Price level versus inflation targeting under heterogeneous expectations: a laboratory experiment

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Abstract

Since the 2007 crisis, macroeconomists have been interested in monetary policies that could help with stabilizing inflation and output (Honkapohja, 2015). Two ideas gained particular attention: (i) that inflation should be replaced by the nominal price level (PLT) as the target for the central bank; and (ii) that the central bank should provide explicit guidance about its interest rate rule. We conduct a laboratory experiment to test the validity of these two hypotheses.

Our experiment uses a Learning-to-Forecast design based on a simple DSGE economy. Subjects are given a qualitative description of the economy and are asked to predict inflation and output gap two-periods ahead for 50 periods. There are five treatments. Baseline treatment (1) incorporates a standard inflation targeting rule. The other four treatments utilize a PLT Taylor rule and are based on a two-by-two design: a 'weak' PLT rule (2) with guidance and (3) without guidance; and a 'strong' PLT rule (4) with guidance and (5) without guidance.

We find that subjects within each treatment coordinate on similar behavior, but large differences between the treatments prevail. Guidance has a negligible effect, whereas a weak or strong Taylor rule specification turns out to be crucial for stability. PLT can be a robust monetary policy, but only if it is sufficiently responsive to the deviations of output and prices.

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1 Introduction

Until the second half of the 2000's, most economists and policy makers believed that the monetary policy, embodied by the well known Taylor rule, reached mature and satisfying level. Central banks began applying inflation target based interest rate rules in the 1980s, and this coincided with a period known as the Great Moderation, a quarter of century of relatively small inflation and output volatility in developed countries. Many empirical studies would in fact claim to identify the monetary policy as one of the most important factors leading to the Great Moderation, as it stabilized the propagation mechanisms of economic shocks (the so called 'policy hypothesis', see Cogley and Sargent, 2005; Galí and Gambetti, 2009; Giannone et al., 2008, for an overview).

Once the 2007 crisis erupted, central banks accordingly cut their interest rates, but, as soon became apparent, this response proved too slow to counter the unfolding recession. What made matters worse was that, despite the interest rates of many central banks approaching the zero lower bound, the recession remained rampant, leaving little space for conventional policies (Chen et al., 2015). For example, the FED kept its interest rate at 0.25% level from December 2008 until December 2015, and then below 1% until March 2017. Nevertheless, the GDP growth in the US through these years was close to only 2%, and the employment has recovered to the pre-crisis level only by the end of 2016. An even more striking example comes with the events in Europe. The ECB also cut interest rates (though not as aggressively as the FED), but after a brief recovery in 2010 and 2011, the Euro Area experienced another year of negative growth. In addition, this output contraction hit some countries particularly strong, often causing major political disturbances, as in the case of Greece or Spain. See also Reifschneider and Roberts (2006) for a study of a similar crisis in Japan.

The events of the crisis inspired a wave of macroeconomic literature on robust monetary policy (Boivin et al., 2010; Chung et al., 2015; Krugman, 2014; Summers, 2014; Woodford, 2012). The question is how to pull the economies from the current recession (Bech et al., 2014; Yellen, 2013), but also how to prevent such big recessions in the future. Two policy alternatives gained particular attention: guidance and nominal price-level targeting (PLT) (Honkapohja and Mitra, 2014).

In this paper we report a macroeconomic laboratory experiment, in which we evaluate these two alternative monetary policies: guidance and PLT. Subjects were tasked with forecasting inflation and output gap in a simple economy, which was based on a standard Dynamic Stochastic General Equilibrium model (DSGE) with zero lower bound on the interest rate set by the central bank.

The usual definition of PLT is that the central bank pursues a Taylor rule, trying to steer the inflation such that the whole *price level trajectory* follows a preplanned path with a fixed trend (Giannoni, 2010). Guidance in its broadest definition means that the central bank tries to manage inflation expectations by a public commitment to a certain policy (Magill and Quinzii, 2014). For instance, during a period of recession, the central bank could acknowledge to keep its interest rate at a low value for a longer period; or it could explicate conditions under which it would raise the interest rate again.

The underlying idea of both the guidance and the PLT policies is that they give economic agents more information about the monetary policy, see Covas and Zhang (2010) for a discussion about the PLT and Femia et al. (2013) for an empirical evaluation of FED's guidance. Under rational expectations (RE), this allows to curb the business cycle, and speeds up recovery from large technology shocks (Evans, 2012). However, much of these results rely on the assumption of RE. The recent crisis shows that the empirical validity of RE is questionable (Cornea-Madeira et al., 2017), and as a result, these policy measures should be tested in a more realistic environment, which allows the agents to *learn and adapt new information* (Anufriev et al., 2013). One such interesting study was conducted by Honkapohja and Mitra (2014), who show that under adaptive (econometric) learning, PLT policy can be stabilizing only if the agents are aware of it, that is only if the bank provides some guidance about its policy. This is an important result, as adaptive learning is still quite a small departure from perfect rationality.

The goal of our paper is to provide an experimental test for the theoretical findings on PLT and guidance. Laboratory experiments are a novel approach in empirical macroeconomics (Assenza et al., 2013; Hommes et al., 2015). The idea is to take a macroeconomic model, and replace economic agents with real subjects. The subjects then are tasked to decide on consumption, or to forecast aggregate variables as in Learning-to-Forecast experiments (Bao et al., 2017; Hommes, 2011). There are several virtues of this approach. In an experiment, unlike in real economies, the researcher can easily control the setup of the markets and manipulate policy measures and fundamentals. It is possible to directly observe the decisions or expectations of the subjects, and to obtain rich samples, in terms of both the number of independent observations from a constant environment (groups within a treatment), as well as of the time span within each group. Finally, macroeconomic models with micro-foundations aim at describing the 'everyman', normal consumers, many of whom have little or no economic education, similar to the subjects that were invited to our experiment.

To the best of our knowledge, the experimental literature on the role of guidance for monetary policy is limited, and does not unequivocally support this policy. Arifovic and Petersen (2017) report that subjects find it easier to coordinate on a path leading from ZLB if the central bank uses qualitative instead of quantitative guidance. Furthermore Mokhtarzadeh and Petersen (2017) show that when the central bank tries to manage subjects' expectations through its projections, subjects react better (and coordinate on more stable dynamics) to inflation and output projections than to direct interest rate projections. This contradicts usefulness of what is typically meant as guidance by the interest rate. A similar experiment by Ahrens et al. (2017) proves that only "high-quality" inflation projections can play such a stabilizing role.

We are aware of only one experimental study on the role of PLT. Amano et al. (2011) use a standard DSGE model with inflation target and PLT Taylor rules to generate artificial, non-persistent inflation time series. Next, subjects are asked to forecast these inflation sequences. The authors find that the subjects predict inflation as if it was persistent (*c.f.,* Huber et al., 2010; Mokhtarzadeh and Petersen, 2017), and that they under-react to the observed price level deviation. This study, however, uses exogenous inflation time-series, and therefore cannot reliably evaluate individual learning or stability properties of PLT monetary policy. Nevertheless, we will confirm the pattern of the individual behavior, which was reported by Amano et al. (2011), in our laboratory study where inflation and output gap depend on the individual forecasts.

Our experiment is inspired by Honkapohja and Mitra (2014) and based on a simple DSGE model with Euler learning. We emphasize that we use the nonlinear version of the model, which allows us to study the off-equilibrium behavior of our subjects. This links our study to the ZLB experiment by Hommes et al. (2015), though, unlike that paper, we focus on linear Taylor rules and constant fiscal policy. We run five treatments in total, which vary in terms of the monetary policy and subject information. First, we look at the baseline case of inflationary targeting. All other four treatments are based on a PLT Taylor rule, with weak or strong response coefficients, and with or without guidance. The difference between the strong and weak PLT Taylor rules is that the weak rule (suggested by Honkapohja and Mitra, 2014) is stable under adaptive learning, but not under naive expectations, while the strong one is stable under both.

In our experiment, following the definition of Honkapohja and Mitra (2014), we take guidance in its simplest form. To be specific, in the guidance treatments, the subjects are explicitly informed about the role of the price level deviation in the monetary rule; and during the experiment, this variable belongs to their information set.

The experiment results in two major findings. First, guidance essentially plays no role, as the difference between guidance and no-guidance treatments is negligible. This implies that the subjects either did not consider, or could not properly use the additional information given by the central bank. Secondly, the PLT treatments were stable only under the strong rule (with inflation even more stable than under the inflation treatment). This suggests that the central bank may find it very difficult to compensate weak monetary policy with guiding markets by providing additional information about its target. Our experiment also show that the subjects coordinated on simple forecasting rules, but the type of coordination depends on the specific Taylor rule.

The paper is organized in the following way. Section 2 discusses the experimental design and some theoretical issues, which underlay our experiment. Section 3 shows the experimental results and discusses the individual behavior of our subjects. Section 4 concludes and finally, experimental instructions and details on the econometric analysis can be found in the appendices.

2 Experimental design

In this section we discuss the design of the experiment. Section 2.1 provides the details of the design. Sections 2.2 and 2.3 discuss the information, which we have provided to the subjects, as well as the specific framing of the guidance. Section 2.4 formalizes the DSGE model that served as a foundation of the experimental economy. In section 2.6 we formalize the hypotheses of our experiment.

2.1 Experimental treatments

Our experiment is based on a standard DSGE model with a zero-lower bound on the interest rate and Rotemberg price stickiness (we provide the details of the model in Subsection 2.4). The central bank follows a Taylor rule with either inflation target or nominal price level target. There are two state variables in the model: output y_t, (gross) inflation π_t, and in addition the policy variable, the (gross) interest rate R_t. The realized state of the economy depends on the expectations of future inflation and output. One can show that this model has two steady states (with self-fulfilling expectations): (1) full employment with inflation equal to the central bank's target π^* and the corresponding output y^* and interest rate R^*; and (2) the zero-lower bound steady state (ZLB) such that $R^Z = 1$, with corresponding inflation $\pi^Z < 1$ (*ie.*, with negative net inflation), and output, which is below its potential value, *ie.*, $y^Z < y^*$.

Regardless of the treatment, there are $I = 6$ six subjects per group who participate in a 51 periods long session. Within each period, each subject is asked to provide his or her *net* inflation forecast two periods ahead $\pi^e_{i,t+1}$ (the index $t+1$ indicates the period, for which the forecast is formulated), and his or her output gap forecast two periods ahead $o^e_{i,t+1}$. The relationship between the output gap and output level is given by

$$o_t = 100\frac{y_t - y^*}{y^*}. \tag{1}$$

We decided to ask the subjects for the output gap forecasts in order to facilitate initial learning, as this variable has a simple interpretation and its level does not depend on the specific calibration (which we did not show to the subjects). In the instructions and experimental interface, the inflation and output gap are framed as percentage points, for example $\pi^e_{i,t+1} = 1$ corresponds with a forecast of one percentage point of net inflation. These forecasts are used to compute the subjects' average gross inflation forecast $\bar{\pi}^e_{t+1}$ and the subjects' average consumption level forecast $\bar{c}^e_{t+1}$, which in turn are plugged into the DSGE model to determine the realized contemporary inflation π_t, output level y_t (which equals the realized consumption c_t plus fixed government spending $g_t = g$) and interest rate R_t. Subjects observe these realized variables as new net inflation, output gap and net interest rate, and the group moves to the next period.

The information provided to the subjects is discussed in detail in Subsection 2.2. In summary, each subject is given only a qualitative description of the economy, and can observe only the realized aggregate variables and her or his own forecasts and payoffs.

Subjects are paid in the same way across all five treatments. For every inflation and output gap forecast we compute score as

$$
\begin{aligned}
\text{Points}^{\pi}_{i,t} =& 100 \frac{1}{1 + |\pi^e_{i,t} - \pi_t|} \in (0, 100], \\
\text{Points}^{y}_{i,t} =& 100 \frac{1}{1 + |o^e_{i,t} - o_t|} \in (0, 100],
\end{aligned}
$$

so for example if a subject predicts -1% inflation, whereas the realized inflation is equal to -4%, the subject would receive 25 points for this forecast. At the end of the group's session, for each subject we add separately inflation and output gap scores, and pay only for inflation forecasting accuracy, or only for output gap forecasting accuracy randomly with probability 0.5 (following a roll of dice), with the exchange rate of 0.75 Euro for every 100 points. This means that the subjects could earn anything between 0 and 37.5 Euro. We decided to pay randomly for one task only in order to motivate subjects to pay high attention to both forecasting tasks, and to discourage them from hedging.

Our experiment has five treatments. There are two treatment differences: the specification of the Taylor rule, and in addition, subjects may or may not receive guidance in the form of additional information about the monetary policy of the central bank. These five treatments are:

1. **INF** – Central Bank uses a Taylor rule with *inflation target*, given by

$$
\text{IFT: } R_t = 1 + \max\left\{0, R^* - 1 + \psi_\pi \left(\pi^e_{t+1} - \pi^*\right) + \psi_y \frac{y^e_{t+1} - y^*}{y^*}\right\}, \tag{2}
$$

   which is bounded from below by unity and where $\psi_\pi = 1.5$ and $\psi_y = 1$ are two policy parameters. We used these values as they guarantee that the economy is stable under naive expectations (see the model discussion in Subsection 2.4). This is the baseline treatment.

In the other four treatments, the Central Bank always uses *a nominal price level target* in its Taylor rule, which is given by

$$
\text{PLT: } R_t = 1 + \max\left\{0, R^* - 1 + \psi_P \frac{P^e_{t+1} - \bar{P}_{t+1}}{\bar{P}_{t+1}} + \psi_y \frac{y^e_{t+1} - y^*}{y^*}\right\}, \tag{3}
$$

where $\bar{P}_t \equiv \pi^* \bar{P}_{t-1}$ defines the trajectory which the central bank takes as the intended price path (note that it is based on the same inflation target level π^* as in the **INF** treatment). This leads to the following four treatments based on a 2×2 design:

2. **StrongNo** – Strong PLT rule (3) with *high* policy parameters $\psi_P = 3$ and $\psi_y = 2$;

3. **WeakNo** – Weak PLT rule (3) with *low* policy parameters $\psi_P = 0.25$ and $\psi_y = 1$;

4. **StrongGuid** – Strong PLT rule (3) with *high* policy parameters $\psi_P = 3$ and $\psi_y = 2$ and additional guidance provided by the central bank to the subjects;
5. **WeakGuid** – Weak PLT rule (3) with *low* policy parameters $\psi_P = 0.25$ and $\psi_y = 1$ and additional guidance provided by the central bank to the subjects.

The weak PLT rule corresponds to $\psi_P = 0.25$ and $\psi_y = 1$ (as in Honkapohja and Mitra, 2014), while the strong PLT rule corresponds with $\psi_P = 3$ and $\psi_y = 2$. Notice that the strong rule is quite harsh, as *e.g.*, one percentage point of the output gap implies that the interest rate increases by two percentage points. The difference between weak and strong PLT rules is that only the model with the strong rule is stable under homogeneous naive expectations. On the other hand, the weak rule is stable under adaptive learning, and correspondingly was suggested by the learning literature (Honkapohja and Mitra, 2014). Therefore, differences between treatments 2 and 3, and between 4 and 5 will allow us to test whether subjects are closer to a simple forecasting rule, such as naive expectations, or whether they are actually able to use more sophisticated adaptive learning.

As will be explained in Subsection 2.3, guidance means that the subjects are given additional information about the behavior of the central bank, namely that the central bank intends to keep prices at a certain trajectory. On the other hand, subjects in the two PLT treatments without guidance are given the same information as those in the inflation targeting. This allows us to directly test whether a simple version of guidance can help the central bank in stabilizing the business cycle.

2.2 Information provided to subjects

In all five treatments, subjects are told that they act as professional forecasters for a statistical bureau. We inform the subjects that they belong to a fixed group and that other subjects have the same task, but we do not specify the exact size or composition of their groups. We provide the subjects with a qualitative description of the economy. In particular, subjects are informed about the positive and negative signs of the relationship between their predictions and the realized interest rate, inflation and output gap. However, we do not show the subjects the exact mathematical formulation of the DSGE model that is underlying the experimental economy, and subjects do not know the Taylor rule, with which the central bank sets the interest rate.

Every subject is informed that she or he will observe the past realized inflation, output gap and interest rate, as well as her or his own past inflation and output gap forecasts, and the corresponding earnings. However, no subject is shown the forecasts or score of any other subject. Since, the experimental economy is based on a two-period ahead expectations feedback, we inform the subjects that they will receive information about their performance and the realized variables only after the first two forecasts. In order to guide them in these initial periods, we mention in the instructions that both the inflation and output gap 'have historically been between -5% and 8%'.

The difference between treatments **INF**, **StrongNo** and **WeakNo** (no guidance) on the one hand, and **StrongGuid** and **WeakGuid** (guidance) on the other hand, is that the subjects *in the guidance treatments **StrongGuid** and **WeakGuid** receive additional information about the interest rate policy of the Central Bank*. Namely, we explain in detail that the central banks wants the price level to follow a certain trajectory. We inform them that they cannot directly observe that path, but they will be given the exact value of the deviation of the prices from this path, that is, subjects observe the $\left(P_{t-1} - \bar{P}_{t-1}\right)/\bar{P}_{t-1}$ variable. Subjects are informed that the Central Bank increases (decreases) the interest rate when the predicted price level deviation is too high (too low).

