2)	-0.068***	-0.101***	-0.063***	-0.091***	-0.081***	-0.119***
	(0.012)	(0.018)	(0.012)	(0.019)	(0.017)	(0.022)
tt	-0.001	-0.001	-0.001*	-0.002***	-0.002***	-0.003**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
zlbt	-0.002	-0.001	-0.002	-0.004**	-0.002	-0.001
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)
zlbT3t	0.000	0.000	0.003***	0.006***	-0.003*	-0.003
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.003)
zlbT1t	0.000	-0.002**	-0.000	0.001	-0.000	-0.003
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(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.

ples are comparable to those in Tables 2 and 3. Moreover, $ZLB_{i,t}T1_it$, the interaction term with the time trend is statistically insignificant and practically zero. For forecasts, we find coefficients on $ZLB_{i,t}T1_it$ that deviate somewhat from zero, and coefficients on $ZLB_{i,t}T1_i$ that are adjusted accordingly such that the (time) average of the ZLB treatment difference between T1 and T2 remains the same as in Section 3.1. Since coefficients on $ZLB_{i,t}T1_it$ are mostly statistically not significant, we do not find convincing evidence of time effects on this treatment difference.

Note however, that for the full sample and the subsample of subjects that answered the liquidity trap correctly, the coefficient on the interaction term $ZLB_{t,i}$ is statistically significant and negative. Together with the above, this implies that in Treatment 2 as well as in Treatment 1 subjects were becoming more pessimistic over time at the zero lower bound. Moreover, this happened at about the same rate in both treatments. Further note, that the coefficients on $ZLB_{t,i}t$ are more negative than the coefficients on t. This implies that, for Treatments 1 and 2. Then negative time effect that we already found in earlier regressions is mainly driven by subjects becoming more pessimistic over time at periods where the ZLB is binding.

Next, we turn to treatment 3. Whereas up to now, there were no significant differences between treatment 2 and 3, this changes when we explicitly consider differences across the time dimension. However, we only find statistically significant differences for subjects that answered the liquidity trap question correctly (middle two columns of Tables 8 and 9).

In particular, we find statistically significant negative coefficients on $ZLB_{i,t}T3_it$ and positive ones on $ZLB_{i,t}T3_i$ here. This implies that in earlier ZLB periods (where the value of t is low) predictions were more negative in T3 than in T2. However, for intermediate T this effect disappears and towards the end of the experiment the opposite holds. There subjects have lower ZLB expectations in T2 than in T3. Further note that the coefficient on $ZLB_{i,t}T3_it$ numerically (more than) offsets the estimated coefficient on $ZLB_{i,t}t$. Unlike for Treatment 2, it is, therefore, not the case in treatment 3 that subjects become more pessimistic over time in ZLB periods.

In other words, for subjects that understand what a liquidity trap is we find the following. When they observe a binding ZLB together with information on the hypothetical interest rate (T3) at the beginning of the experiment, they have even lower expectations than subjects that only explicitly observe the binding ZLB. However, as time passes and subjects experience more recessionary periods with binding ZLB, this does not induce them to make even lower predictions than before in the treatment with hypothetical interest rate information.

By contrast, if subjects receive no explicit information on how severe the ZLB constraint is binding but only observe the actual nominal interest rate, then subjects initially are less pessimistic when the ZLB hits. However, as ZLB episodes last longer or start to occur more frequently, subjects become more and more pessimistic if they do not see the hypothetical interest rate. This even goes so far that these subjects eventually – after experiencing a considerably history of low output and inflation outcomes with a binding ZLB – become more pessimistic at the ZLB than subjects that are explicitly shown the hypothetical Taylor rate.

Our results therefore imply that not explicitly providing information about the hypothetical interest rate may be beneficial for a central bank at the beginning of a liquidity trap in the short run. However, not providing this information may do more harm than good in the long run if the central bank is not able to permanently exit the liquidity trap quickly.

Model Modelling ideas:

- one fraction of agents ignore the ZLB and always use the MSV solution that holds in the absence of a ZLB constraint.

- another fraction agents form expectations differently depending on what information the CB provides. If no information is provided, they initially form expectations as the first fraction, but they try to learn over time and hence become more pessimsitic over time. This might be modelled with something like the learning model of Viktor Marinkov. If instead, they are provided with interest rate information they are initially already have lower expectations. So they immediately build a solution that is closer to rational expectations and takes the binding zlb constraint somewhat into account. However, they are still to optimistic anityally and learn over time. Again, maybe, with a variant of the learning model of Viktor. Finally, if you provide them with zlb plus hypothetical tylor rule they do not need to learn anything and immediately have the correct msv solution (i.e. Rational expectations)

- Potentially we could incorporate a third group of macro experts (low MIS) with rational expectations no matter what information they get. But maybe then there are to many types and too many parameters. Also, so far I have not been able to empirically identify anything about their learning behavior in the different treatments. The assumption could be that they are really always fully rational in all treatments and nothing changes over time, but I am not sure if we have enough convincing evidence for that assumption yet. However, if we do not include something with differences in MIS in the theoretical model there may be too much of a disconnect between the main empirical findings and the model, so that is something to think about..

4 Concluding Remarks

How do agents form expectations at the ZLB, where nominal interest rates lose their signaling function? We intended to shed some light onto this question by means of a broad-based online learning-to-forecast (LtF) experiment. More specifically, through the implementation of different treatments related with different information sets, we aimed at revealing the role of interest rate information and of macroeconomic and in particular monetary policy literacy in expectation formation.

Our experiment and our econometric analysis of the subjects' data delivered a variety of results worth highlighting. First, we found that the very observation of a nominal interest rate constrained by the zero lower bound led subjects to build systematically lower expectations than in the case where they did not obtained this information, being this effect larger for subjects who knew already about the concept of a liquidity trap. By contrast, for subjects who did not know what is liquidity trap, the observation of the nominal interest rate did not lead to significantly different expectations at the zero lower bound.

Our findings have important policy implications, as they highlight the difference between the *observation* of a variable such as the nominal interest rate, and *understanding* what it implies. Monetary policy communication needs to acknowledge the existence of possible bias due to behavioral reasons in the perception of monetary policy signals such as cognitive constraints or simply a poor macroeconomic literacy.

References

Arifovic, J. and Petersen, L. (2017), 'Stabilizing expectations at the zero lower bound: Experimental evidence', *Journal of Economic Dynamics and Control* **82**, 21–43.

Bernanke, B. (2017), Monetary policy in a new era. Paper prepared for conference on Rethinking Macroeconomic Policy, Peterson Institute, Washington DC, October 12-13, 2017.

Blinder, A. S., Ehrmann, M., Fratzscher, M., de Haan J. and Jansen, D.-J. (2008)), 'Central bank communication and monetary policy: A survey of theory and evidence', *Journal of Economic Literature* **46**(4), 910–945.

Bordalo, P., Gennaioli, N., La Porta, R. and Shleifer, A. (2019), 'Diagnostic expectations and stock returns', *Journal of Finance* **LXXIV**(6).

Campbell, J., Evans, C., Fisher, J. and Justiniano, A. (2012), 'Macroeconomic effects of FOCM forward guidance', *Brookings Papers on Economic Activity* **Spring**.