Subjects' inflation and output gap forecasts have to stay within the $[-5\%, 15\%]$ interval (regardless of the treatment), to rule out explosive dynamics. However, we did not want the framing to preclude subject coordination on the run-away trajectories, as not to interfere with the initial learning periods. Therefore, subjects were not initially informed about the constraint on their forecasts. Instead, the subject interface was programmed to issue a warning whenever a subject would try to submit a forecast outside of the allowed interval.

The instructions cover in detail this information. In addition, they contain a table and graph of the payoff function, and explain screenshots of the subject screen. During the session, subject's screen displays graphs and tables of the realized variables (inflation, output gap, interest rate; and under the guidance treatments the price level deviation), the individual past forecasts and scores (per period and accumulated), number of the current period and remaining number of forecasts that the subjects should submit this period. We use a number of control questions to test whether the subjects understand the instructions. Appendix A contains the instructions and control questions for the different treatments.

2.3 Guidance specification

In our experiment, guidance implies that (1) the subjects are explicitly informed that the central bank *commits* to minimizing price level deviations, and (2) throughout the session the subjects are informed (by a graph and table) about the realized values of this variable. This is the simplest possible version of guidance, which provides subjects with the knowledge about central bank's target and reaction to the realized price deviation path which they observe throughout their session. In contrast, under the non-guidance treatments, subjects are only informed that the central bank will increase (decrease) the interest rate when inflation and/or output gap forecasts too high (too low), without any further details on the target of the Central Bank.[1]

[1] The term 'guidance' has different meanings in the macroeconomic literature. In particular, 'forward guidance' means that the central bank announces, and commits to an interest rate policy such that if inflation or output fall below a specific threshold, the central bank will keep the nominal interest rate at some low level for a predetermined number of periods. This version of guidance requires a number of more complex design choices (like the threshold conditions, value and duration of the 'low nominal interest rate'). For forward-guidance experiments, see Ahrens et al. (2017) and and Mokhtarzadeh and Petersen (2017).

2.4 Experimental economy

The economy in our experiment is based on a standard DSGE model with zero lower bound and Rotemberg price stickiness, in its Euler learning form. For the derivation of the model, see for example Honkapohja and Mitra (2014).[2] The model is based on a representative Ricardian consumer-firm owner, who maximizes an infinite discounted sum of utility subject to standard production, saving and market clearing conditions. Assuming fixed government spending $g_t = g$, non-distortionary lump-sum taxes and an interest rate rule $R_t(\cdot)$, the model can be described as a two dimensional system such that in period t, the consumption level c_t and the gross inflation π_t are a function of the two-period ahead consumer expectations of these two variables. The relationship is given by the following set of nonlinear equations:

1. The aggregate consumption:

$$c_t = c_{t+1}^e \left(\frac{\pi_{t+1}^e}{\beta R_t}\right)^{1/\sigma} + \varepsilon_t^c. \tag{4}$$

2. The Phillips curve:

$$\pi_t = Q^{-1}[K(c_t, \pi_{t+1}^e)] + \varepsilon_t^\pi, \tag{5}$$

where

$$Q(\pi_t) = (\pi_t - 1)\pi_t$$

and[3]

$$\kappa(c_t, \pi_{t+1}^e) = \beta\pi_{t+1}^e(\pi_{t+1}^e - 1) + \frac{\nu}{\alpha\gamma}(c_t + \bar{g})^{(1+\varepsilon)/\alpha} + \frac{1-\nu}{\gamma}(c_t + \bar{g})c_t^{-\sigma}, \tag{6}$$

$$K(c_t, \pi_{t+1}^e) = \begin{cases} \kappa(c_t, \pi_{t+1}^e) & \text{if } \kappa(c_t, \pi_{t+1}^e) > -0.25, \\ -0.25 & \text{else.} \end{cases}$$

Notice that the interest rate rule $R_t(\cdot)$ depends on the treatment. It is either based on an inflation target (2) or price level target (3). In the latter case, the central bank keeps track of the realized price level, which increases the dimensionality of the model to three. Table 1 summarizes the parameter values, and the corresponding full employment and ZLB steady states. The two small noise terms in equations (4) and (5) are uncorrelated IID shocks to the consumption and inflation, such that $\varepsilon_t^c \sim NID\left(0, (0.0005c^*)^2\right)$, $\varepsilon_t^\pi \sim NID\left(0, 0.0005^2\right)$ and $Cov\left(\varepsilon_t^c, \varepsilon_t^\pi\right) = 0$. The small variance of the two noise terms was chosen so that if the

[2]Remark that Honkapohja and Mitra (2014) use so-called steady state learning version of the DSGE model for their adaptive learning. We decided to use the Euler learning instead, as the DSGE model under steady state learning and naive expectations is extremely unstable. As it will be apparent in the next section, naive expectations fit the behavior of our subjects better than the adaptive learning.

[3]The lower bound $K(\cdot) > -0.25$ in equation (6) is necessary to avoid complex values of the realized inflation, and corresponds with realized gross inflation $\pi_t = 0.5$.

Parameter	Notation	Value
Number of agents/subjects	I	6
Discount factor	β	0.99
Government spending	$\bar{g}$	0.2
Output elasticity	α	0.7
Rotemberg price stickiness	γ	350
Labor supply elasticity	ϵ	1
Demand's elasticity of substitution	ν	21
Consumption elasticity	σ	1
Gross inflation target	π^*	1.05
Steady state gross interest rate	R^*	1.(06)
Steady state consumption	c^*	0.745358
Steady state output	y^*	0.945358
ZLB gross inflation	π^Z	0.99
ZLB gross interest rate	R^Z	1
ZLB consumption	c^Z	0.742765
ZLB output	y^Z	0.942765
ZLB output gap	o^Z	-0.2766%
Taylor rules		
Inflation target rule	(ψ_π, ψ_y)	$(1.5, 1)$
Weak PLT rule	(ψ_P, ψ_y)	$(0.25, 1)$
Strong PLT rule	(ψ_P, ψ_y)	$(3, 2)$

Table 1: Experimental economy parametrization.

agents would repeatedly forecast the full employment steady state, the realized inflation and consumption both stay within one permil point (0.1%) of the steady state 95% of time.

Under Rational Expectations, the model is solved to obtain model consistent expectations such that for every period t it holds that $\pi^e_{t+1} = E_t(\pi_{t+1})$ and $c^e_{t+1} = E_t(c_{t+1})$, that is the representative consumer does not make systematic errors. However, in the experiment we take the average net inflation and output gap forecasts of the six subjects, transform them into the consumption level and gross inflation level forecasts and directly input them into the interest rate rule ((2) in treatment **INF**, and (3) in treatments **StrongNo**, **WeakNo**, **StrongGuid** and **WeakGuid**), the consumption rule (4) and finally the Phillips curve (5). Notice that the permitted forecasting intervals (between -5% and 15%) allow for coordination on the ZLB steady state, as well as on interesting dynamics around both steady states.

Previous experimental work suggests that subjects may fail to form rational expectations. Instead, we expect their forecasts to be much closer to adaptive expectations (Assenza et al., 2013; Hommes et al., 2015; Pfajfar and Žakelj, 2016). Under pure naive expectations, treatment **INF** is stable. As for the PLT treatments, guidance plays no role under naive expectations. On the other hand, the Taylor rule parametrization is crucial. The PLT Taylor rule with $(\psi_P, \psi_y) = (0.25, 1)$ (as in Honkapohja and Mitra, 2014) is highly unstable under naive expectations. Therefore, we decided to run additional PLT treatments with $(\psi_P, \psi_y) = (3, 2)$, for which the system becomes stable under naive expectations.[4] Hence, the treatment **StrongNo**, unlike **WeakNo**, is expected to yield potentially converging dynamics; and the first test for guidance will be the difference between treatments **WeakNo** and **WeakGuid**.

2.5 Experiment

We run 6 groups for each of the 5 treatments, recruiting 180 subjects in total. The sessions were conducted at the CREED laboratory, University of Amsterdam, in November and December 2015, and January 2016. We wrote the experimental software in C++, using standard library and Wt, a C++ Web Toolkit under the standard GNU General Public License.[5] The duration of each session was typically around two hours. We asked subjects for 51 pairs of forecasts, which results in 50 periods of data per group.[6]

2.6 Testable hypotheses

Under Rational Expectations, the experimental economy should immediately converge to either the ZLB or the full employment steady state. However, previous experimental evidence suggests that within the New Keynesian macroeconomic framework, the subjects do not truly converge to these steady states, or they do so only after a prolonged period of time. Therefore, our experiment will serve to directly test the following hypotheses:

Hypothesis 1 Weak PLT rule is sufficient to stabilize the economy. All four PLT treatments (**StrongNo**, **WeakNo**, **StrongGuid** and **WeakGuid**) will exhibit stable dynamics (convergence or mild oscillations).

Hypothesis 2 Guidance *will* help in stabilizing the economy, which implies that treatment **StrongGuid** is *more stable* than treatment **StrongNo**, and treatment **WeakGuid** is *more stable* than **WeakNo**.

Hypothesis 3 Subjects will learn forecasting rules that emphasize full employment steady state, instead of more complicated heuristics with trend following.

Hypothesis 1 and **Hypothesis 2** can be directly translated into statistical tests. Following the literature, we will compare the relevant treatments by testing the differences in

[4]For this PLT rule, the eigenvalues of the model under naive expectations are just below the edge of the unit circle. For a detailed discussion on the properties of our experimental economy under naive expectations, refer to Appendix D.

[5]The Wt library is available at `http://www.webtoolkit.eu/wt`. The software (compiled for the Windows 7 operating system), as well as the source code can be provided on demand.

[6]Due to an unexplained software or hardware failure, the last period was not recorded in the case of four groups, leaving only 49 data points. These groups are INF05, PLTStrongGuid01, PLTWeakGuid02 and PLTWeakGuid05. In addition, one subject in group INF07 was extremely slow. Despite the help of the experimenters, he was unable to act efficiently throughout the session, which then had to be terminated after period 41. We leave this group out of the following data analysis, but the group's results are presented in Appendix B.

the distribution of inflation and output gap stability. We will quantify this with the Relative Absolute Deviations (Stöckl et al., 2010). Under adaptive (econometric) learning, both **Hypotheses 1** and **2** should be true (Honkapohja and Mitra, 2014). In order to test **Hypothesis 3**, we will estimate simple behavioral forecasting rules for each subject and investigate the resulting distribution.

3 Experimental results

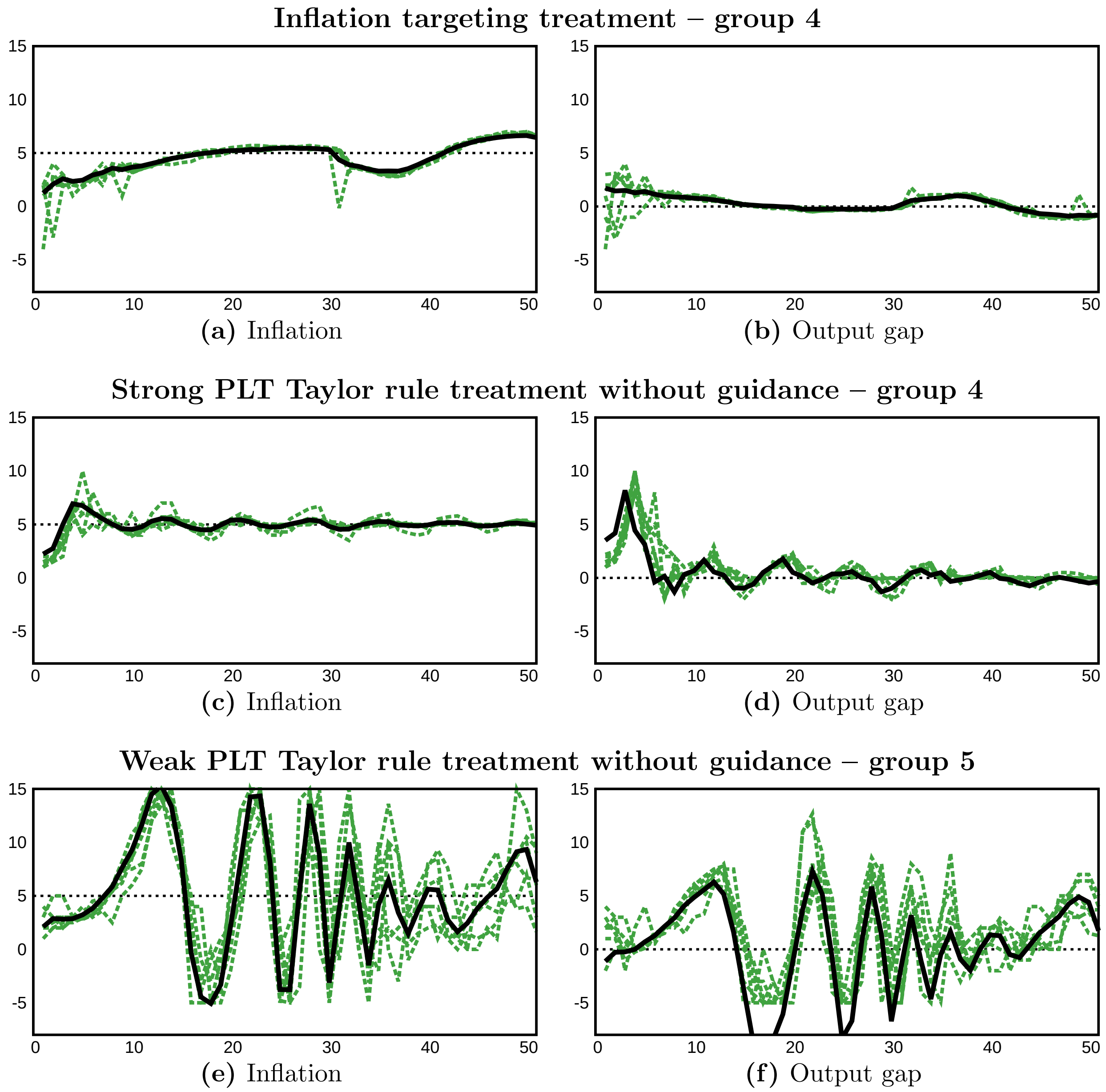
In this section we discuss the results from our experiment. We will start with a general overview of the aggregate dynamics, which was observed in the five treatments. In section 3.2, we will test the differences between the treatments in terms of stability. Section 3.3 will give a brief description of the individual behavior.

3.1 Overview

The first observation is that all 30 groups in all treatments started close to each other, with both the initial inflation and the initial output gap in the vicinity of 2.5%. Second observation is that despite similar initial conditions, the experiment resulted in clear differences between the treatments. Figure 3.1 (spread over two pages) shows realized group inflation and output gap for representative groups from all treatments. Figure 3.2 shows realized inflation and output gap paths separately for each treatment. The figures for all groups can be found in Appendix B.

Under the inflation treatment (**INF**), two types of dynamics are possible. First, mild oscillations appear in some of the groups, as in the case of group 4 from that treatment (Figures 3.1a and 3.1b). Despite some mild instability, subjects are well coordinated and quickly learn to predict accurately both variables. Second, some of the groups exhibit convergent dynamics, as in the case of group 6 (Appendix B). Even though the economy does not always converge to the full employment steady state, this treatment seems relatively stable.

Similar dynamics appear under the strong Taylor rule PLT treatment without guidance (**StrongNo**). Figures 3.1c and 3.1d show the results for group 4, in which we observe a high degree of coordination and converging dynamics. The groups under this treatment seem to be somewhat more unstable in the initial periods, and they tend to generate faster business cycle fluctuations than under the inflation treatment **INF**, but they all eventually settle down close to the full employment steady state. On the other hand, under the no guidance treatment with weak PLT Taylor rule (**WeakNo**), all six groups exhibited highly unstable dynamics (see Figs. 3.1e and 3.1f). Subjects repeatedly hit the upper and lower boundaries of their forecasts, which results in fast oscillations with large amplitude. Without these forecasting constraints, these economies would likely collapse to zero output or diverge. In addition, subjects find it much more difficult to coordinate in this unstable environment, they make higher forecasting errors and obtain lower earnings.



(a) Inflation (b) Output gap

(c) Inflation (d) Output gap

(e) Inflation (f) Output gap

Figure 3.1: Experimental results, with one representative group per treatment. Left panels display the inflation, and right panels the output gap. In each figure, the realized variable is shown with a black line, while the corresponding six subject forecasts are shown with dashed green lines.

Interestingly, the guidance seems to have little effect on the dynamics under the PLT Taylor rule. Figures 3.1g and 3.1h show results from group 2 from the strong PLT treatment with guidance (**StrongGuid**), and Figures 3.1i and 3.1j shows results from group 3 under the weak PLT treatment with guidance (**WeakGuid**). The realized inflation and output gap in these two groups look remarkably similar to those from their no guidance counterparts.

3.2 Measuring the stability of the treatments

We use the standard measure of Relative Absolute Deviation (RAD) to quantify the degree, to which the five different monetary policies stabilized the economy (see Stöckl et al., 2010, for a general definition and discussion). The RAD measure for variable x and group g is defined

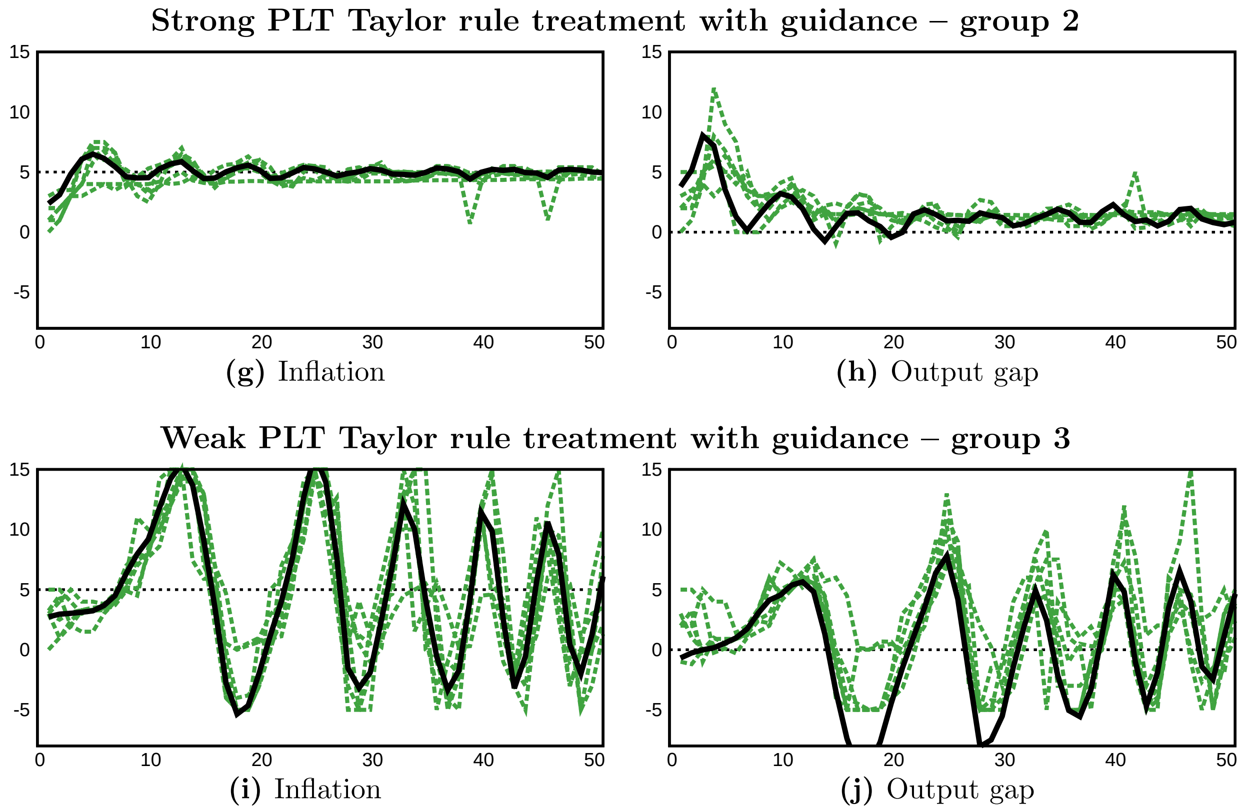


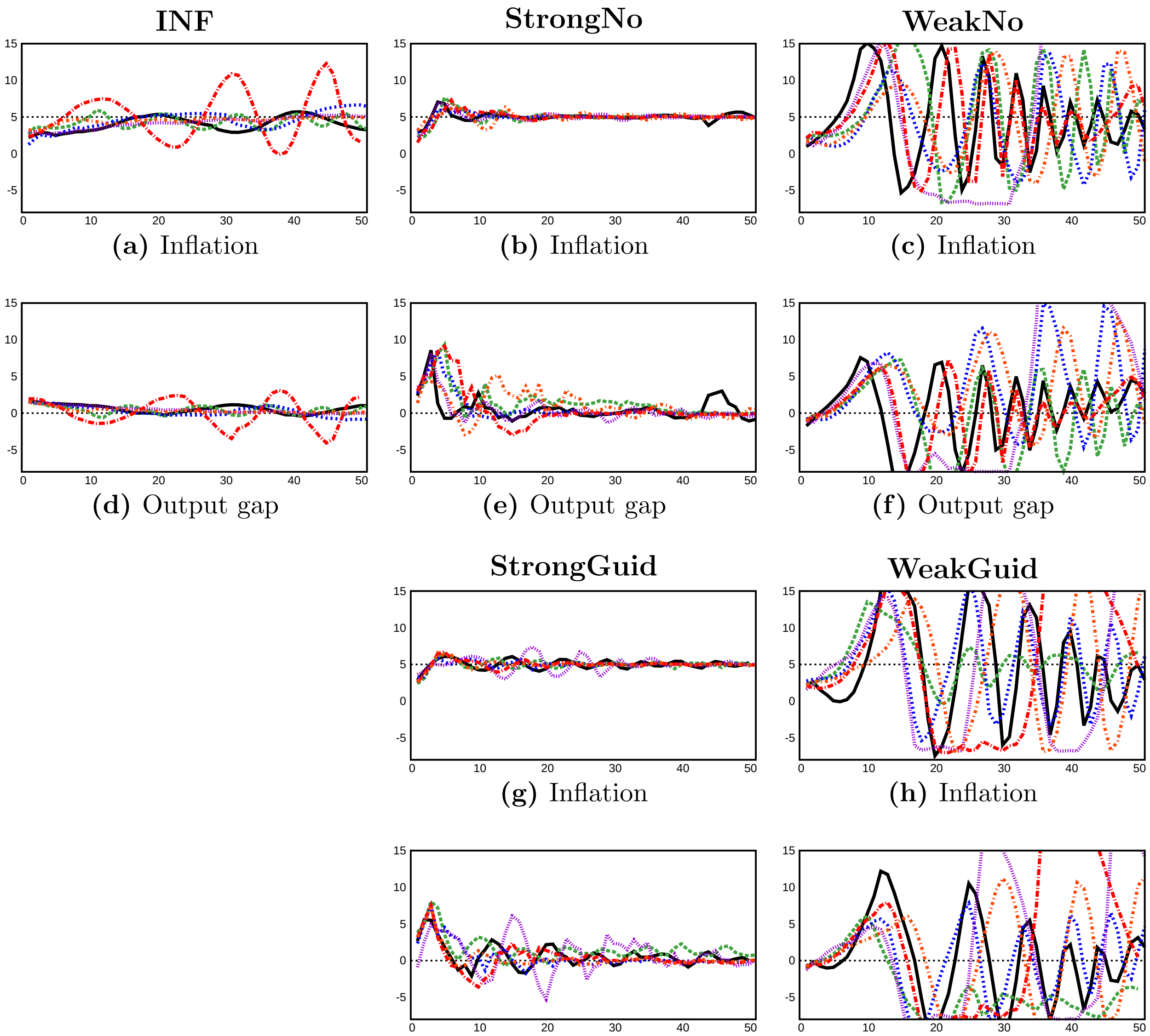
Figure 3.1: (Cont.) Experimental results, with one representative group per treatment. Left panels show the results for the inflation, and right panels for the output gap. In each figure, the realized variable is shown with a black line, while the corresponding six subject forecasts are shown with dashed green lines.

as

$$RAD_g = \frac{1}{T-10} \sum_{t=11}^{T} \frac{|x_{g,t} - x_t^f|}{x_t^f} \quad \text{for } x^f \neq 0, \tag{7}$$

where T denotes the length of the session of group g, $x_{g,t}$ denotes the realized value of x in period t in group g and x_t^f denotes the fundamental value of variable x in period t. In our case, the fundamental inflation is $\pi^* = 1.05$, while the RAD for the output by definition coincides with the average absolute output gap, expressed as a fraction (compare the definition of the RAD (7) with the definition of the output gap in equation (1)). Note that we exclude the initial 10 observations, as we interpret these as an initial learning phase.

The RAD measures can be found in Table 2. Furthermore, we test the RAD distribution differences between the treatments with Mann-Whitneu U test (MWU test), and the resulting test statistics are reported in Table 3. The first clear observation is that there is little variation between the guidance and their respective no guidance treatments (**StrongGuid** versus **StrongNo** and **WeakGuid** versus **WeakNo**). This is confirmed by the MWU test, according to which there is no significant difference between the distribution of inflation and output gap RAD measures between these two pairs of treatments. From this, we conclude that **Hypothesis 2** is rejected: guidance, as framed in our experiment, does not have a significant effect on the stability of the economy.



(a) Inflation **(b)** Inflation **(c)** Inflation

(d) Output gap **(e)** Output gap **(f)** Output gap

(g) Inflation **(h)** Inflation

(i) Output gap **(j)** Output gap

Figure 3.2: Realized inflation and output gap for each treatment. Each graph shows either realized inflation, or realized output gap, in six groups in each treatment.

A second observation is that there are significant differences (according to MWU tests) between the two weak PLT Taylor rule treatments and the three other treatments. Under the weak PLT Taylor rule the economies have explosive dynamics, while the strong PLT Taylor rule can enforce convergence to the full employment steady state. In addition, RAD measures imply that the PLT treatments with the strong Taylor rule outperform the inflation target rule in terms of the inflation stability, but not in terms of the output gap stability. We conclude that, in line with the theoretical literature, the price level target indeed can be a promising monetary policy, but only if sufficiently reactive. This rejects **Hypothesis 1** and implies that the weak PLT Taylor rule is not sufficiently responsive to the business cycle to stabilize it.

Group	INF	StrongGuid	StrongNo	WeakGuid	WeakNo
			Inflation		
#1	0.85	0.37	0.207	5.934***	4.31***
#2	0.805	0.241	0.146	2.308	6.066***
#3	0.77	0.133	0.0557	5.275***	4.803***
#4	0.531	0.66	0.206	9.1***	10.13***
#5	2.937***	0.165	0.118	8.903***	4.26***
#6	0.336	0.0847	0.337	6.858***	4.742***
Average	1.038	0.2753	0.1783	6.396	5.719
			Output gap		
#1	0.503	0.822	0.674	5.058	3.663
#2	0.51	1.175	0.953	5.741***	4.992
#3	0.452	0.339	0.194	4.334	5.689***
#4	0.316	1.745	0.495	9.126	11.09
#5	1.731	0.553	0.49	9.795	3.534
#6	0.221	0.235	1.28	6.191	5.025
Average	0.6219	0.8113	0.6811	6.708	5.666

Table 2: Relative Absolute Deviation (RAD) of the experimental **inflation** and **output gap** for the five treatments, in percentages. $***$ ($**$) denotes groups for which the average RAD from the last 40 periods is larger than 2 percentage points on 1% (5%) significance level.

Treatment	StrongGuid	StrongNo	WeakGuid	WeakNo
		Inflation		
INF	3*	1*	1*	0*
StrongGuid		13	0*	0*
StrongNo			0*	0*
WeakGuid				13
		Output gap		
INF	12	15	0*	0*
StrongGuid		16	0*	0*
StrongNo			0*	0*
WeakGuid				10

Table 3: Mann Whitney U test statistics for the differences in the distribution of the Relative Absolute Deviation of the experimental **inflation** and **output gap** for the five treatments. For a 6×6 sample the critical value for 5% p-value is equal to 5. $*$ denotes treatments for which the difference between the treatments is statistically significant.

3.3 Individual behavior

The experimental results reject both **Hypothesis 1** and **2**, which suggest that the subjects coordinated on rules that may contain more elements than just the full-employment steady state levels. To further test **Hypothesis 3**, we use the following procedure.

In the experiment, we organized 6 groups per treatment, which in total gives us a sample of 180 subjects. Following the previous literature, we assume that the subject forecasting can be explained by the following (two dimensional) first-order rule:

$$
\begin{aligned}
\pi^e_{t+1} &= c^\pi + \alpha^\pi_1 \pi^e_t + \alpha^\pi_2 \pi_{t-1} + \alpha^\pi_3 o_{t-1} + \beta^\pi(\pi_{t-1} - \pi_{t-2}) \\
&\qquad + \delta^\pi r_{t-1} + \gamma^\pi D_{t-1} + \varepsilon^\pi_t, \\
o^e_{t+1} &= c^o + \alpha^o_1 o^e_t + \alpha^o_2 o_{t-1} + \alpha^o_3 \pi_{t-1} + \beta^o(o_{t-1} - o_{t-2}) \\
&\qquad + \delta^o r_{t-1} + \gamma^o D_{t-1} + \varepsilon^o_t,
\end{aligned} \tag{8}
$$

where the superscript e denotes forecasts, π denotes the inflation, o denotes the output gap, r denotes the net interest rate and D denotes the price level deviation. For clarity, we suppress the subject index, but in principal subjects can use very different specifications of (8). Note that D_t is used only in the guidance treatments, otherwise γ's are set to zero. Finally,

$$
\begin{pmatrix} \varepsilon^\pi_t \\ \varepsilon^o_t \end{pmatrix} \equiv \varepsilon_t \sim NID\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma^2_\pi & \rho_{\pi,o}\sigma_\pi\sigma_o \\ \rho_{\pi,o}\sigma_\pi\sigma_o & \sigma^2_o \end{pmatrix} \right) \tag{9}
$$

are jointly normally distributed random errors, which are pairwise independent in the dimensions of time and subjects, but not necessarily for one subject in one period ($\rho_{\pi,o} \neq 0$).

For each subject, we estimate the forecasting rule (8) *jointly* with a simple Maximum Likelihood estimator, which allows us to use the Likelihood Ratio test for all the following tests, for the two rules jointly. We add lags of the two forecasts until there is no evidence of auto-correlation, and hence eliminate the insignificant variables until the two rules contain only significant ones (if any). For the details on the estimation algorithm, and the results for each individual subject, see Appendix C.

We were able to estimate a two-dimensional rule for all subjects, and most of these rules are non-trivial (that is they contain significant variables). Average estimated coefficients, as well as number of significant coefficients per treatment, are provided in Table 4. See also Appendix C for the full estimation results. From these 180 two-dimensional rules, some stylized fact emerge:

1. Subjects remained largely heterogeneous within groups, within treatments and between treatments. This means that they used both different values and different subsets of coefficients, even if they belonged to the same group.

2. In general the inflation rules are simpler: they contain fewer significant coefficients.

3. A clear between-treatments pattern is that the subjects used simpler rules under the inflation targeting **INF** and strong Taylor rule PLT treatments **StrongNo** and **StrongGuid**. We interpret this as a sign that in a more difficult, unstable environment, subjects try to use more information.

4. Subjects learn to incorporate guidance information and the interest rate mostly under the unstable treatment **WeakGuid**. For example, δ^π is significant for 13 subjects under

	Inflation forecasting rule							Output gap forecasting rule						
	c^π	π^e_t	π_{t-1}	o_t	$\Delta\pi_{t-1}$	r_{t-1}	D_{t-1}	c^o	o^e_t	o_{t-1}	π_{t-1}	Δo_{t-1}	r_{t-1}	D_{t-1}
INF	0.568	0.373	0.431	0	0.586	0.0528	n/a	0.512	0.176	0.539	−0.0638	0.413	−0.022	n/a
(SD)	(1.3)	(0.443)	(0.528)	(0)	(0.645)	(0.279)		(1.44)	(0.3)	(0.558)	(0.263)	(0.609)	(0.174)	
Sign.	11	16	18	0	18	3		18	17	27	2	15	14	
SNo	1.72	0.193	0.484	0	0.397	−0.0229	n/a	0.633	0.178	0.653	−0.105	0.17	0.00328	n/a
(SD)	(1.94)	(0.303)	(0.517)	(0)	(0.763)	(0.097)		(2.89)	(0.249)	(0.437)	(0.524)	(0.408)	(0.351)	
Sign.	19	16	18	0	13	9		23	22	32	6	10	18	
WNo	1.88	0.131	0.0522	0.327	0.496	0.276	n/a	1.17	0.101	0.801	−0.478	0.436	0.293	n/a
(SD)	(1.92)	(0.303)	(0.742)	(0.535)	(0.312)	(0.369)		(1.44)	(0.292)	(0.47)	(0.473)	(0.277)	(0.389)	
Sign.	26	22	25	13	29	21		32	35	36	31	36	36	
SGu	1.42	0.212	0.507	−0.0967	0.299	−0.0249	−0.394	1.17	0.206	0.455	−0.193	0.216	0.00106	−0.276
(SD)	(2.7)	(0.344)	(0.665)	(0.572)	(0.542)	(0.189)	(1.01)	(3.88)	(0.305)	(1.39)	(0.998)	(0.496)	(0.486)	(2.31)
Sign.	19	16	18	1	13	9	13	23	27	31	9	18	22	22
WGu	0.616	0.15	0.632	−0.112	0.513	0.106	−0.0313	−0.32	0.127	0.467	−0.118	0.428	0.277	−0.0455
(SD)	(3.66)	(0.286)	(0.801)	(0.99)	(0.354)	(0.319)	(0.212)	(4.23)	(0.271)	(1.16)	(0.865)	(0.302)	(0.553)	(0.236)
Sign.	19	22	32	10	34	23	23	24	28	32	29	32	33	28

Table 4: Average estimated forecasting rules. SNo, WNo, SGu and WGu denote **StrongNo**, **WeakNo**, **StrongGuid** and **WeakGuid** treatments respectively. SD denotes standard deviation *across the subjects from the treatment* and Sign. denotes number of subjects, for which the coefficient was significant on 5% significance level. Remark that insignificant coefficients are treated as equal to 0 for computing the mean and SD.