Chung, H., Laforte, J.-P., Reifschneider, D. and Williams, J. C. (2012), 'Have we underestimated the likelihood and severity of zero lower bound events?', *Journal of Money, Credit and Banking* **44**, 47–82.

Clarida, R., GalÃ, J. and Gertler, M. (1999), 'The science of monetary policy: A new keynesian perspective', *Journal of Economic Literature* **37**(4), pp. 1661–1707.
URL: *http://www.jstor.org/stable/2565488*

Coibion, O. and Gorodnichenko, Y. (2015), 'Information rigidity and expectations formation process: A simple framework and new facts', *American Economic Review* **105**(8), 2644–2678.

Coibion, O., Gorodnichenko, Y. and Wieland, J. (2012), 'The optimal inflation rate in new keynesian models: Should central banks raise their inflation targets in light of the zero lower bound?', *Review of Economic Studies* **79**(4), 1371–406.

Del Negro, M., Giannoni, M. and Patterson, C. (2015), The forward guidance puzzle, Staff Reports 574, Federal Reserve Bank of New York.

Eggertsson, G. B. and Woodford, M. (2003), 'The zero bound on interest rates and optimal monetary policy', *Brookings Papers on Economic Activity* **34**(1), 139–235.

Galí, J. (2008), *Monetary Policy, Inflation and the Business Cycle*, Princeton University Press.

Gürkaynak, R., Sack, B. and Swanson, E. (2005), 'The sensitivity of long-term interest raets to economic news: Evidence and implications for macroeconomic models', *American Economic Review* pp. 425–36.

Hommes, C. and Lustenhouwer, J. (2019*a*), 'Inflation targeting and liquidity traps under endogenous credibility', *Journal of Monetary Economics* . forthcoming.

Hommes, C. and Lustenhouwer, J. (2019*b*), 'Managing unanchored, heterogenous expectations and liquidity traps', *Journal of Economic Dynamics and Control* . forthcoming.

Kiley, M. T. and Roberts, J. M. (2017), 'Monetary policy in a low interest rate world', *Brookings Papers on Economic Activity* pp. 317–396.

Kryvtsov, O. and Petersen, L. (2019), Expectations and monetary policy. Unpublished manuscript, Simon Fraser University.

Kryvtsov, O. and Petersen, L. (2021), 'Central bank communication that works: Lessons from lab experiments', *Journal of Monetary Economics* **117**, 760–780.

Marimon, R. and Sunder, S. (1993), 'Indeterminacy of equilibria in a hyperinflationary world: Experimental evidence', *Econometrica* **61**(5), 1073â€“1107.

McKay, A., Nakamura, E. and Steinsson, J. (2016), 'The power of forward guidance revisited', *American Economic Review* **106**(10).

Proaño, C. R. and Lojak, B. (2020), 'Animal spirits, risk premia and monetary policy at the zero lower bound', *Journal of Economic Behavior and Organization* **171**, 221–233.

Proaño, C. R. and Lojak, B. (2021), 'Monetary policy with a state-dependent inflation target in a behavioral two-country monetary union model', *Journal of Economic Dynamics and Control* **133**, 104236.

Reifschneider, D. and Williams, J. C. (2000), 'Three lessons for monetary policy in a low-inflation era', *Journal of Money, Credit and Banking* **32**(4), 936–66.

Woodford, M. (2003), *Interest and Prices: Foundations of a Theory of Monetary Policy*, Princeton University Press.

A Appendix

A.1 Not controlling for past forecasts and nowcasts

By controlling for agents' past forecasts and nowcasts in the models of Section 3.1 to 3.3, we may have somewhat underestimated the effects of providing subjects with explicit nominal interest rate information. The reason for this is that the experiment featured prolonged episodes of a binding ZLB, so that a binding ZLB in one period meant that the the ZLB most likely also was binding in the previous period. This means that the explicit nominal interest rate information at the ZLB not only affected a subject's current prediction, but also his previous forecast and nowcast. By including the previous forecast and nowcast in the regressions specification, some of the treatment may therefore have been absorbed here.

The below tables indeed show that the treatment effects found in Sections 3.1 to 3.3 become larger when we do not include the past forecast and nowcast in the regression model. The previously presented results can hence be seen as reflecting a lower bound on the actual 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	0.114***	0.190***	0.123***	0.203***	0.095**	0.162***
	(0.033)	(0.050)	(0.029)	(0.053)	(0.046)	(0.050)
ZLB	0.055	0.095	0.110	0.180	-0.067	-0.099
	(0.089)	(0.119)	(0.084)	(0.118)	(0.104)	(0.129)
ZLB*T2	-0.157***	-0.162***	-0.207***	-0.254***	-0.038	0.066
	(0.034)	(0.027)	(0.036)	(0.032)	(0.045)	(0.047)
ZLB*T3	-0.136***	-0.139***	-0.230***	-0.262***	0.031	0.090
	(0.025)	(0.027)	(0.034)	(0.036)	(0.055)	(0.075)
pi(t-1)	0.885***	0.882***	0.882***	0.866***	0.892***	0.914***
	(0.016)	(0.025)	(0.016)	(0.025)	(0.027)	(0.030)
pi(t-2)	-0.060**	-0.113***	-0.049*	-0.099***	-0.081***	-0.141***
	(0.026)	(0.032)	(0.027)	(0.035)	(0.029)	(0.032)
y(t-1)	0.061**	0.146***	0.066***	0.171***	0.051	0.095**
	(0.024)	(0.028)	(0.017)	(0.026)	(0.043)	(0.038)
y(t-2)	0.046***	-0.001	0.044**	-0.004	0.049**	0.005
	(0.017)	(0.021)	(0.018)	(0.024)	(0.024)	(0.027)
Obs	17916	17660	12020	11898	5896	5762
R^2	0.778	0.713	0.791	0.732	0.753	0.679
F-stat	8775.653	6138.097	6369.172	4532.681	2507.003	1700.329

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

	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	0.039*	0.066*	0.054***	0.082**	0.011	0.035
	(0.022)	(0.039)	(0.019)	(0.040)	(0.031)	(0.041)
ZLB	0.089	0.099	0.141**	0.174	-0.030	-0.074
	(0.067)	(0.101)	(0.065)	(0.106)	(0.079)	(0.099)
ZLB*T2	-0.182***	-0.143***	-0.231***	-0.231***	-0.063*	0.077
	(0.026)	(0.033)	(0.028)	(0.038)	(0.038)	(0.052)
ZLB*T3	-0.161***	-0.125***	-0.241***	-0.265***	-0.019	0.123***
	(0.020)	(0.031)	(0.042)	(0.055)	(0.041)	(0.045)
y(t-1)	0.867***	0.919***	0.871***	0.931***	0.860***	0.894***
	(0.025)	(0.026)	(0.018)	(0.024)	(0.045)	(0.037)
y(t-2)	0.067***	-0.002	0.066***	0.003	0.068**	-0.012
	(0.019)	(0.019)	(0.018)	(0.019)	(0.028)	(0.030)
pi(t-1)	0.049***	0.073***	0.053***	0.065***	0.041**	0.090***
	(0.013)	(0.019)	(0.013)	(0.020)	(0.021)	(0.022)
pi(t-2)	-0.056***	-0.090***	-0.051***	-0.082***	-0.068***	-0.106***
	(0.016)	(0.024)	(0.016)	(0.025)	(0.022)	(0.026)
Obs	17957	17706	12081	11949	5876	5757
R^2	0.806	0.760	0.814	0.770	0.791	0.744
F-stat	10431.341	7840.985	7379.655	5570.045	3102.129	2328.472