StrongGuid and for 23 subjects under **WeakGuid** treatment (out of 36 subjects per each treatment). This leads to an interesting result that people seek the monetary authority's guidance if times are unstable, but this does not counter the effect of a relatively weak response of the central bank. It also corresponds well with the previous stylized findings.

5. A typical result is that the subjects used 'close to' adaptive rules (with significant weights on past forecasts and/or past observations, not necessarily adding up to unity). In addition, trend chasing is popular, with both β 's often significant and then positive.

6. There is a clear relationship between the stability of a treatment, and degree to which subjects learn to follow trends in realized inflation and output gap. Compared to the strong PLT Taylor rule treatments **StrongNo** and **StrongGuid**, subjects under the weak PLT rule treatments **WeakNo** and **WeakGuid** are more likely to have a trend following component in their heuristics, and if they do, it is approximately twice as large. On the other hand, trend heuristics were as common under the two strong PLT rule treatments as under the **INF** treatment, however, in the latter treatment the average coefficients are approximately twice as large. This corresponds well to the stability ranking of the treatments, as explained in the previous part of this section, and therefore shows that the learning of the trend chasing behavior and the macroeconomic instability are self-reinforcing processes.

7. In general, subject rules are far from a fundamentalist rule (forecasting only the full employment steady states values of inflation and output gap), but constants equal to these fundamental values do appear. This implies that some of the subjects learned the value of the steady state inflation and output gap, but they would also extrapolate short-run trends.

Altogether, these results reject **Hypothesis 3**. Furthermore, they are in line with Amano et al. (2011), who in their experimental study demonstrate that the subjects under-react to the price-level deviation and instead use forecasting rules with a high weight on realized inflation. Finally, the observed trend following behavior, and its relationship with market stability, corroborates the literature on Learning to Forecast experiments Hommes (2011); Hommes et al. (2015).

4 Conclusions

In this paper we report a simple Learning-to-Forecast experiment on the relevance of guidance and Price Level Targeting (PLT). We focus on a standard non-linear DSGE economy, in which the realized inflation and output gap depend on two-period ahead forecasts of these two variables and the specific (linear) Taylor interest rate rule. We ask the subjects to forecast inflation and output gap and pay them for their forecasting accuracy. Subjects are given only a qualitative description of the economy. We consider five treatments: (1) with an inflation target Taylor rule; and with PLT Taylor rule with (2) strong parametrization, (3) weak parametrization, (4) strong parametrization and guidance, and (5) weak parametrization and guidance. We frame the guidance as additional information: subjects (i) are explicitly informed about how the interest rate rule depends on the price level deviation, and (ii) can observe the realized price level deviation throughout the session. We find that the guidance has no effect on the individual and aggregate behavior. PLT rule can be a robust monetary policy, but only if it reacts sufficiently strong to the price level deviation and output gap, otherwise the realized dynamics are highly unstable. This shows that the subjects do not follow sophisticated adaptive (econometric) learning, but instead use simple forecasting heuristics, such as adaptive expectations and/or trend following.

After the recent financial crisis of 2007, developed economies plummeted into a prolonged recession. Central banks failed to stimulate the economies with interest rate cuts, as they hit the zero-lower bound constraint. This shows the relevance of the zero-lower bound steady state, which is characterized by a spiral of deflation and output contraction. The macroeconomic literature focused on developing monetary policies that could pull the economies from the recession, and prevent future crises of a similar magnitude. Two prominent ideas are guidance and Taylor rule based on nominal price level target (PLT). Guidance means that the central bank more openly discloses (and commits to) its monetary policy rule.

Both PLT and guidance have promising properties under Rational Expectations, since they give the economic agents more information about the monetary policy, and thus allow for a faster convergence towards the full employment steady state. Nevertheless, Rational Expectations require an unrealistic cognitive load from economic agents such as consumers or firms. On the other hand, even a small departure from Rational Expectations, can lead to different evaluation of PLT and guidance. For instance, Honkapohja and Mitra (2014) show that under adaptive (econometric) learning, PLT Taylor rule actually requires the guidance to stabilize the economy.

The main goal of our paper is to provide an experimental test to the robustness of guidance and PLT monetary policies. We regard our work as complementary to the theoretical literature on learning in macroeconomics. We consider guidance framed as in Honkapohja and Mitra (2014): additional information, which the agents receive about the target of the central bank. In addition, we look at PLT Taylor rules with two sets of parameters: (1) as suggested in the adaptive learning literature, and (2) a much more harsh parametrization, which is required to stabilize the economy under pure naive expectations.

There are two main findings of our experiment. First, the strong PLT Taylor rule was required to stabilize the economy, and in terms of inflation stability can even outperform the classical inflation based Taylor rule. On the other hand, under the weak PLT Taylor rule the experimental sessions resulted in highly unstable dynamics. This suggest that our subjects were less sophisticated than what is required by both Rational Expectations and adaptive learning. Instead, the subjects followed much simpler forecasting rules. We find that a simple first-order heuristic – extrapolating observed trends from an anchor – could explain their behavior well, which is in line with the literature on the Learning-to-Forecast experiments.

A second main finding of our experiment is that the guidance had no visible effect on the behavior of the subjects. Estimations demonstrate that they would consider the additional information of the guidance much more often under the Weak PLT Taylor rule treatment. Nevertheless, this would not offset the under-reaction of the monetary authority to the deviations from the full employment steady state. This finding may have important implictations on how the central banks should run their monetary policy, but requires further experimental and theoretical investigation.

Estimations of the individual behavior in our experiment lead to one additional interesting outcome. Subjects under the two Weak PLT Taylor rule treatments, with much more unstable dynamics, would use more complicated forecasting heuristics. We interpret this finding in the following way. The level of sophistication of individual behavior is not simply a constant that depends on individual characteristics. Instead, the subjects will increase the complexity of their behavior if they face a more complicated environment. This insight may have important consequences for economic models of learning, and should be studied more carefully in future work.

The design of our experiment can be easily extended to incorporate alternative monetary policies. One interesting question is whether a more involved form of guidance (such as a public commitment to a specific path of interest rate) can have a stabilizing macroeconomic effect, in particular whether a more involved communication of the central bank can anchor individual expectations. This would link our experiment with the works of Ahrens et al. (2017); Arifovic and Petersen (2017); Mokhtarzadeh and Petersen (2017).

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Appendices

A Experimental instructions and control questions

The first set of instructions was given to the subjects from the treatments **INF**, **StrongNo** and **WeakNo** (treatment without guidance). The second set of instructions was given to subjects from the treatments **StrongGuid** and **WeakGuid** (treatments with guidance).

All subjects had to answer control questions 1, 2 and 3. In addition, subjects from the treatments **StrongGuid** and **WeakGuid** (treatments with guidance) had to answer control question 4 in order to start the experiment.

Experimental instructions (treatments INF, StrongNo and WeakNo)

Welcome to this experiment! The experiment is anonymous, the data from your choices will only be linked to your station ID, not to your name. You will be paid privately at the end, after all participants have finished the experiment. After the main part of the experiment and before the payment you will be asked to fill out a short questionnaire. On your desk you will find a calculator and scratch paper, which you can use during the experiment.

During the experiment you are not allowed to use your mobile phone. You are also not allowed to communicate with other participants. If you have a question at any time, please raise your hand and someone will come to your desk.

General information and experimental economy

All participants will be randomly divided into groups of a fixed size. The group composition will not change during the experiment. You and all other participants will take the roles of statistical research bureaus making predictions of inflation and the so-called "output gap". The experiment consists of 50 periods in total. In each period you will be asked to predict inflation and output gap for the next period.

The economy you are participating in is described by three variables: inflation π_t, output gap y_t and interest rate R_t. The subscript t indicates the period the experiment is in. In total there are 50 periods, so t increases during the experiment from 1 to 50.

Inflation (π_t) measures the percentage change in the price level of the economy. In each period, inflation depends on inflation predictions of the statistical research bureaus in the economy (that is on your own forecast as well as on the forecasts of the other bureaus in the experiment), on output gap, on interest rate and on a small random term. There is a **positive** relation between the actual inflation and (i) the inflation predictions and (ii) the actual output gap. This means that if the inflation predictions of the research bureaus or the actual output gap increase, then actual inflation will also increase (everything else equal). In economies similar to this one, inflation has historically been between -5% and 8%.

Output gap (y_t) represents the amount of goods produced by firms and consumed by households in the economy. In each period, output gap depends on inflation predictions and output gap predictions of the statistical research bureaus in the economy (that is on your own forecast as well as on the forecasts of the other bureaus in the experiment), on the interest rate and on a small random term. There is a **positive** relation between the actual output gap and both the inflation predictions and output gap predictions. This means that if the inflation predictions or output gap predictions of the research bureaus increase, then actual output gap will also increase (everything else equal). There is a **negative** relation between output gap and the interest rate. This means that if the interest rate increases, then actual output gap will instead decrease (everything else equal). In economies similar to this one, output gap has historically been between -5% and 8%.

Interest rate (R_t) measures the cost of borrowing money and is determined by the central bank. The central bank sets the interest rate in response to the inflation and the output gap. In each period, if inflation and output gap forecasts are considered too high, the central bank increases the interest rate. If inflation and output gap forecasts are considered too low, the central bank decreases the interest rate. The interest rate cannot take negative values.

Prediction task

Your task in each period of the experiment is to predict inflation and output gap in the next period. For example, in period 21 you have to predict inflation and output gap in period 22. When the experiment starts, you have to predict inflation and output gap for the first two periods, i.e. π_1^f and y_1^f and then π_2^f and y_2^f. The superscript f indicates that these are forecasts. When all participants have made their predictions for the second period, the actual inflation (π_1), the interest rate (R_1) and the actual output gap (y_1) for period 1 are announced. Then period 2 of the experiment begins. In period 2 you make inflation and output gap predictions for period 3 (π_3^f and y_3^f). When all participants have made their predictions for period 3, actual inflation (π_2), interest rate (R_2) and output gap (y_2) for period 2 are announced. This process repeats itself for 50 periods.

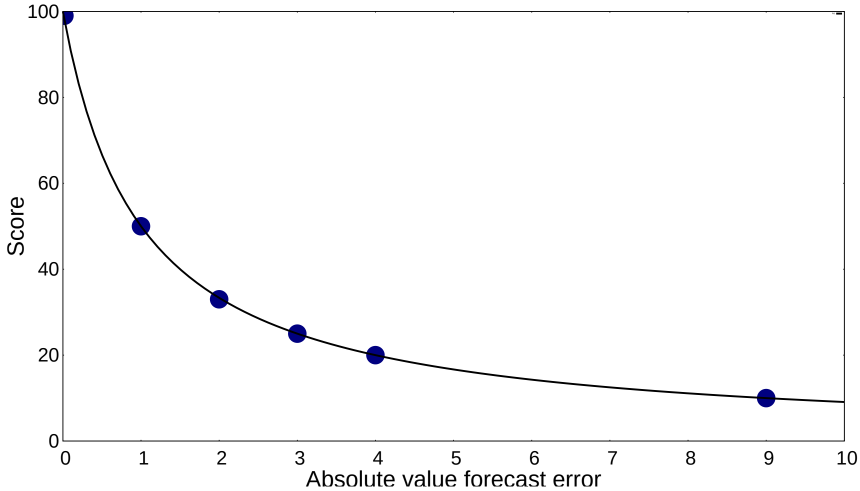
Thus, in a certain period t when you make predictions of inflation and output gap for the next period $t+1$, the following information is available to you:

- realized values of inflation, interest rate and output gap, up to and including period $t-1$;
- Your predictions up to and including your prediction for period t;
- Your prediction scores up to and including period $t-1$ (see below).

Payments

Your payment will depend on the accuracy of your predictions. You will be paid either for predicting inflation or for predicting output gap. The accuracy of your predictions is measured by the absolute distance between your prediction and the actual values (this distance is the prediction error). For each period the prediction error is calculated as soon as the actual values are known; you subsequently get a prediction score that decreases as the prediction error increases. The table below gives the relation between the prediction error and the prediction score. The prediction error is calculated in the same way for inflation and output gap.

Prediction error	0	1	2	3	4	9
Score	100	50	33.33	25	20	10



Example: If (for a certain period) you predict an inflation of 2%, and the actual inflation turns out to be 3%, then you make an absolute error of $3\% - 2\% = 1\%$. Therefore you get a prediction score of 50. If you predict an inflation of 1%, and the actual inflation turns out to be negative, for example -2%, you make a prediction error of $1\% - (-2\%) = 3\%$. Then you get a prediction score of 25. For a perfect prediction, with a prediction error of zero, you get a prediction score of 100.

The figure above shows the relation between your prediction score (vertical axis) and your prediction error (horizontal axis). Points in the graph correspond to the prediction scores in the previous table. At the end of the experiment, you will have two total scores, one for inflation predictions and one for output gap predictions. These total scores simply consist of the sum of all prediction scores you got during the experiment, separately for inflation and output gap predictions. **When the experiment has ended, one of the two total scores will be randomly selected for payment.**

Your final payment will consist of 0.75 euro for each 100 points in the selected total score (200 points therefore equals 1.50 euro). This will be the only payment from this experiment, i.e. you will not receive a show-up fee on top of it.

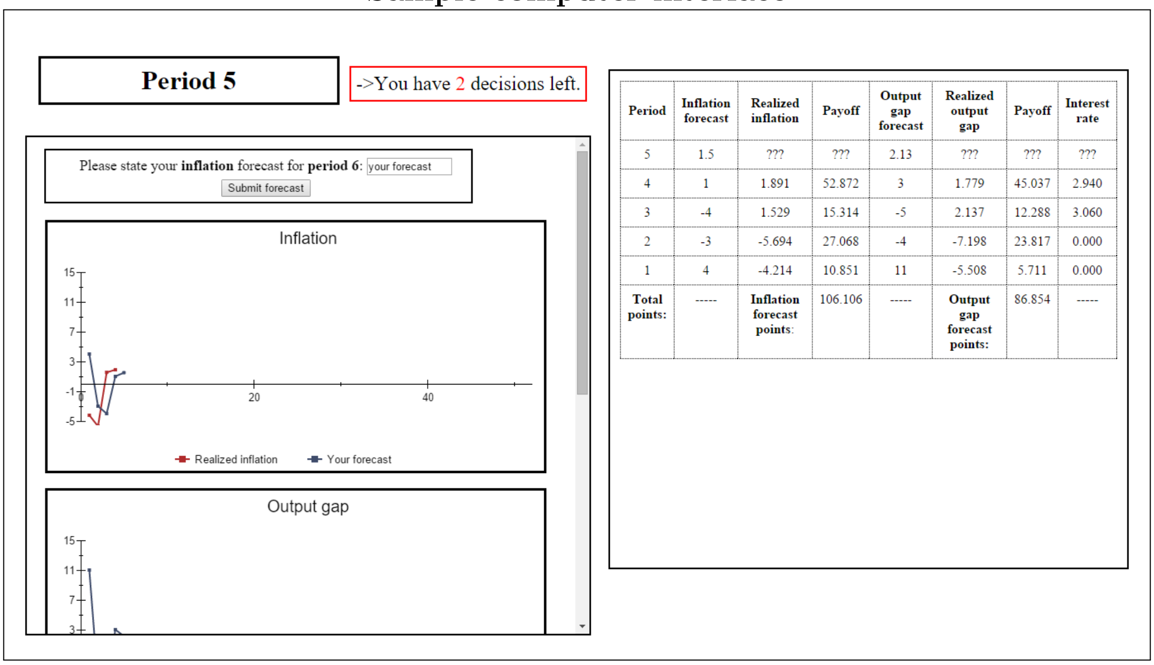
Computer interface

The computer interface will be mainly self-explanatory and example screenshot is presented below. The top part of the screen will tell you the current period, and how many decisions (forecasts) you still have to make in the current period (if you made all the forecasts, you will be asked to wait for other subjects). The right part of the screen will show you a table with all of the information available up to the period that you are in. That is, in period t, i.e. when you are asked to make your prediction for period $t+1$, this will be actual inflation, interest rate and output gap until period $t-1$, your predictions until period t, and the prediction scores arising from your predictions until period $t-1$ for both inflation and output gap. The sum of the prediction scores over the different periods are shown in the bottom right of the screen, separately for your inflation and output gap predictions. Once the current period will become large, you may need to scroll down the table to see the early periods.

The left part of the screen will show you the information on inflation, interest rate and output gap in graphs. The axis of the inflation graph shows values in percentage points (i.e. 3 corresponds to 3%). Please note that maybe you need to scroll the graph box down to see bottom figures and the decision box for the output gap forecast (compare the last two figures).

In this panel you will also be asked to enter your predictions. When submitting your prediction, use a decimal point if necessary (not a comma). For example, if you want to submit a prediction of 2.5% type "2.5"; for a prediction of -1.75% type "-1.75". The order of the boxes in the panel is: box for inflation forecast, three graphs with inflation, output and interest rate information and box for output gap forecast.

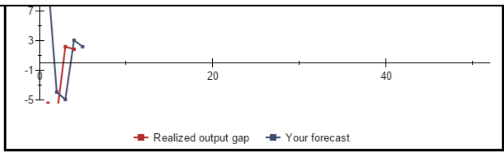
Sample computer interface

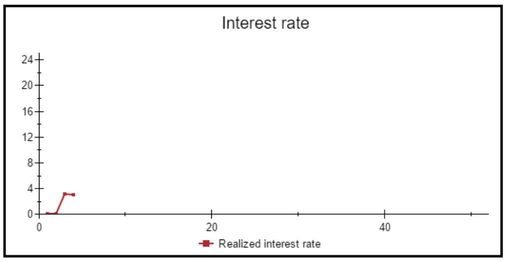


Period	Inflation forecast	Realized inflation	Payoff	Output gap forecast	Realized output gap	Payoff	Interest rate
5	1.5	???	???	2.13	???	???	???
4	1	1.891	52.872	3	1.779	45.037	2.940
3	-4	1.529	15.314	-5	2.137	12.288	3.060
2	-3	-5.694	27.068	-4	-7.198	23.817	0.000
1	4	-4.214	10.851	11	-5.508	5.711	0.000
Total points:	-----	Inflation forecast points:	106.106	-----	Output gap forecast points:	86.854	-----

Period 5

->You have 2 decisions left.





Please state your **output gap** forecast for **period 6**: your forecast

Submit forecast

Period	Inflation forecast	Realized inflation	Payoff	Output gap forecast	Realized output gap	Payoff	Interest rate
5	1.5	???	???	2.13	???	???	???
4	1	1.891	52.872	3	1.779	45.037	2.940
3	-4	1.529	15.314	-5	2.137	12.288	3.060
2	-3	-5.694	27.068	-4	-7.198	23.817	0.000
1	4	-4.214	10.851	11	-5.508	5.711	0.000
Total points:	-----	Inflation forecast points:	106.106	-----	Output gap forecast points:	86.854	-----

Experimental instructions (treatments StrongGuid and WeakGuid)

Welcome to this experiment! The experiment is anonymous, the data from your choices will only be linked to your station ID, not to your name. You will be paid privately at the end, after all participants have finished the experiment. After the main part of the experiment and before the payment you will be asked to fill out a short questionnaire. On your desk you will find a calculator and scratch paper, which you can use during the experiment.

During the experiment you are not allowed to use your mobile phone. You are also not allowed to communicate with other participants. If you have a question at any time, please raise your hand and someone will come to your desk.

General information and experimental economy

All participants will be randomly divided into groups of a fixed size. The group composition will not change during the experiment. You and all other participants will take the roles of statistical research bureaus making predictions of inflation and the so-called "output gap". The experiment consists of 50 periods in total. In each period you will be asked to predict inflation and output gap for the next period.

The economy you are participating in is described by three variables: inflation π_t, output gap y_t and interest rate R_t. The subscript t indicates the period the experiment is in. In total there are 50 periods, so t increases during the experiment from 1 to 50.

Inflation (π_t) measures the percentage change in the price level of the economy. In each period, inflation depends on inflation predictions of the statistical research bureaus in the economy (that is on your own forecast as well as on the forecasts of the other bureaus in the experiment), on output gap, on interest rate and on a small random term. There is a **positive** relation between the actual inflation and (i) the inflation predictions and (ii) the actual output gap. This means that if the inflation predictions of the research bureaus or the actual output gap increase, then actual inflation will also increase (everything else equal). In economies similar to this one, inflation has historically been between -5% and 8%.

Output gap (y_t) represents the amount of goods produced by firms and consumed by households in the economy. In each period, output gap depends on inflation predictions and output gap predictions of the statistical research bureaus in the economy (that is on your own forecast as well as on the forecasts of the other bureaus in the experiment), on the interest rate and on a small random term. There is a **positive** relation between the actual output gap and both the inflation and output gap predictions. This means that if the inflation predictions or output gap predictions of the research bureaus increase, then actual output gap will also increase (everything else equal). There is a **negative** relation between output gap and the interest rate. This means that if the interest rate increases, then actual output gap will instead decrease (everything else equal). In economies similar to this one, output gap has historically been between -5% and 8%.

Interest rate (R_t) measures the cost of borrowing money and is determined by the central bank. The central bank sets the interest rate in response to the output gap and the relative deviation of the price level from its intended level (see below). In each period, if output gap forecasts are considered too high, the central bank increases the interest rate. If output gap forecasts are considered too low, the central bank decreases the interest rate. The interest rate cannot take negative values. Furthermore, throughout all 50 periods the central banks commits to the following inflation stabilizing policy.

The central banks wants to guide the actual inflation (price growth) in such a way that the actual **price level** P_t will not deviate from its intended path P_t^{int}, in which price growth (actual inflation) is neither too large nor too low. The intended price level, which the central bank desires for a specific period, can vary between periods. This intended price level is not known, but what is known is the *relative* deviation of the price level from this intended level. In each period, if price level forecasts are considered too high relative to the intended level, the central bank increases the interest rate. If price forecasts are considered too low relative to the intended level, the central bank decreases the interest rate. The interest rate cannot take negative values.

Prediction task

Your task in each period of the experiment is to predict inflation and output gap in the next period. For example, in period 21 you have to predict inflation and output gap in period 22. When the experiment starts, you have to predict inflation and output gap for the first two periods, i.e. π_1^f and y_1^f and then π_2^f and y_2^f. The superscript f indicates that these are forecasts. When all participants have made their predictions for the second period, the actual inflation (π_1), the interest rate (R_1), the actual output gap (y_1) and the relative deviation of the price level ($\frac{P_1-P_1^{int}}{P_1^{int}}$) for period 1 are announced. Then period 2 of the experiment begins. In period 2 you make inflation and output gap predictions for period 3 (π_3^f and y_3^f). When all participants have made their predictions for period 3, inflation (π_2), interest rate (R_2), output gap (y_2) and $\frac{P_2-P_2^{int}}{P_2^{int}}$ relative deviation of the price level for period 2 are announced. This process repeats itself for 50 periods.

Thus, in a certain period t when you make predictions of inflation and output gap for the next period $t+1$, the following information is available to you:

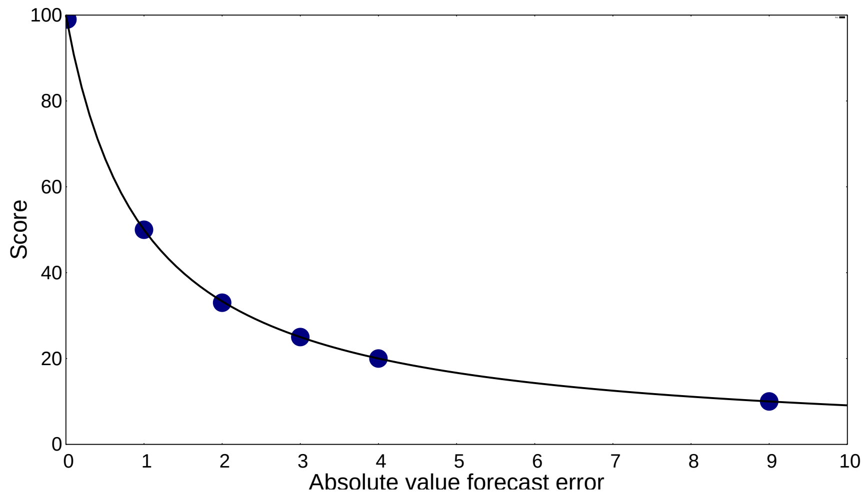
- realized values of inflation, output gap and deviations of the price level from the one intended by the central bank, up to and including period $t-1$;
- Your predictions up to and including your prediction for period t;
- Your prediction scores up to and including period $t-1$ (see below).

Payments

Your payment will depend on the accuracy of your predictions. You will be paid either for predicting inflation or for predicting output gap. The accuracy of your predictions is measured by the absolute distance between your prediction and the actual values (this distance is the prediction error). For each period the prediction error is calculated as soon as the actual values are known; you subsequently get a prediction score that decreases as the prediction error increases. The table below gives the relation between the prediction error and the prediction score. The prediction error is calculated in the same way for inflation and output gap.

Example: If (for a certain period) you predict an inflation of 2%, and the actual inflation turns out to be 3%, then you make an absolute error of $3\% - 2\% = 1\%$. Therefore you get a prediction score of 50. If you predict an inflation of 1%, and the actual inflation turns out to be negative, for example -2%, you make a prediction error of $1\% - (-2\%) = 3\%$. Then you get a prediction score of 25. For a perfect prediction, with a prediction error of zero, you get a prediction score of 100.

Prediction error	0	1	2	3	4	9
Score	100	50	33.33	25	20	10



The figure above shows the relation between your prediction score (vertical axis) and your prediction error (horizontal axis). Points in the graph correspond to the prediction scores in the previous table. At the end of the experiment, you will have two total scores, one for inflation predictions and one for output gap predictions. These total scores simply consist of the sum of all prediction scores you got during the experiment, separately for inflation and output gap predictions. **When the experiment has ended, one of the two total scores will be randomly selected for payment.**

Your final payment will consist of 0.75 **euro for each** 100 **points in the selected total score (**200 **points therefore equals** 1.50 **euro). This will be the only payment from this experiment, i.e. you will not receive a show-up fee on top of it.**

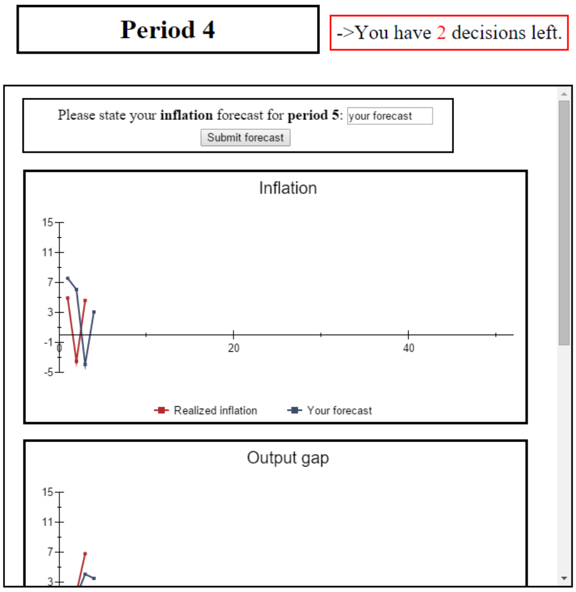
Computer interface

The computer interface will be mainly self-explanatory and example screenshot is presented below. The top part of the screen will tell you the current period, and how many decisions (forecasts) you still have to make in the current period (if you made all the forecasts, you will be asked to wait for other subjects). The right part of the screen will show you a table with all of the information available up to the period that you are in. That is, in period t, i.e. when you are asked to make your prediction for period $t+1$, this will be actual inflation, interest rate, output gap and deviation of price level from the level intended by the central bank until period $t-1$, your predictions until period t, and the prediction scores arising from your predictions until period $t-1$ for both inflation and output gap. The sum of the prediction scores over the different periods are shown in the bottom right of the screen, separately for your inflation and output gap predictions. Once the current period will become large, you may need to scroll down the table to see the early periods

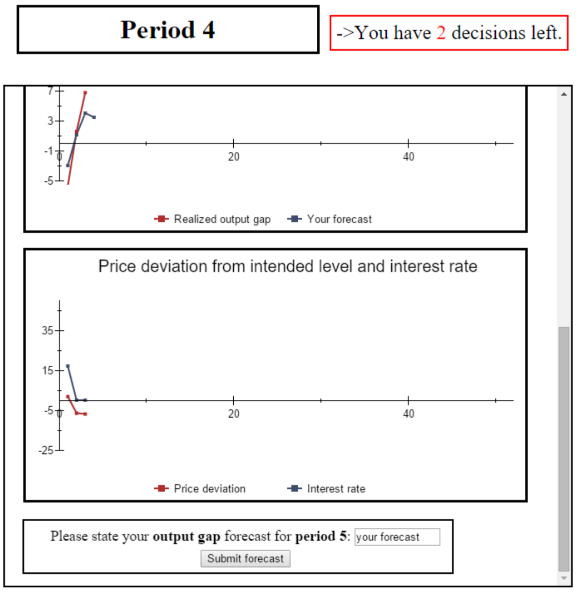
The left part of the screen will show you the information in graphs on inflation, output gap, interest rate and the relative deviation of the price level from its intended value. The vertical axis of the graph shows values in percentage points (i.e. 3 corresponds to 3%). Please note that maybe you need to scroll the graph box down to see bottom figures and the decision box for the output gap forecast (compare the last two figures).

In this panel you will also be asked to enter your predictions. When submitting your prediction, use a decimal point if necessary (not a comma). For example, if you want to submit a prediction of 2.5% type "2.5"; for a prediction of -1.75% type "-1.75". The order of the boxes in the panel is: box for inflation forecast, three graphs with inflation, output gap and interest rate/price deviation from the level intended by the central bank information;; and box for output forecast.

Sample computer interface



Period	Inflation forecast	Realized inflation	Payoff	Output gap forecast	Realized output gap	Payoff	Interest rate	Pri lev devia
4	3	???	???	3.44	???	???	???	??
3	-4	4.525	10.497	4	6.728	26.818	0.000	-6.9
2	6	-3.592	9.440	1.11	1.528	70.487	0.000	-6.5
1	7.5	4.856	27.446	-3	-5.733	26.787	17.097	1.8
Total points:	-----	Inflation forecast points:	47.384	-----	Output gap forecast points:	124.093	-----	---



Period	Inflation forecast	Realized inflation	Payoff	Output gap forecast	Realized output gap	Payoff	Interest rate	Pri lev devia
4	3	???	???	3.44	???	???	???	??
3	-4	4.525	10.497	4	6.728	26.818	0.000	-6.9
2	6	-3.592	9.440	1.11	1.528	70.487	0.000	-6.5
1	7.5	4.856	27.446	-3	-5.733	26.787	17.097	1.8
Total points:	-----	Inflation forecast points:	47.384	-----	Output gap forecast points:	124.093	-----	---

Control questions

Question 1
Suppose that the statistical bureaus predict that inflation will increase. Holding all other factors equal, including the interest rate, this means that:

(a) the output gap will **increase**;

(b) the output gap will **stay on the same level**;

(c) the output gap will **decrease**;

Question 2
Suppose that the statistical bureaus predict that output gap in period decrease. Holding all other factors equal, this means that:

(a) the central bank will **increase** the interest rate, which in turn has a **positive** impact on the output gap;

(b) the central bank will **decrease** the interest rate, which in turn has a **negative** impact on the output gap;

(c) the central bank will **increase** the interest rate, which in turn has a **negative** impact on the output gap.

(d) the central bank will **decrease** the interest rate, which in turn has a **positive** impact on the output gap;

Question 3
Suppose that your inflation prediction for period 9 is -1%, and the realized inflation in that period is 3%. For this forecast you will receive score of

(a) 10 points;

(b) 100 points;

(c) 20 points;

(d) 33.33 points.

Question 4 – only for guidance treatment
Suppose that the prices fall below the intended level of the central bank. Holding all other factors equal, this means that:

(a) the central bank will **increase** the interest rate.

(b) the central bank will **decrease** the interest rate.

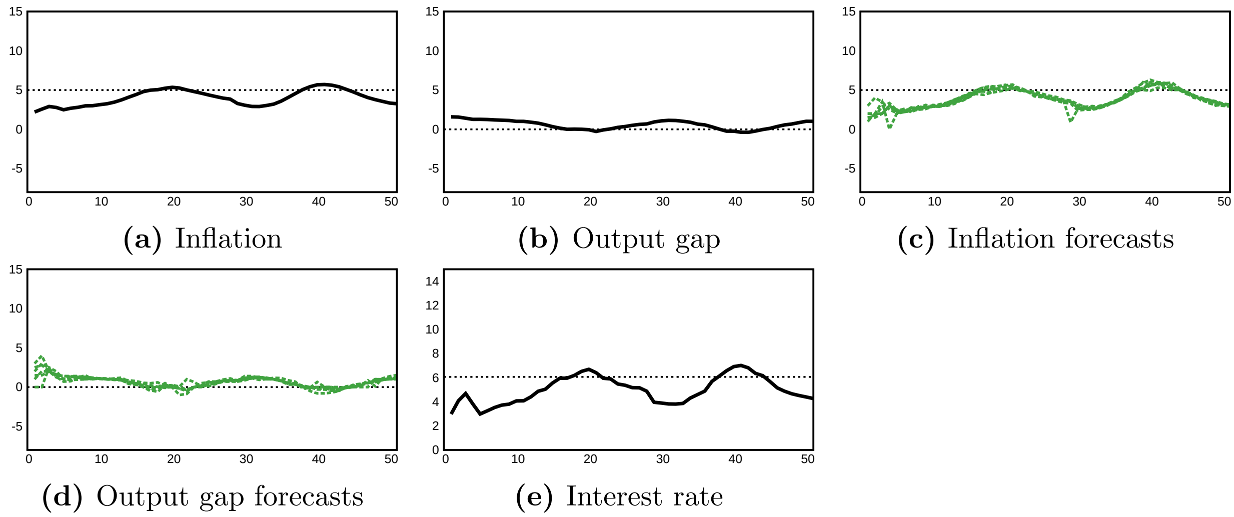
(c) the central bank will **not change** the interest rate.