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

	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	0.114***	0.190***	0.122***	0.202***	0.095**	0.162***
	(0.033)	(0.050)	(0.029)	(0.053)	(0.046)	(0.050)
ZLB	-0.197**	-0.190	-0.183**	-0.152	-0.170	-0.184
	(0.096)	(0.128)	(0.089)	(0.123)	(0.132)	(0.181)
ZLB*MIS	0.435***	0.557***	0.407***	0.410***	0.305**	0.474**
	(0.083)	(0.098)	(0.092)	(0.120)	(0.136)	(0.236)
ZLB*T1	0.153***	0.196***	0.018	0.038	0.185***	0.142*
	(0.035)	(0.039)	(0.035)	(0.052)	(0.060)	(0.086)
ZLB*T1*MIS	0.011	-0.146	1.220***	1.388***	-0.540***	-0.636**
	(0.121)	(0.160)	(0.229)	(0.303)	(0.179)	(0.279)
pi(t-1)	0.885***	0.882***	0.881***	0.865***	0.892***	0.914***
	(0.016)	(0.025)	(0.016)	(0.026)	(0.027)	(0.030)
pi(t-2)	-0.060**	-0.113***	-0.051*	-0.100***	-0.081***	-0.142***
	(0.026)	(0.032)	(0.027)	(0.035)	(0.029)	(0.032)
y(t-1)	0.061**	0.146***	0.067***	0.173***	0.051	0.096**
	(0.024)	(0.028)	(0.017)	(0.026)	(0.043)	(0.038)
y(t-2)	0.046***	-0.001	0.046**	-0.003	0.049**	0.006
	(0.017)	(0.022)	(0.018)	(0.024)	(0.024)	(0.027)
Obs	17916	17660	12020	11898	5896	5762
R^2	0.779	0.714	0.793	0.734	0.753	0.679
F-stat	7701.899	5388.196	5632.588	4002.113	2194.797	1489.920

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

	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	0.040*	0.067*	0.053***	0.082**	0.011	0.035
	(0.022)	(0.039)	(0.019)	(0.041)	(0.031)	(0.041)
ZLB	-0.178***	-0.173*	-0.154**	-0.114	-0.169*	-0.219*
	(0.068)	(0.105)	(0.063)	(0.105)	(0.096)	(0.131)
ZLB*MIS	0.395***	0.574***	0.335***	0.246**	0.295**	0.715***
	(0.073)	(0.104)	(0.086)	(0.112)	(0.125)	(0.195)
ZLB*T1	0.085***	0.114***	-0.102***	-0.125***	0.245***	0.265***
	(0.027)	(0.035)	(0.035)	(0.042)	(0.058)	(0.082)
ZLB*T1*MIS	0.416***	0.144	1.969***	2.213***	-0.597***	-1.058***
	(0.086)	(0.125)	(0.239)	(0.347)	(0.177)	(0.238)
y(t-1)	0.867***	0.919***	0.873***	0.933***	0.860***	0.894***
	(0.025)	(0.026)	(0.018)	(0.024)	(0.045)	(0.037)
y(t-2)	0.067***	-0.001	0.069***	0.005	0.069**	-0.011
	(0.019)	(0.020)	(0.018)	(0.019)	(0.028)	(0.030)
pi(t-1)	0.050***	0.073***	0.052***	0.064***	0.041**	0.089***
	(0.013)	(0.019)	(0.013)	(0.021)	(0.021)	(0.022)
pi(t-2)	-0.057***	-0.090***	-0.053***	-0.083***	-0.068***	-0.106***
	(0.017)	(0.024)	(0.016)	(0.026)	(0.022)	(0.027)
Obs	17957	17706	12081	11949	5876	5757
R^2	0.807	0.762	0.818	0.774	0.791	0.745
F-stat	9190.356	6906.971	6636.221	4984.642	2717.921	2048.606

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

A.2 More controls

	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	0.010	0.098	0.016	0.092	-0.002	0.110
	(0.053)	(0.077)	(0.043)	(0.066)	(0.083)	(0.113)
ZLB	0.005	0.081	0.050	0.134*	-0.110	-0.053
	(0.062)	(0.085)	(0.056)	(0.080)	(0.080)	(0.104)
ZLB*T2	-0.067***	-0.121***	-0.096***	-0.164***	0.014	0.009
	(0.025)	(0.043)	(0.023)	(0.041)	(0.044)	(0.065)
ZLB*T3	-0.041	-0.100***	-0.104***	-0.161***	0.086	0.026
	(0.032)	(0.039)	(0.028)	(0.040)	(0.053)	(0.075)
E(t-1)pi(t-1)	0.176***	0.100***	0.188***	0.132***	0.152***	0.044
	(0.041)	(0.022)	(0.046)	(0.023)	(0.049)	(0.032)
E(t-1)pi(t)	0.158***	0.266***	0.157***	0.264***	0.157***	0.265***
	(0.024)	(0.023)	(0.031)	(0.020)	(0.027)	(0.032)
pi(t-1)	0.892***	0.902***	0.886***	0.884***	0.902***	0.941***
	(0.017)	(0.022)	(0.018)	(0.022)	(0.029)	(0.037)
pi(t-2)	-0.338***	-0.405***	-0.333***	-0.409***	-0.348***	-0.399***
	(0.032)	(0.029)	(0.031)	(0.034)	(0.047)	(0.037)
pi(t-3)	-0.035	-0.034	-0.038**	-0.041*	-0.028	-0.021
	(0.021)	(0.028)	(0.018)	(0.025)	(0.032)	(0.040)
pi(t-4)	-0.001	-0.015	0.006	-0.008	-0.015	-0.027
	(0.012)	(0.020)	(0.013)	(0.018)	(0.020)	(0.033)
y(t-1)	0.067***	0.141***	0.069***	0.165***	0.064	0.088**
	(0.023)	(0.027)	(0.018)	(0.023)	(0.045)	(0.044)
y(t-2)	0.026	-0.041*	0.019	-0.049*	0.039	-0.024
	(0.017)	(0.022)	(0.019)	(0.026)	(0.027)	(0.028)
y(t-3)	-0.031*	-0.014	-0.026	-0.019	-0.042	-0.005
	(0.018)	(0.023)	(0.016)	(0.024)	(0.029)	(0.031)
y(t-4)	0.038**	0.043*	0.030*	0.038*	0.056**	0.053
	(0.017)	(0.023)	(0.017)	(0.021)	(0.026)	(0.037)
$i(t-1)$ (if obs.)	0.016	-0.004	0.021*	0.005	0.007	-0.021
	(0.014)	(0.018)	(0.012)	(0.016)	(0.022)	(0.028)
Obs	17534	17475	11812	11783	5722	5692
R^2	0.808	0.745	0.818	0.766	0.787	0.706
F-stat	5136.597	3568.676	3711.835	2696.218	1474.058	950.881