(d) it is not possible to say what the central bank will do.

Solution:
1a, 2d, 3c, 4b

B Experimental results (graphical representation)

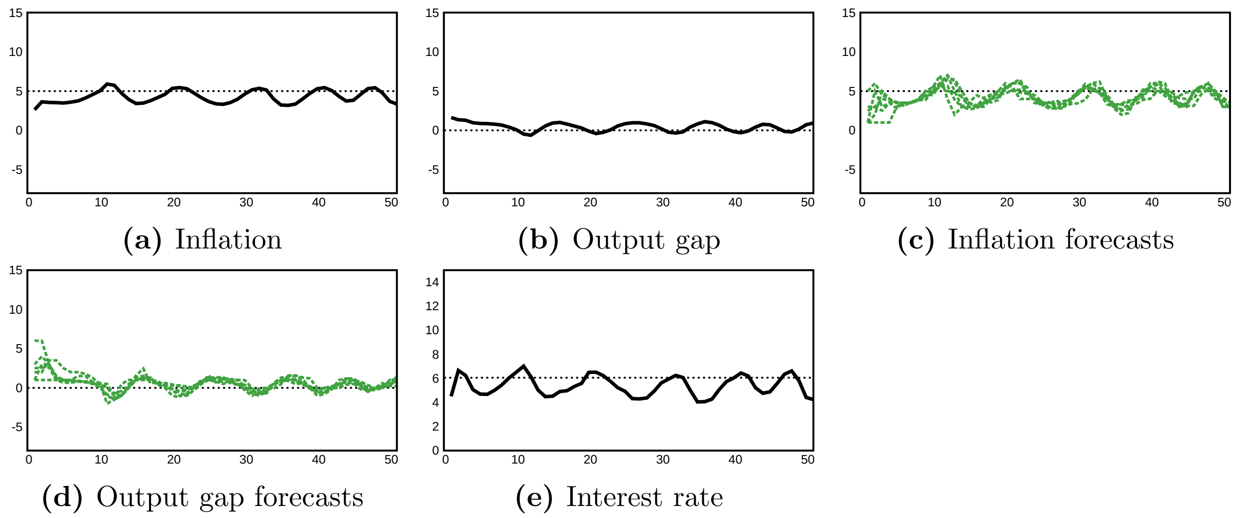
B.1 Inflation targeting



(a) Inflation (b) Output gap (c) Inflation forecasts

(d) Output gap forecasts (e) Interest rate

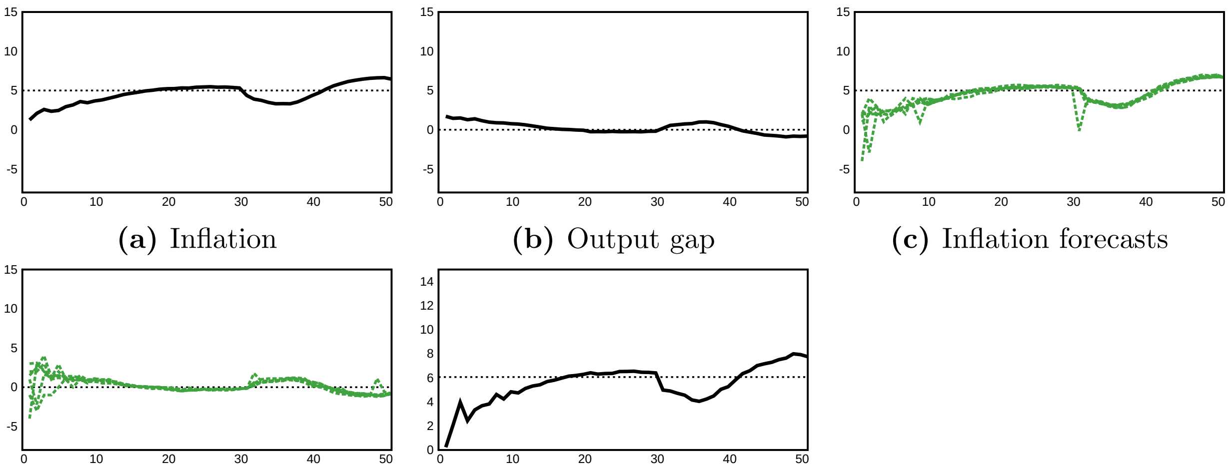
Figure B.1.1: Group number 1 (Inflation Targeting).



(a) Inflation (b) Output gap (c) Inflation forecasts

(d) Output gap forecasts (e) Interest rate

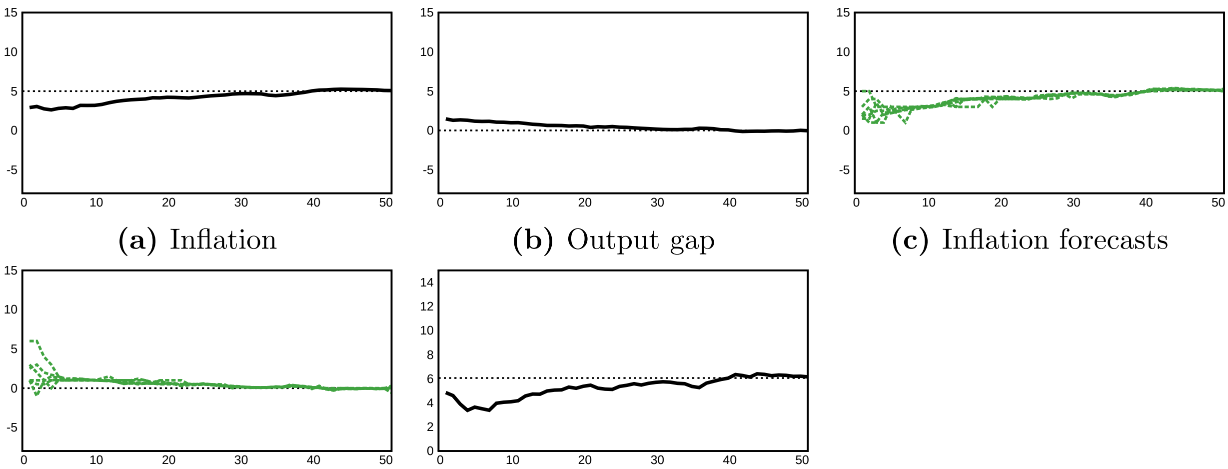
Figure B.1.2: Group number 2 (Inflation Targeting).



(a) Inflation (b) Output gap (c) Inflation forecasts

(d) Output gap forecasts (e) Interest rate

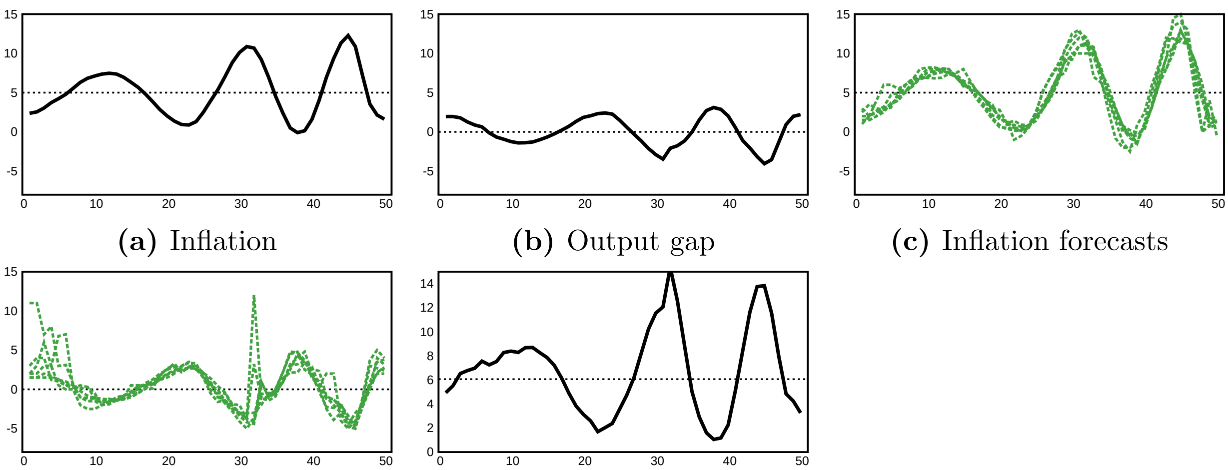
Figure B.1.3: Group number 3 (Inflation Targeting).



(a) Inflation (b) Output gap (c) Inflation forecasts

(d) Output gap forecasts (e) Interest rate

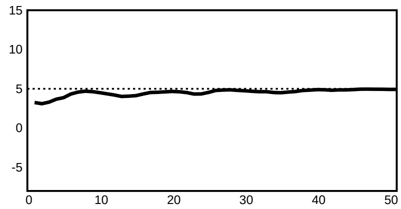
Figure B.1.4: Group number 4 (Inflation Targeting).



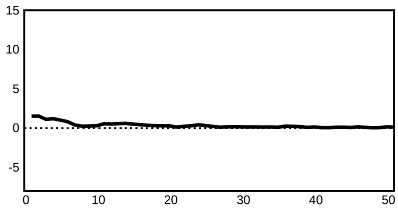
(a) Inflation (b) Output gap (c) Inflation forecasts

(d) Output gap forecasts (e) Interest rate

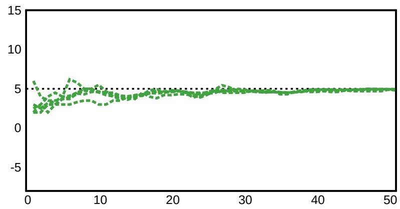
Figure B.1.5: Group number 5 (Inflation Targeting).



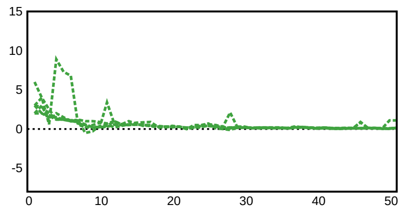
(a) Inflation



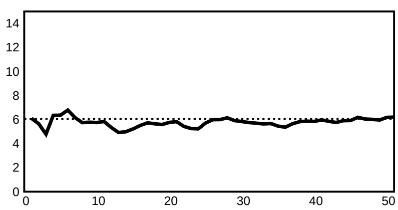
(b) Output gap



(c) Inflation forecasts

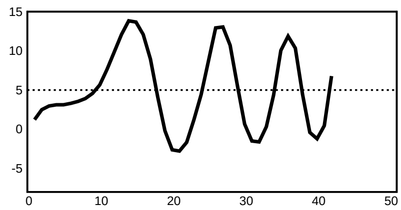


(d) Output gap forecasts

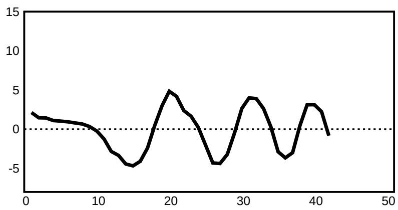


(e) Interest rate

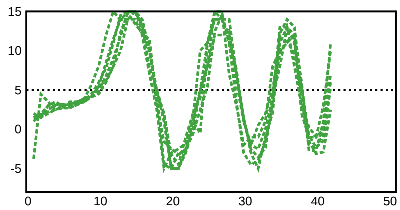
Figure B.1.6: Group number 6 (Inflation Targeting).



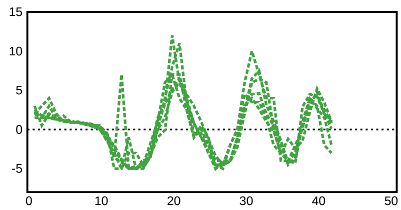
(a) Inflation



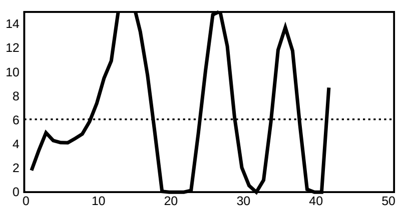
(b) Output gap



(c) Inflation forecasts



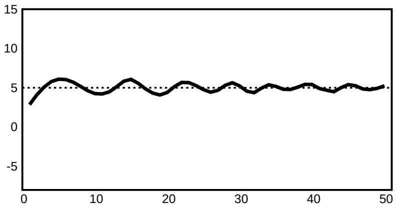
(d) Output gap forecasts



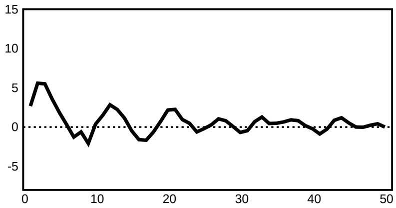
(e) Interest rate

Figure B.1.7: Group number 7* (Inflation Targeting). The group in which one of the subjects was extremely slow. The group was terminated after period 41 and not used in the econometric analysis.

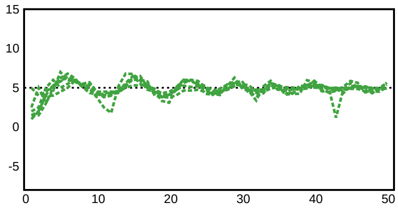
B.2 PLT: Stable with Guidance



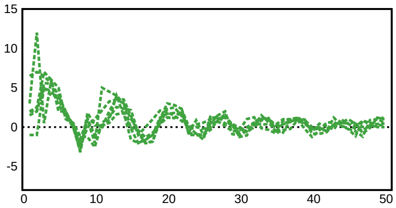
(a) Inflation



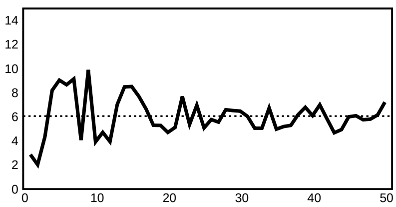
(b) Output gap



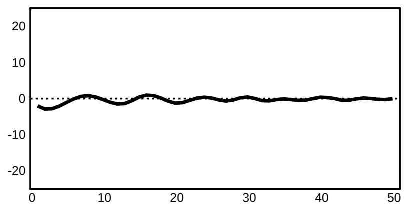
(c) Inflation forecasts



(d) Output gap forecasts

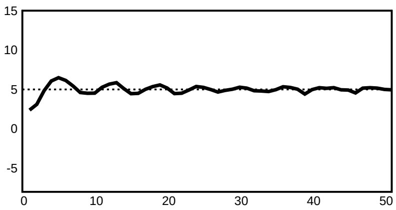


(e) Interest rate

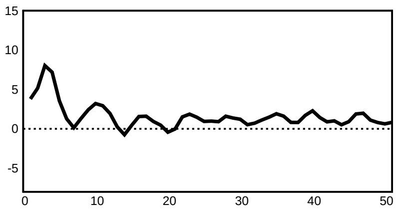


(f) Price Deviation

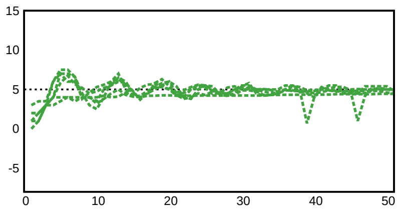
Figure B.2.1: Group number 1 (PLT: Stable with Guidance).