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

	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	-0.011	0.011	0.007	0.021	-0.050	-0.012
	(0.031)	(0.059)	(0.030)	(0.055)	(0.045)	(0.072)
ZLB	0.060	0.085	0.095**	0.128*	-0.042	-0.028
	(0.044)	(0.070)	(0.042)	(0.070)	(0.057)	(0.078)
ZLB*T2	-0.129***	-0.098***	-0.155***	-0.143***	-0.045	0.038
	(0.022)	(0.032)	(0.024)	(0.032)	(0.044)	(0.065)
ZLB*T3	-0.109***	-0.086***	-0.157***	-0.167***	0.002	0.070
	(0.025)	(0.032)	(0.035)	(0.046)	(0.054)	(0.044)
E(t-1)y(t-1)	0.192***	0.084**	0.245***	0.084***	0.094	0.083
	(0.050)	(0.033)	(0.060)	(0.029)	(0.068)	(0.063)
E(t-1)y(t)	0.163***	0.292***	0.151***	0.312***	0.178***	0.247***
	(0.023)	(0.026)	(0.028)	(0.030)	(0.036)	(0.034)
y(t-1)	0.878***	0.918***	0.875***	0.928***	0.883***	0.897***
	(0.023)	(0.027)	(0.019)	(0.023)	(0.043)	(0.044)
y(t-2)	-0.246***	-0.340***	-0.283***	-0.352***	-0.170***	-0.311***
	(0.035)	(0.035)	(0.042)	(0.037)	(0.044)	(0.047)
y(t-3)	-0.032**	-0.015	-0.038**	-0.024	-0.021	0.004
	(0.015)	(0.018)	(0.019)	(0.020)	(0.019)	(0.024)
y(t-4)	0.057***	0.052***	0.048**	0.044**	0.075***	0.071***
	(0.018)	(0.020)	(0.022)	(0.021)	(0.020)	(0.026)
pi(t-1)	0.056***	0.090***	0.063***	0.082***	0.040**	0.104***
	(0.013)	(0.018)	(0.014)	(0.016)	(0.020)	(0.028)
pi(t-2)	-0.057***	-0.087***	-0.053***	-0.075***	-0.066***	-0.108***
	(0.011)	(0.019)	(0.012)	(0.018)	(0.019)	(0.026)
pi(t-3)	-0.034***	-0.033*	-0.036***	-0.036*	-0.033**	-0.031
	(0.012)	(0.020)	(0.013)	(0.020)	(0.015)	(0.025)
pi(t-4)	-0.014	-0.022	-0.002	-0.014	-0.039**	-0.039*
	(0.013)	(0.016)	(0.014)	(0.016)	(0.018)	(0.022)
$i(t-1)$ (if obs.)	-0.001	-0.002	-0.000	0.002	-0.001	-0.008
	(0.009)	(0.013)	(0.009)	(0.012)	(0.013)	(0.020)
Obs	17568	17511	11863	11832	5705	5679
R^2	0.832	0.793	0.842	0.804	0.816	0.770
F-stat	6090.904	4667.718	4396.687	3390.210	1760.340	1322.336

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

	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	0.012	0.100	0.018	0.093	-0.002	0.111
	(0.053)	(0.077)	(0.043)	(0.067)	(0.082)	(0.112)
ZLB	-0.111**	-0.118*	-0.095*	-0.075	-0.101	-0.142
	(0.054)	(0.069)	(0.054)	(0.070)	(0.072)	(0.105)
ZLB*MIS	0.254***	0.364***	0.251***	0.248***	0.143	0.311
	(0.062)	(0.079)	(0.069)	(0.094)	(0.098)	(0.193)
ZLB*T1	0.067*	0.152***	-0.055	0.032	0.084	0.150*
	(0.037)	(0.047)	(0.042)	(0.055)	(0.060)	(0.084)
ZLB*T1*MIS	-0.029	-0.141	0.987***	0.838***	-0.408***	-0.484**
	(0.103)	(0.128)	(0.194)	(0.226)	(0.146)	(0.240)
E(t-1)pi(t-1)	0.176***	0.099***	0.184***	0.127***	0.152***	0.044
	(0.041)	(0.022)	(0.046)	(0.023)	(0.049)	(0.032)
E(t-1)pi(t)	0.157***	0.265***	0.155***	0.263***	0.157***	0.264***
	(0.024)	(0.022)	(0.031)	(0.020)	(0.027)	(0.032)
pi(t-1)	0.892***	0.903***	0.886***	0.884***	0.902***	0.940***
	(0.017)	(0.022)	(0.018)	(0.022)	(0.029)	(0.037)
pi(t-2)	-0.337***	-0.404***	-0.328***	-0.405***	-0.348***	-0.398***
	(0.032)	(0.029)	(0.031)	(0.034)	(0.047)	(0.037)
pi(t-3)	-0.034	-0.034	-0.038**	-0.041*	-0.028	-0.021
	(0.021)	(0.028)	(0.018)	(0.024)	(0.032)	(0.040)
pi(t-4)	-0.001	-0.014	0.006	-0.008	-0.015	-0.026
	(0.012)	(0.020)	(0.013)	(0.018)	(0.020)	(0.033)
y(t-1)	0.067***	0.140***	0.070***	0.166***	0.065	0.088**
	(0.024)	(0.027)	(0.018)	(0.023)	(0.045)	(0.044)
y(t-2)	0.026	-0.041*	0.021	-0.048*	0.040	-0.023
	(0.017)	(0.022)	(0.019)	(0.025)	(0.027)	(0.028)
y(t-3)	-0.031*	-0.015	-0.025	-0.018	-0.042	-0.006
	(0.018)	(0.023)	(0.016)	(0.024)	(0.029)	(0.031)
y(t-4)	0.038**	0.043*	0.030*	0.038*	0.055**	0.053
	(0.017)	(0.023)	(0.017)	(0.021)	(0.026)	(0.037)
$i(t-1)$ (if obs.)	0.016	-0.005	0.021*	0.004	0.007	-0.021
	(0.013)	(0.017)	(0.012)	(0.016)	(0.021)	(0.028)
Obs	17534	17475	11812	11783	5722	5692
R^2	0.808	0.746	0.819	0.767	0.787	0.706
F-stat	4798.701	3335.212	3484.639	2525.352	1375.781	888.049

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

	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	-0.009	0.014	0.007	0.020	-0.050	-0.011
	(0.031)	(0.059)	(0.030)	(0.056)	(0.044)	(0.071)
ZLB	-0.113***	-0.097*	-0.099***	-0.050	-0.096*	-0.146*
	(0.036)	(0.054)	(0.034)	(0.054)	(0.056)	(0.075)
ZLB*MIS	0.222***	0.369***	0.212***	0.139*	0.108	0.499***
	(0.057)	(0.079)	(0.060)	(0.081)	(0.111)	(0.147)
ZLB*T1	0.061**	0.089***	-0.080**	-0.074**	0.158***	0.215***
	(0.025)	(0.034)	(0.032)	(0.037)	(0.049)	(0.064)
ZLB*T1*MIS	0.288***	0.059	1.439***	1.377***	-0.409***	-0.782***
	(0.079)	(0.091)	(0.174)	(0.244)	(0.158)	(0.183)
E(t-1)y(t-1)	0.191***	0.083**	0.233***	0.073***	0.094	0.084
	(0.050)	(0.033)	(0.058)	(0.028)	(0.068)	(0.063)
E(t-1)y(t)	0.161***	0.289***	0.146***	0.307***	0.178***	0.243***
	(0.023)	(0.026)	(0.028)	(0.030)	(0.036)	(0.034)
y(t-1)	0.877***	0.918***	0.876***	0.930***	0.884***	0.898***
	(0.023)	(0.027)	(0.019)	(0.023)	(0.043)	(0.044)
y(t-2)	-0.243***	-0.336***	-0.267***	-0.337***	-0.169***	-0.308***
	(0.035)	(0.034)	(0.040)	(0.035)	(0.043)	(0.046)
y(t-3)	-0.032**	-0.015	-0.036**	-0.022	-0.021	0.003
	(0.015)	(0.018)	(0.018)	(0.019)	(0.019)	(0.025)
y(t-4)	0.057***	0.052***	0.048**	0.044**	0.074***	0.071***
	(0.018)	(0.019)	(0.022)	(0.020)	(0.020)	(0.026)
pi(t-1)	0.056***	0.091***	0.062***	0.082***	0.040**	0.103***
	(0.013)	(0.018)	(0.013)	(0.016)	(0.020)	(0.028)
pi(t-2)	-0.057***	-0.087***	-0.052***	-0.075***	-0.066***	-0.109***
	(0.011)	(0.019)	(0.012)	(0.019)	(0.019)	(0.026)
pi(t-3)	-0.034***	-0.033*	-0.037***	-0.037*	-0.033**	-0.030
	(0.012)	(0.020)	(0.012)	(0.020)	(0.015)	(0.025)
pi(t-4)	-0.014	-0.022	-0.003	-0.015	-0.039**	-0.038*
	(0.013)	(0.016)	(0.014)	(0.016)	(0.018)	(0.022)
$i(t-1)$ (if obs.)	-0.001	-0.003	-0.000	0.002	-0.001	-0.008
	(0.009)	(0.013)	(0.009)	(0.012)	(0.013)	(0.019)
Obs	17568	17511	11863	11832	5705	5679
R^2	0.833	0.793	0.843	0.806	0.816	0.770
F-stat	5700.212	4368.928	4161.543	3193.696	1643.744	1237.832

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

A.3 Panel OLS

	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	0.003	0.049*	0.007	0.076***	-0.007	-0.010
	(0.020)	(0.029)	(0.016)	(0.027)	(0.037)	(0.040)
ZLB	0.005	0.064	0.031	0.105*	-0.069	-0.035
	(0.039)	(0.060)	(0.035)	(0.057)	(0.056)	(0.082)
T2	-0.019	-0.032*	-0.012	-0.030	-0.040	-0.045
	(0.017)	(0.017)	(0.015)	(0.020)	(0.033)	(0.032)
T3	0.012	0.028*	0.017	-0.017	0.011	0.113***
	(0.016)	(0.015)	(0.014)	(0.012)	(0.029)	(0.034)
ZLB*T2	-0.056***	-0.071***	-0.067***	-0.102***	-0.017	0.015
	(0.020)	(0.023)	(0.020)	(0.027)	(0.037)	(0.040)
ZLB*T3	-0.038	-0.058**	-0.075***	-0.101***	0.049	0.034
	(0.023)	(0.027)	(0.023)	(0.024)	(0.042)	(0.057)
E(t-1)pi(t-1)	0.415***	0.266***	0.438***	0.305***	0.366***	0.198***
	(0.037)	(0.023)	(0.045)	(0.021)	(0.045)	(0.049)
E(t-1)pi(t)	0.233***	0.425***	0.236***	0.408***	0.227***	0.442***
	(0.027)	(0.024)	(0.037)	(0.021)	(0.029)	(0.039)
pi(t-1)	0.909***	0.908***	0.905***	0.892***	0.917***	0.940***
	(0.015)	(0.017)	(0.019)	(0.020)	(0.021)	(0.027)
pi(t-2)	-0.618***	-0.696***	-0.623***	-0.691***	-0.605***	-0.698***
	(0.025)	(0.027)	(0.028)	(0.032)	(0.035)	(0.034)
y(t-1)	0.040**	0.126***	0.039**	0.145***	0.039	0.083**
	(0.019)	(0.023)	(0.017)	(0.021)	(0.037)	(0.036)
y(t-2)	-0.005	-0.068***	-0.017	-0.085***	0.016	-0.034
	(0.018)	(0.022)	(0.019)	(0.024)	(0.029)	(0.031)
Obs	17534	17475	11812	11783	5722	5692
R^2	0.802	0.752	0.813	0.774	0.781	0.711
F-stat	6450.906	4816.798	4660.072	3671.233	1855.764	1271.717

* $p < .1$, ** $p < .05$, ***$p < .01$

	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	-0.025*	0.014	-0.015	0.029	-0.043**	-0.017
	(0.014)	(0.026)	(0.016)	(0.025)	(0.021)	(0.032)
ZLB	0.045	0.070	0.072**	0.105*	-0.027	-0.010
	(0.036)	(0.060)	(0.035)	(0.061)	(0.054)	(0.069)
T2	0.011	-0.032***	0.021**	-0.014	-0.018	-0.082***
	(0.008)	(0.011)	(0.009)	(0.012)	(0.013)	(0.018)
T3	0.034***	0.023*	0.037***	0.006	0.028*	0.054***
	(0.009)	(0.013)	(0.013)	(0.012)	(0.016)	(0.017)
ZLB*T2	-0.099***	-0.065***	-0.112***	-0.103***	-0.059**	0.024
	(0.012)	(0.015)	(0.018)	(0.021)	(0.023)	(0.033)
ZLB*T3	-0.081***	-0.058***	-0.118***	-0.128***	-0.007	0.060**
	(0.017)	(0.016)	(0.027)	(0.029)	(0.035)	(0.028)
E(t-1)y(t-1)	0.336***	0.179***	0.392***	0.178***	0.229***	0.185***
	(0.046)	(0.031)	(0.051)	(0.025)	(0.074)	(0.070)
E(t-1)y(t)	0.224***	0.416***	0.195***	0.411***	0.274***	0.412***
	(0.025)	(0.017)	(0.033)	(0.021)	(0.032)	(0.032)
y(t-1)	0.864***	0.909***	0.860***	0.917***	0.873***	0.891***
	(0.021)	(0.021)	(0.015)	(0.019)	(0.042)	(0.035)
y(t-2)	-0.431***	-0.534***	-0.460***	-0.529***	-0.369***	-0.532***
	(0.030)	(0.028)	(0.037)	(0.031)	(0.040)	(0.042)
pi(t-1)	0.055***	0.090***	0.062***	0.082***	0.041***	0.107***
	(0.007)	(0.011)	(0.010)	(0.012)	(0.015)	(0.017)
pi(t-2)	-0.075***	-0.108***	-0.069***	-0.096***	-0.091***	-0.130***
	(0.014)	(0.022)	(0.015)	(0.022)	(0.019)	(0.028)
Obs	17568	17511	11863	11832	5705	5679
R^2	0.823	0.788	0.833	0.800	0.806	0.764
F-stat	7438.049	5899.191	5371.610	4293.236	2145.649	1671.420