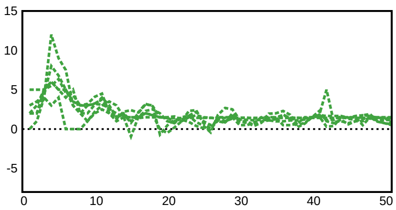
(a) Inflation



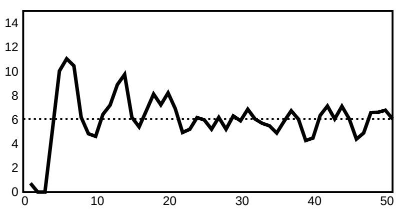
(b) Output gap



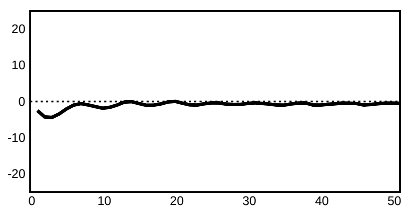
(c) Inflation forecasts



(d) Output gap forecasts

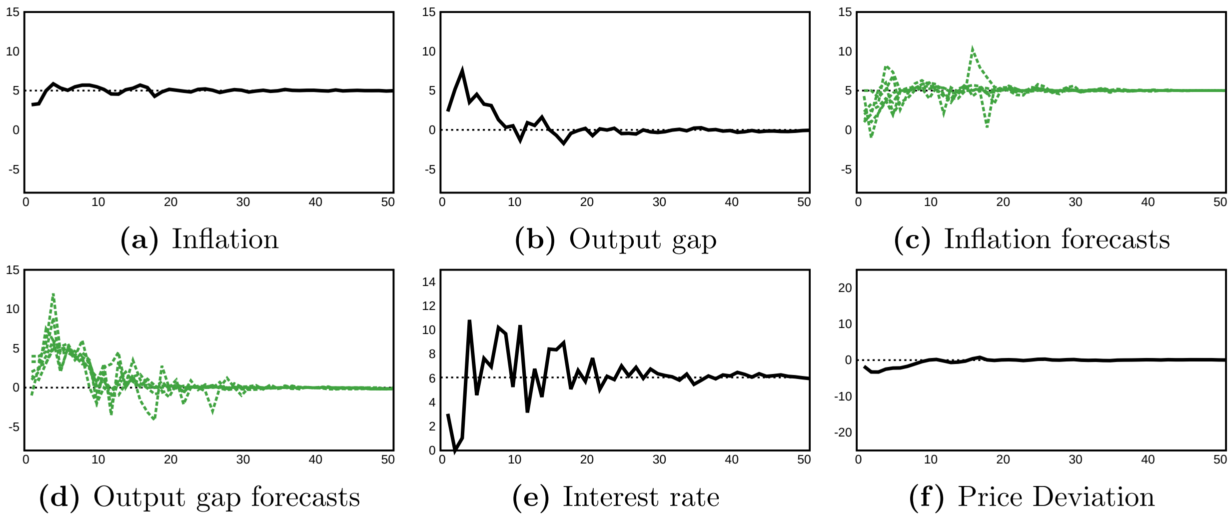


(e) Interest rate



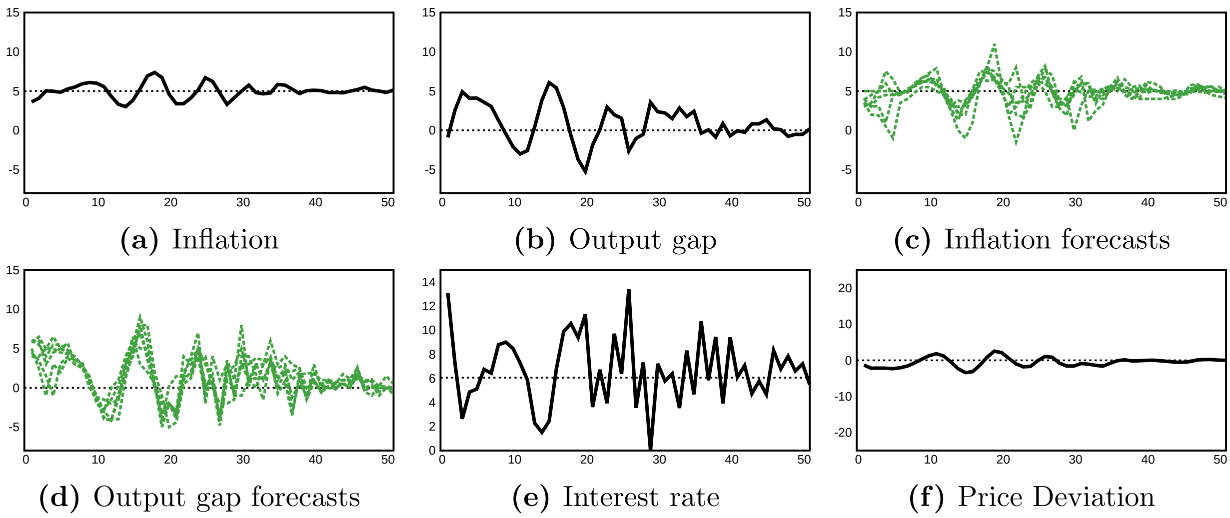
(f) Price Deviation

Figure B.2.2: Group number 2 (PLT: Stable with Guidance).



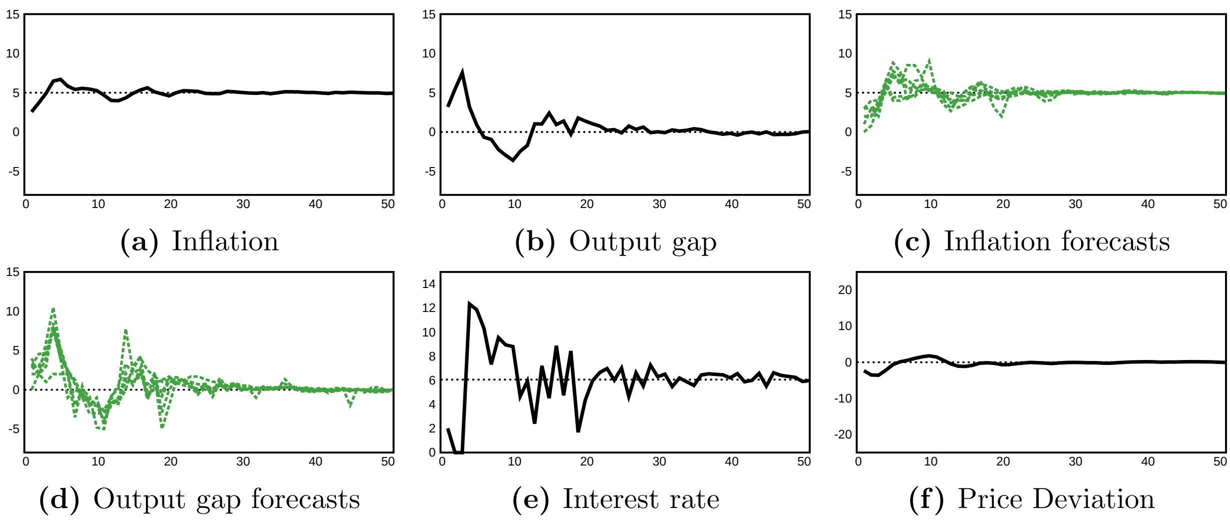
(a) Inflation (b) Output gap (c) Inflation forecasts
(d) Output gap forecasts (e) Interest rate (f) Price Deviation

Figure B.2.3: Group number 3 (PLT: Stable with Guidance).



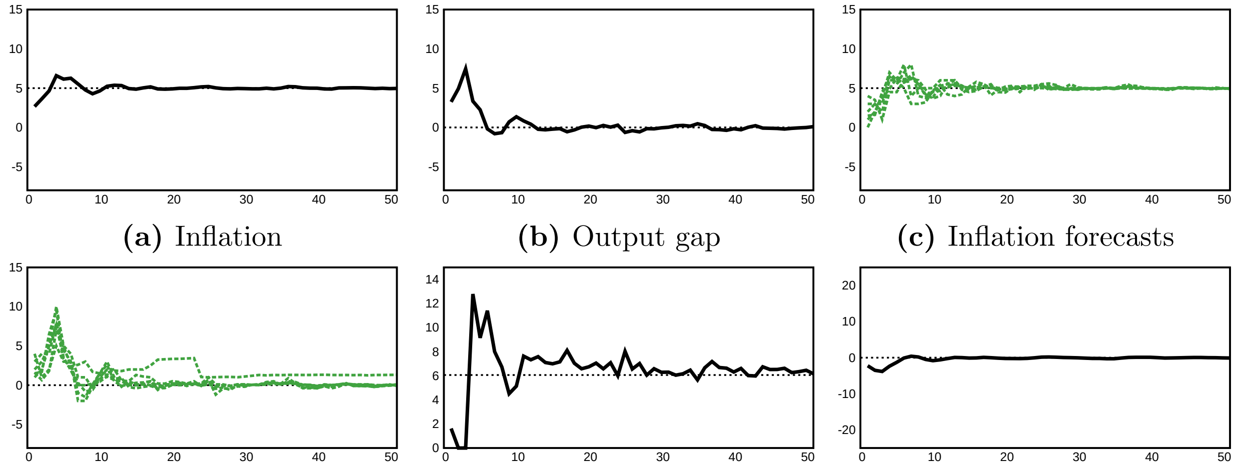
(a) Inflation (b) Output gap (c) Inflation forecasts
(d) Output gap forecasts (e) Interest rate (f) Price Deviation

Figure B.2.4: Group number 4 (PLT: Stable with Guidance).



(a) Inflation (b) Output gap (c) Inflation forecasts
(d) Output gap forecasts (e) Interest rate (f) Price Deviation

Figure B.2.5: Group number 5 (PLT: Stable with Guidance).

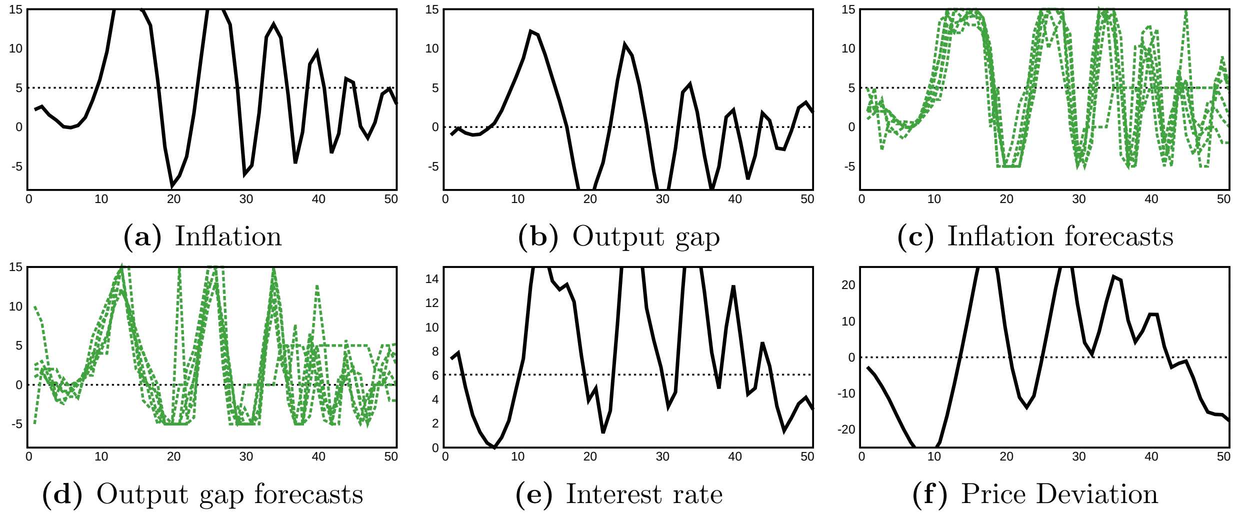


(a) Inflation **(b)** Output gap **(c)** Inflation forecasts

(d) Output gap forecasts **(e)** Interest rate **(f)** Price Deviation

Figure B.2.6: Group number 6 (PLT: Stable with Guidance).

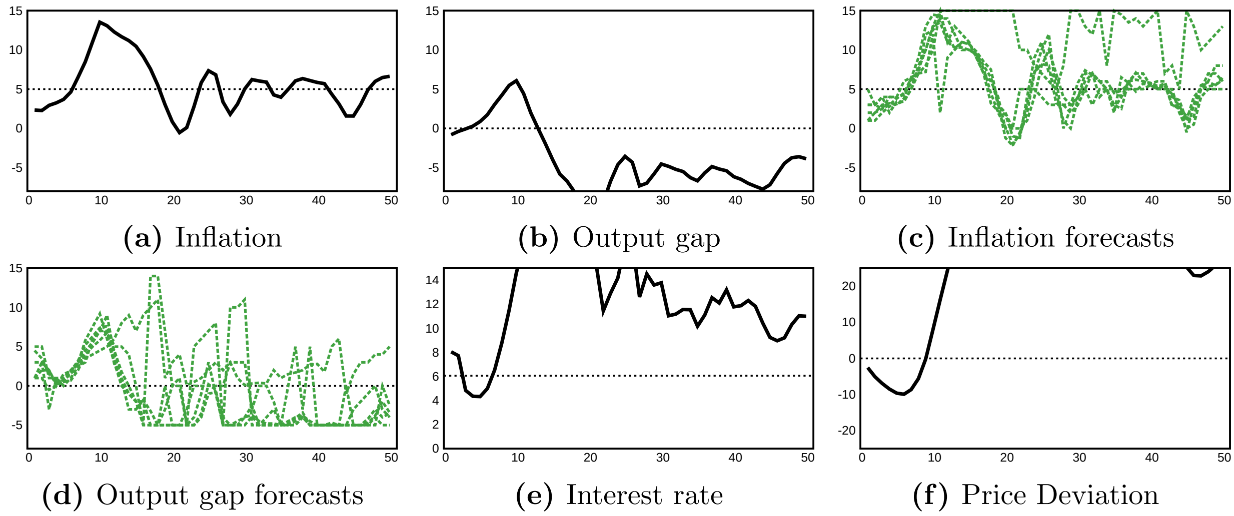
B.3 PLT: Unstable with Guidance



(a) Inflation **(b)** Output gap **(c)** Inflation forecasts

(d) Output gap forecasts **(e)** Interest rate **(f)** Price Deviation

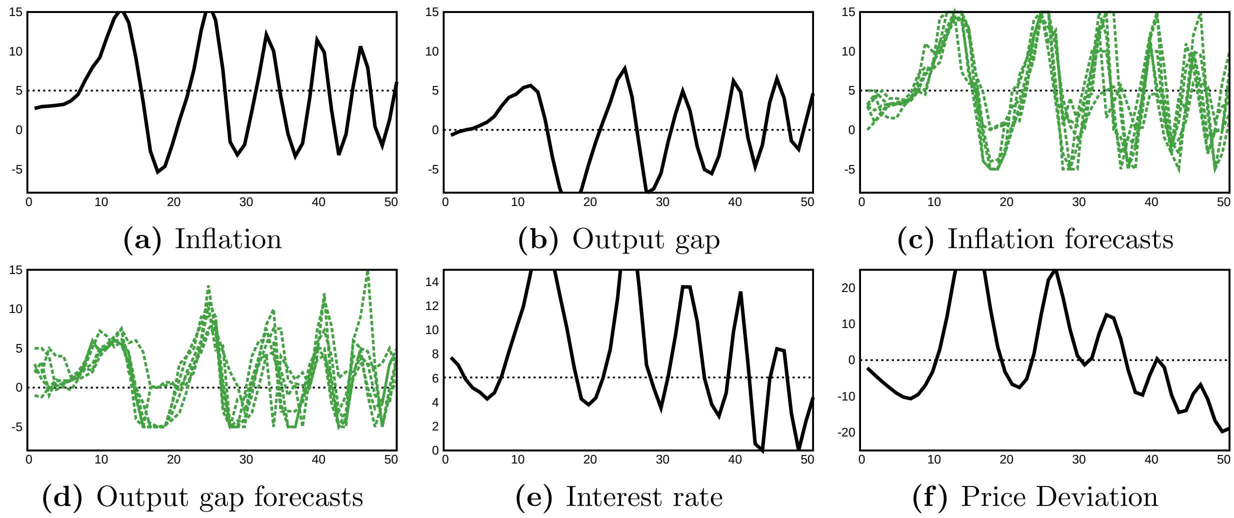
Figure B.3.1: Group number 1 (PLT: Unstable with Guidance).



(a) Inflation **(b)** Output gap **(c)** Inflation forecasts

(d) Output gap forecasts **(e)** Interest rate **(f)** Price Deviation

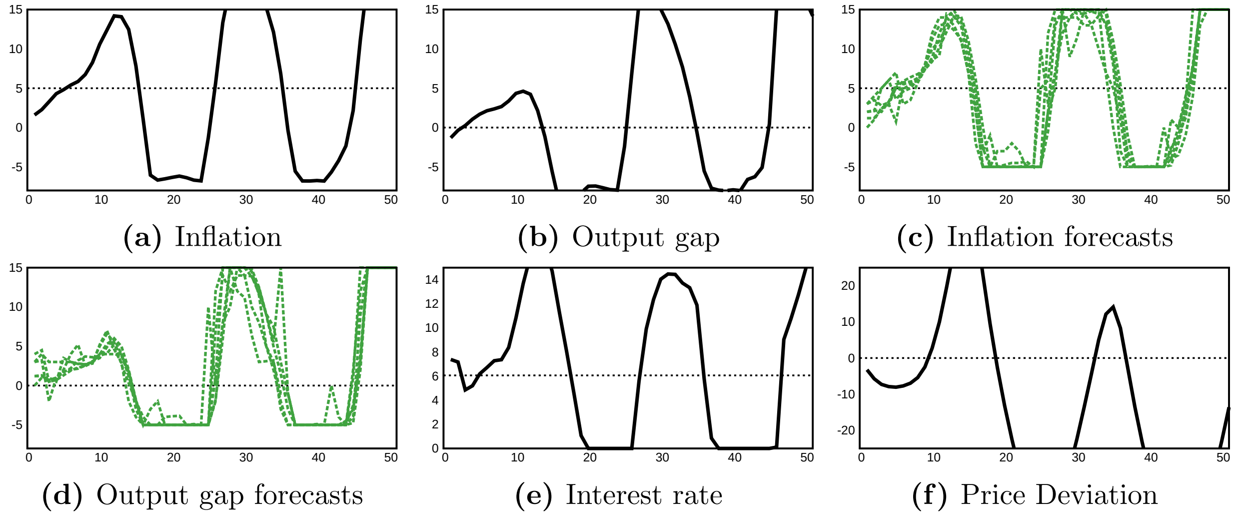
Figure B.3.2: Group number 2 (PLT: Unstable with Guidance).