* $p < .1$, ** $p < .05$, ***$p < .01$

	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	-0.044**	0.029	-0.033*	0.059*	-0.102***	-0.054
	(0.020)	(0.031)	(0.019)	(0.032)	(0.030)	(0.049)
ZLB	-0.069*	-0.048	-0.060	-0.020	-0.060	-0.060
	(0.042)	(0.061)	(0.036)	(0.055)	(0.072)	(0.109)
MIS	0.183***	0.080*	0.235***	-0.034	0.246***	0.277**
	(0.042)	(0.042)	(0.039)	(0.046)	(0.064)	(0.120)
ZLB*MIS	0.117**	0.202**	0.127*	0.136	0.050	0.161
	(0.058)	(0.079)	(0.072)	(0.083)	(0.088)	(0.166)
T1	0.019	0.041**	-0.008	0.006	0.100**	0.096*
	(0.016)	(0.016)	(0.018)	(0.018)	(0.039)	(0.054)
T1*MIS	-0.051	-0.175**	0.072	0.103	-0.261***	-0.424***
	(0.063)	(0.082)	(0.098)	(0.121)	(0.085)	(0.157)
ZLB*T1	0.051*	0.092***	-0.017	0.038	0.077	0.084
	(0.027)	(0.031)	(0.029)	(0.037)	(0.056)	(0.072)
ZLB*T1*MIS	-0.006	-0.107	0.563***	0.413**	-0.292**	-0.318
	(0.102)	(0.133)	(0.146)	(0.189)	(0.148)	(0.212)
E(t-1)pi(t-1)	0.411***	0.264***	0.424***	0.299***	0.365***	0.196***
	(0.037)	(0.023)	(0.046)	(0.020)	(0.045)	(0.049)
E(t-1)pi(t)	0.234***	0.425***	0.238***	0.408***	0.228***	0.444***
	(0.027)	(0.025)	(0.037)	(0.020)	(0.028)	(0.038)
pi(t-1)	0.909***	0.908***	0.905***	0.892***	0.917***	0.940***
	(0.015)	(0.017)	(0.019)	(0.020)	(0.021)	(0.027)
pi(t-2)	-0.615***	-0.694***	-0.612***	-0.686***	-0.605***	-0.699***
	(0.025)	(0.027)	(0.028)	(0.032)	(0.035)	(0.033)
y(t-1)	0.040**	0.125***	0.040**	0.146***	0.040	0.084**
	(0.019)	(0.023)	(0.017)	(0.022)	(0.037)	(0.036)
y(t-2)	-0.005	-0.068***	-0.016	-0.084***	0.017	-0.033
	(0.017)	(0.022)	(0.019)	(0.024)	(0.029)	(0.031)
Obs	17534	17475	11812	11783	5722	5692
R^2	0.802	0.752	0.814	0.775	0.782	0.711
F-stat	5473.342	4076.943	3981.593	3112.554	1570.678	1073.723

* $p < .1$, ** $p < .05$, ***$p < .01$

	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	-0.017	0.020	0.002	0.032	-0.087***	-0.020
	(0.016)	(0.028)	(0.016)	(0.030)	(0.020)	(0.031)
ZLB	-0.079**	-0.053	-0.067**	-0.021	-0.062	-0.078
	(0.036)	(0.061)	(0.032)	(0.058)	(0.062)	(0.089)
MIS	0.061**	-0.034	0.074***	-0.031	0.154***	0.015
	(0.026)	(0.031)	(0.025)	(0.041)	(0.046)	(0.066)
ZLB*MIS	0.147***	0.257***	0.152***	0.080	0.031	0.335**
	(0.050)	(0.068)	(0.051)	(0.069)	(0.104)	(0.131)
T1	-0.019*	0.008	-0.028*	0.004	0.041	0.015
	(0.011)	(0.015)	(0.015)	(0.014)	(0.028)	(0.047)
T1*MIS	-0.012	-0.026	0.005	-0.001	-0.146*	-0.052
	(0.050)	(0.053)	(0.110)	(0.092)	(0.077)	(0.113)
ZLB*T1	0.049***	0.065***	-0.052**	-0.045*	0.133***	0.152**
	(0.019)	(0.023)	(0.022)	(0.025)	(0.043)	(0.066)
ZLB*T1*MIS	0.200**	0.010	1.026***	0.974***	-0.307**	-0.568***
	(0.081)	(0.089)	(0.157)	(0.193)	(0.144)	(0.180)
E(t-1)y(t-1)	0.332***	0.177***	0.372***	0.163***	0.227***	0.184***
	(0.046)	(0.030)	(0.052)	(0.024)	(0.075)	(0.070)
E(t-1)y(t)	0.224***	0.416***	0.192***	0.408***	0.277***	0.417***
	(0.025)	(0.017)	(0.032)	(0.020)	(0.032)	(0.031)
y(t-1)	0.864***	0.909***	0.862***	0.919***	0.874***	0.892***
	(0.021)	(0.021)	(0.015)	(0.019)	(0.042)	(0.035)
y(t-2)	-0.427***	-0.532***	-0.438***	-0.512***	-0.369***	-0.535***
	(0.029)	(0.028)	(0.036)	(0.029)	(0.040)	(0.041)
pi(t-1)	0.055***	0.091***	0.062***	0.082***	0.041***	0.107***
	(0.007)	(0.011)	(0.010)	(0.012)	(0.015)	(0.017)
pi(t-2)	-0.075***	-0.108***	-0.069***	-0.097***	-0.091***	-0.130***
	(0.014)	(0.022)	(0.015)	(0.022)	(0.019)	(0.028)
Obs	17568	17511	11863	11832	5705	5679
R^2	0.824	0.788	0.835	0.801	0.806	0.764
F-stat	6315.171	4994.202	4624.306	3664.063	1814.843	1406.944

* $p < .1$, ** $p < .05$, ***$p < .01$

	Full sample		Liq. trap question correct		Liq. trap question w	
	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
E(t)pi(t)-E(t-1)pi(t)	-0.331***	-0.331***	-0.339***	-0.337***	-0.316***	-0.3
	(0.037)	(0.042)	(0.041)	(0.045)	(0.033)	(0
Intercept	-0.388***	-0.264**	-0.391***	-0.287**	-0.384***	-0
	(0.131)	(0.114)	(0.132)	(0.116)	(0.130)	(0
ZLB		0.133		0.147		0
		(0.186)		(0.186)		(0
MIS		-0.477***		-0.489***		-0.7
		(0.074)		(0.092)		(0
ZLB*MIS		-0.373***		-0.308*		-0
		(0.128)		(0.171)		(0
T1		-0.141***		-0.043*		-0.3
		(0.024)		(0.025)		(0
T1*MIS		0.522***		-0.093		1.1
		(0.128)		(0.193)		(0
ZLB*T1		-0.108***		0.054		-0
		(0.037)		(0.034)		(0
ZLB*T1*MIS		-0.193		-1.796***		0
		(0.172)		(0.342)		(0
Obs	17555	17555	11829	11829	5726	5
R^2	0.106	0.113	0.106	0.125	0.106	0
F-stat	2080.322	279.066	1401.914	211.849	680.711	91

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

	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)	-0.342***	-0.344***	-0.349***	-0.350***	-0.329***	-0.334***
	(0.047)	(0.052)	(0.048)	(0.053)	(0.047)	(0.052)
Intercept	-0.166	-0.087	-0.165	-0.103	-0.170	0.002
	(0.126)	(0.067)	(0.127)	(0.068)	(0.125)	(0.069)
ZLB		0.044		0.047		-0.047
		(0.180)		(0.182)		(0.178)
MIS		-0.103**		-0.084		-0.287***
		(0.048)		(0.072)		(0.084)
ZLB*MIS		-0.393***		-0.256**		-0.287
		(0.103)		(0.129)		(0.180)
T1		-0.029**		0.008		-0.145***
		(0.014)		(0.018)		(0.037)
T1*MIS		0.173**		-0.005		0.475***
		(0.071)		(0.113)		(0.091)
ZLB*T1		-0.054		0.157***		-0.151
		(0.038)		(0.031)		(0.108)
ZLB*T1*MIS		-0.476***		-2.364***		0.537
		(0.117)		(0.275)		(0.333)
Obs	17600	17600	11887	11887	5713	5713
R^2	0.115	0.123	0.118	0.140	0.111	0.117
F-stat	2296.094	307.054	1589.138	242.301	710.192	94.215

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

A.4 Random 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	0.003	0.049*	0.007	0.076***	-0.007	-0.010
	(0.020)	(0.029)	(0.016)	(0.027)	(0.037)	(0.040)
ZLB	0.005	0.064	0.031	0.105*	-0.069	-0.035
	(0.039)	(0.060)	(0.035)	(0.057)	(0.056)	(0.082)
T2	-0.019	-0.032*	-0.012	-0.030	-0.040	-0.045
	(0.017)	(0.017)	(0.015)	(0.020)	(0.033)	(0.032)
T3	0.012	0.028*	0.017	-0.017	0.011	0.113***
	(0.016)	(0.015)	(0.014)	(0.012)	(0.029)	(0.034)
ZLB*T2	-0.056***	-0.071***	-0.067***	-0.102***	-0.017	0.015
	(0.020)	(0.023)	(0.020)	(0.027)	(0.037)	(0.040)
ZLB*T3	-0.038	-0.058**	-0.075***	-0.101***	0.049	0.034
	(0.023)	(0.027)	(0.023)	(0.024)	(0.042)	(0.057)
E(t-1)pi(t-1)	0.415***	0.266***	0.438***	0.305***	0.366***	0.198***
	(0.037)	(0.023)	(0.045)	(0.021)	(0.045)	(0.049)
E(t-1)pi(t)	0.233***	0.425***	0.236***	0.408***	0.227***	0.442***
	(0.027)	(0.024)	(0.037)	(0.021)	(0.029)	(0.039)
pi(t-1)	0.909***	0.908***	0.905***	0.892***	0.917***	0.940***
	(0.015)	(0.017)	(0.019)	(0.020)	(0.021)	(0.027)
pi(t-2)	-0.618***	-0.696***	-0.623***	-0.691***	-0.605***	-0.698***
	(0.025)	(0.027)	(0.028)	(0.032)	(0.035)	(0.034)
y(t-1)	0.040**	0.126***	0.039**	0.145***	0.039	0.083**
	(0.019)	(0.023)	(0.017)	(0.021)	(0.037)	(0.036)
y(t-2)	-0.005	-0.068***	-0.017	-0.085***	0.016	-0.034
	(0.018)	(0.022)	(0.019)	(0.024)	(0.029)	(0.031)
Obs	17534	17475	11812	11783	5722	5692
R^2	0.802	0.752	0.813	0.774	0.781	0.711
F-stat	6450.906	4816.798	4660.072	3671.233	1855.764	1271.717

* $p < .1$, ** $p < .05$, ***$p < .01$

	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	-0.025*	0.014	-0.015	0.029	-0.043**	-0.017
	(0.014)	(0.026)	(0.016)	(0.025)	(0.021)	(0.032)
ZLB	0.045	0.070	0.072**	0.105*	-0.027	-0.010
	(0.036)	(0.060)	(0.035)	(0.061)	(0.054)	(0.069)
T2	0.011	-0.032***	0.021**	-0.014	-0.018	-0.082***
	(0.008)	(0.011)	(0.009)	(0.012)	(0.013)	(0.018)
T3	0.034***	0.023*	0.037***	0.006	0.028*	0.054***
	(0.009)	(0.013)	(0.013)	(0.012)	(0.016)	(0.017)
ZLB*T2	-0.099***	-0.065***	-0.112***	-0.103***	-0.059**	0.024
	(0.012)	(0.015)	(0.018)	(0.021)	(0.023)	(0.033)
ZLB*T3	-0.081***	-0.058***	-0.118***	-0.128***	-0.007	0.060**
	(0.017)	(0.016)	(0.027)	(0.029)	(0.035)	(0.028)
E(t-1)y(t-1)	0.336***	0.179***	0.392***	0.178***	0.229***	0.185***
	(0.046)	(0.031)	(0.051)	(0.025)	(0.074)	(0.070)
E(t-1)y(t)	0.224***	0.416***	0.195***	0.411***	0.274***	0.412***
	(0.025)	(0.017)	(0.033)	(0.021)	(0.032)	(0.032)
y(t-1)	0.864***	0.909***	0.860***	0.917***	0.873***	0.891***
	(0.021)	(0.021)	(0.015)	(0.019)	(0.042)	(0.035)
y(t-2)	-0.431***	-0.534***	-0.460***	-0.529***	-0.369***	-0.532***
	(0.030)	(0.028)	(0.037)	(0.031)	(0.040)	(0.042)
pi(t-1)	0.055***	0.090***	0.062***	0.082***	0.041***	0.107***
	(0.007)	(0.011)	(0.010)	(0.012)	(0.015)	(0.017)
pi(t-2)	-0.075***	-0.108***	-0.069***	-0.096***	-0.091***	-0.130***
	(0.014)	(0.022)	(0.015)	(0.022)	(0.019)	(0.028)
Obs	17568	17511	11863	11832	5705	5679
R^2	0.823	0.788	0.833	0.800	0.806	0.764
F-stat	7438.049	5899.191	5371.610	4293.236	2145.649	1671.420

* $p < .1$, ** $p < .05$, ***$p < .01$

	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	-0.044**	0.029	-0.033*	0.059*	-0.102***	-0.054
	(0.020)	(0.031)	(0.019)	(0.032)	(0.030)	(0.049)
ZLB	-0.069*	-0.048	-0.060	-0.020	-0.060	-0.060
	(0.042)	(0.061)	(0.036)	(0.055)	(0.072)	(0.109)
MIS	0.183***	0.080*	0.235***	-0.034	0.246***	0.277**
	(0.042)	(0.042)	(0.039)	(0.046)	(0.064)	(0.120)
ZLB*MIS	0.117**	0.202**	0.127*	0.136	0.050	0.161
	(0.058)	(0.079)	(0.072)	(0.083)	(0.088)	(0.166)
T1	0.019	0.041**	-0.008	0.006	0.100**	0.096*
	(0.016)	(0.016)	(0.018)	(0.018)	(0.039)	(0.054)
T1*MIS	-0.051	-0.175**	0.072	0.103	-0.261***	-0.424***
	(0.063)	(0.082)	(0.098)	(0.121)	(0.085)	(0.157)
ZLB*T1	0.051*	0.092***	-0.017	0.038	0.077	0.084
	(0.027)	(0.031)	(0.029)	(0.037)	(0.056)	(0.072)
ZLB*T1*MIS	-0.006	-0.107	0.563***	0.413**	-0.292**	-0.318
	(0.102)	(0.133)	(0.146)	(0.189)	(0.148)	(0.212)
E(t-1)pi(t-1)	0.411***	0.264***	0.424***	0.299***	0.365***	0.196***
	(0.037)	(0.023)	(0.046)	(0.020)	(0.045)	(0.049)
E(t-1)pi(t)	0.234***	0.425***	0.238***	0.408***	0.228***	0.444***
	(0.027)	(0.025)	(0.037)	(0.020)	(0.028)	(0.038)
pi(t-1)	0.909***	0.908***	0.905***	0.892***	0.917***	0.940***
	(0.015)	(0.017)	(0.019)	(0.020)	(0.021)	(0.027)
pi(t-2)	-0.615***	-0.694***	-0.612***	-0.686***	-0.605***	-0.699***
	(0.025)	(0.027)	(0.028)	(0.032)	(0.035)	(0.033)
y(t-1)	0.040**	0.125***	0.040**	0.146***	0.040	0.084**
	(0.019)	(0.023)	(0.017)	(0.022)	(0.037)	(0.036)
y(t-2)	-0.005	-0.068***	-0.016	-0.084***	0.017	-0.033
	(0.017)	(0.022)	(0.019)	(0.024)	(0.029)	(0.031)
Obs	17534	17475	11812	11783	5722	5692
R^2	0.802	0.752	0.814	0.775	0.782	0.711
F-stat	5473.342	4076.943	3981.593	3112.554	1570.678	1073.723

* $p < .1$, ** $p < .05$, ***$p < .01$

	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	-0.017	0.020	0.002	0.032	-0.087***	-0.020
	(0.016)	(0.028)	(0.016)	(0.030)	(0.020)	(0.031)
ZLB	-0.079**	-0.053	-0.067**	-0.021	-0.062	-0.078
	(0.036)	(0.061)	(0.032)	(0.058)	(0.062)	(0.089)
MIS	0.061**	-0.034	0.074***	-0.031	0.154***	0.015
	(0.026)	(0.031)	(0.025)	(0.041)	(0.046)	(0.066)
ZLB*MIS	0.147***	0.257***	0.152***	0.080	0.031	0.335**
	(0.050)	(0.068)	(0.051)	(0.069)	(0.104)	(0.131)
T1	-0.019*	0.008	-0.028*	0.004	0.041	0.015
	(0.011)	(0.015)	(0.015)	(0.014)	(0.028)	(0.047)
T1*MIS	-0.012	-0.026	0.005	-0.001	-0.146*	-0.052
	(0.050)	(0.053)	(0.110)	(0.092)	(0.077)	(0.113)
ZLB*T1	0.049***	0.065***	-0.052**	-0.045*	0.133***	0.152**
	(0.019)	(0.023)	(0.022)	(0.025)	(0.043)	(0.066)
ZLB*T1*MIS	0.200**	0.010	1.026***	0.974***	-0.307**	-0.568***
	(0.081)	(0.089)	(0.157)	(0.193)	(0.144)	(0.180)
E(t-1)y(t-1)	0.332***	0.177***	0.372***	0.163***	0.227***	0.184***
	(0.046)	(0.030)	(0.052)	(0.024)	(0.075)	(0.070)
E(t-1)y(t)	0.224***	0.416***	0.192***	0.408***	0.277***	0.417***
	(0.025)	(0.017)	(0.032)	(0.020)	(0.032)	(0.031)
y(t-1)	0.864***	0.909***	0.862***	0.919***	0.874***	0.892***
	(0.021)	(0.021)	(0.015)	(0.019)	(0.042)	(0.035)
y(t-2)	-0.427***	-0.532***	-0.438***	-0.512***	-0.369***	-0.535***
	(0.029)	(0.028)	(0.036)	(0.029)	(0.040)	(0.041)
pi(t-1)	0.055***	0.091***	0.062***	0.082***	0.041***	0.107***
	(0.007)	(0.011)	(0.010)	(0.012)	(0.015)	(0.017)
pi(t-2)	-0.075***	-0.108***	-0.069***	-0.097***	-0.091***	-0.130***
	(0.014)	(0.022)	(0.015)	(0.022)	(0.019)	(0.028)
Obs	17568	17511	11863	11832	5705	5679
R^2	0.824	0.788	0.835	0.801	0.806	0.764
F-stat	6315.171	4994.202	4624.306	3664.063	1814.843	1406.944

* $p < .1$, ** $p < .05$, ***$p < .01$

	Full sample		Liq. trap question correct		Liq. trap question w	
	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
E(t)pi(t)-E(t-1)pi(t)	-0.349***	-0.349***	-0.350***	-0.350***	-0.347***	-0.3
	(0.035)	(0.039)	(0.037)	(0.041)	(0.032)	(0
Intercept	-0.391	-0.267	-0.394	-0.289	-0.385	-0
	(0.507)	(0.457)	(0.531)	(0.476)	(0.461)	(0
ZLB		0.132		0.146		0
		(0.189)		(0.191)		(0
MIS		-0.453**		-0.468**		-0.7
		(0.183)		(0.233)		(0
ZLB*MIS		-0.389***		-0.320**		-0
		(0.118)		(0.127)		(0
T1		-0.143**		-0.038		-0.3
		(0.071)		(0.078)		(0
T1*MIS		0.486		-0.190		1.1
		(0.315)		(0.444)		(0
ZLB*T1		-0.110***		0.044*		-0
		(0.035)		(0.026)		(0
ZLB*T1*MIS		-0.142		-1.686***		0
		(0.150)		(0.216)		(0
Obs	17555	17555	11829	11829	5726	5
R^2	0.148	0.150	0.144	0.151	0.154	0
F-stat	3044.964	385.899	1996.300	262.147	1042.589	91

* $p < .1$, ** $p < .05$, ***$p < .01$

	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)	-0.350***	-0.353***	-0.349***	-0.351***	-0.353***	-0.334***
	(0.044)	(0.049)	(0.046)	(0.051)	(0.042)	(0.052)
Intercept	-0.168	-0.084	-0.165	-0.103	-0.173	0.002
	(0.330)	(0.237)	(0.312)	(0.215)	(0.336)	(0.069)
ZLB		0.042		0.047		-0.047
		(0.183)		(0.185)		(0.178)
MIS		-0.118		-0.076		-0.287***
		(0.112)		(0.144)		(0.084)
ZLB*MIS		-0.381***		-0.263**		-0.287
		(0.095)		(0.118)		(0.180)
T1		-0.034		0.002		-0.145***
		(0.040)		(0.042)		(0.037)
T1*MIS		0.196		0.019		0.475***
		(0.140)		(0.256)		(0.091)
ZLB*T1		-0.050		0.161***		-0.151
		(0.037)		(0.032)		(0.108)
ZLB*T1*MIS		-0.485***		-2.375***		0.537
		(0.112)		(0.269)		(0.333)
Obs	17600	17600	11887	11887	5713	5713
R^2	0.133	0.138	0.129	0.142	0.141	0.117
F-stat	2700.525	351.213	1757.505	245.315	940.543	94.215

* $p < .1$, ** $p < .05$, ***$p < .01$