(a) Inflation (b) Output gap (c) Inflation forecasts

(d) Output gap forecasts (e) Interest rate (f) Price Deviation

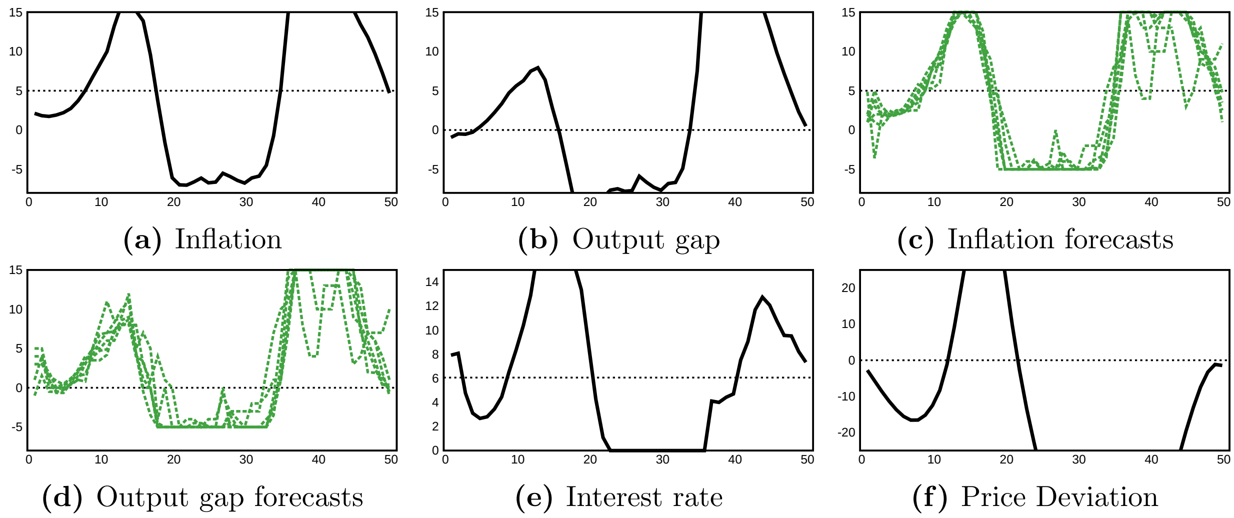
Figure B.3.3: Group number 3 (PLT: Unstable with Guidance).



(a) Inflation (b) Output gap (c) Inflation forecasts

(d) Output gap forecasts (e) Interest rate (f) Price Deviation

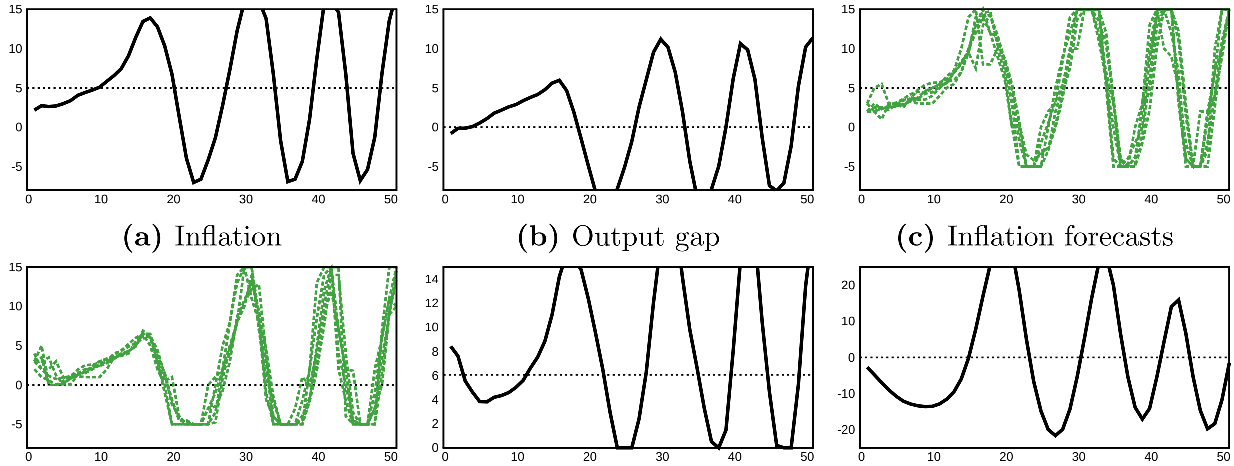
Figure B.3.4: Group number 4 (PLT: Unstable with Guidance).



(a) Inflation (b) Output gap (c) Inflation forecasts

(d) Output gap forecasts (e) Interest rate (f) Price Deviation

Figure B.3.5: Group number 5 (PLT: Unstable with Guidance).

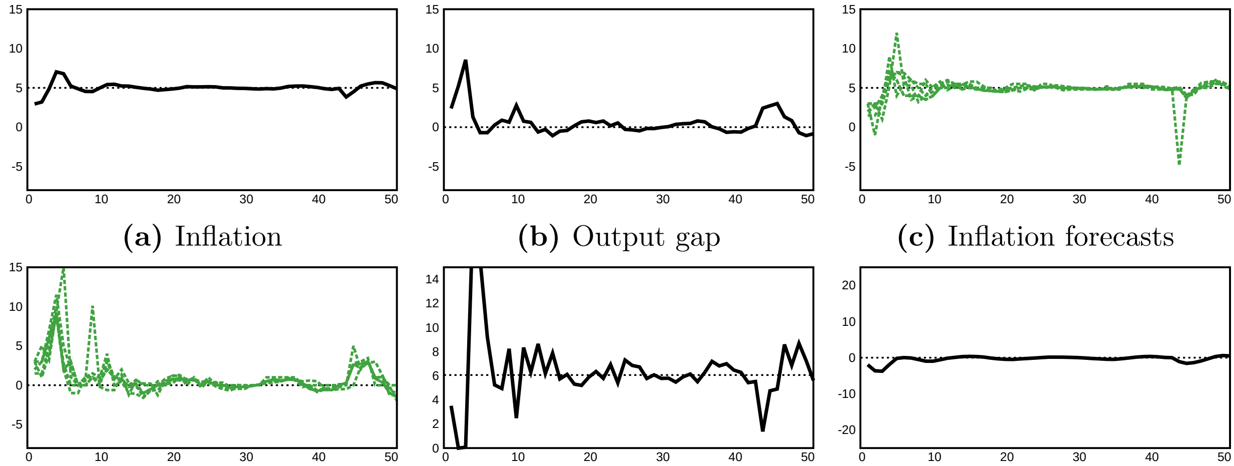


(a) Inflation **(b)** Output gap **(c)** Inflation forecasts

(d) Output gap forecasts **(e)** Interest rate **(f)** Price Deviation

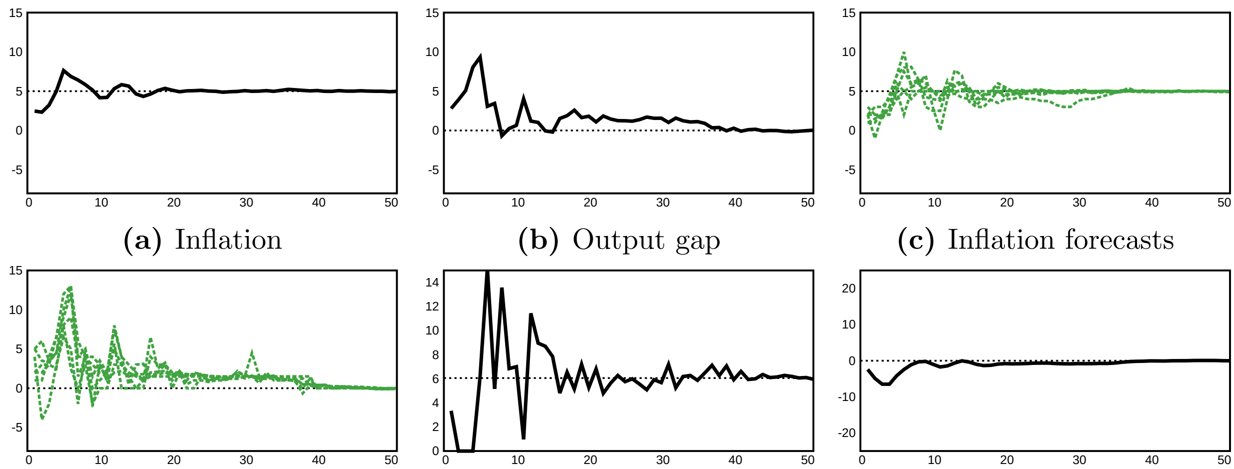
Figure B.3.6: Group number 6 (PLT: Unstable with Guidance).

B.4 PLT: Stable with No Guidance


(a) Inflation (b) Output gap (c) Inflation forecasts

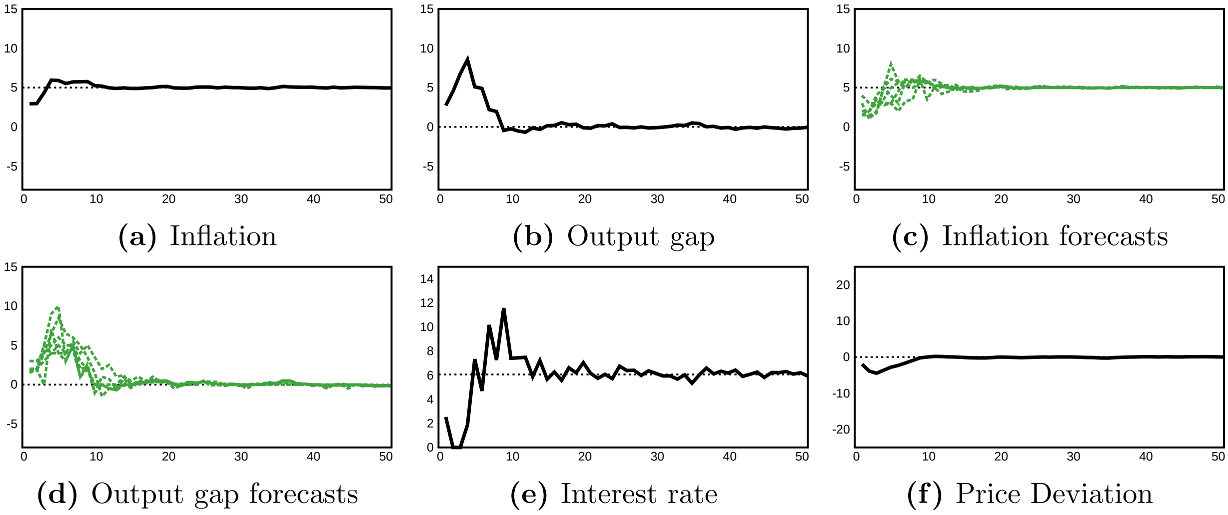
(d) Output gap forecasts (e) Interest rate (f) Price Deviation

Figure B.4.1: Group number 1 (PLT: Stable with No Guidance).


(a) Inflation (b) Output gap (c) Inflation forecasts

(d) Output gap forecasts (e) Interest rate (f) Price Deviation

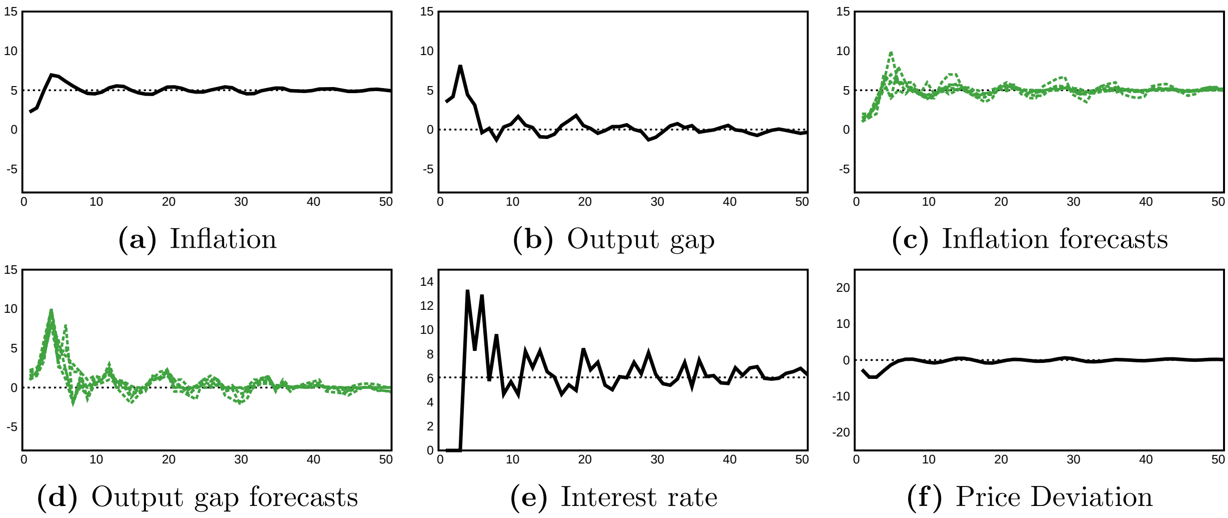
Figure B.4.2: Group number 2 (PLT: Stable with No Guidance).



(a) Inflation (b) Output gap (c) Inflation forecasts

(d) Output gap forecasts (e) Interest rate (f) Price Deviation

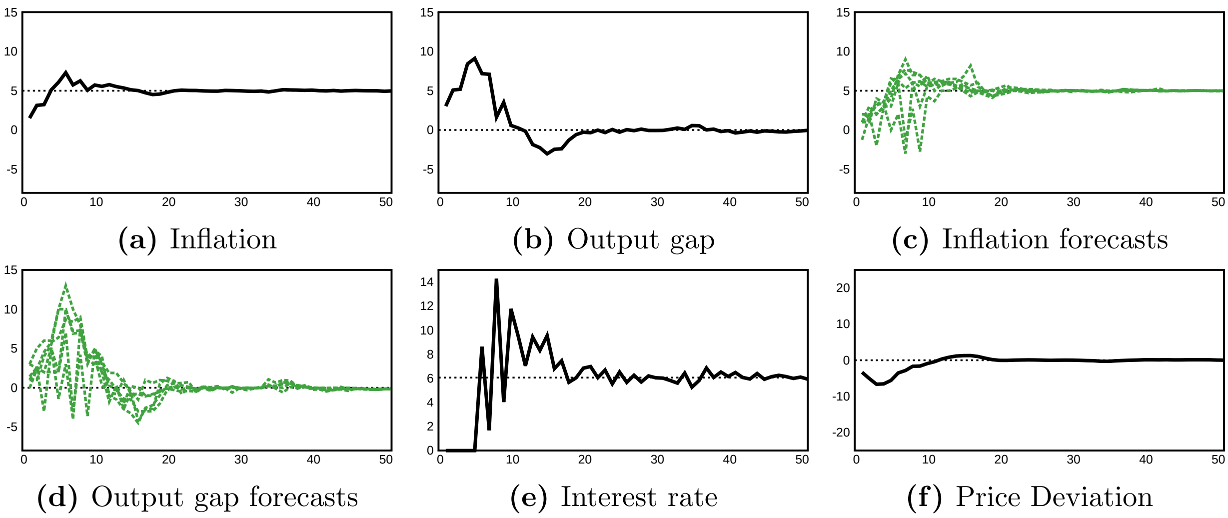
Figure B.4.3: Group number 3 (PLT: Stable with No Guidance).



(a) Inflation (b) Output gap (c) Inflation forecasts

(d) Output gap forecasts (e) Interest rate (f) Price Deviation

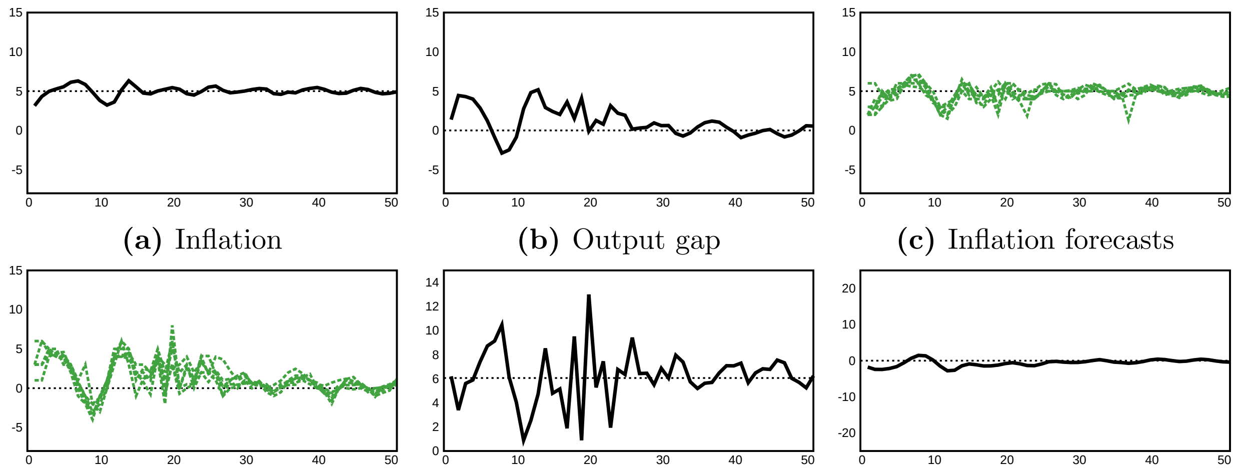
Figure B.4.4: Group number 4 (PLT: Stable with No Guidance).



(a) Inflation (b) Output gap (c) Inflation forecasts

(d) Output gap forecasts (e) Interest rate (f) Price Deviation

Figure B.4.5: Group number 5 (PLT: Stable with No Guidance).

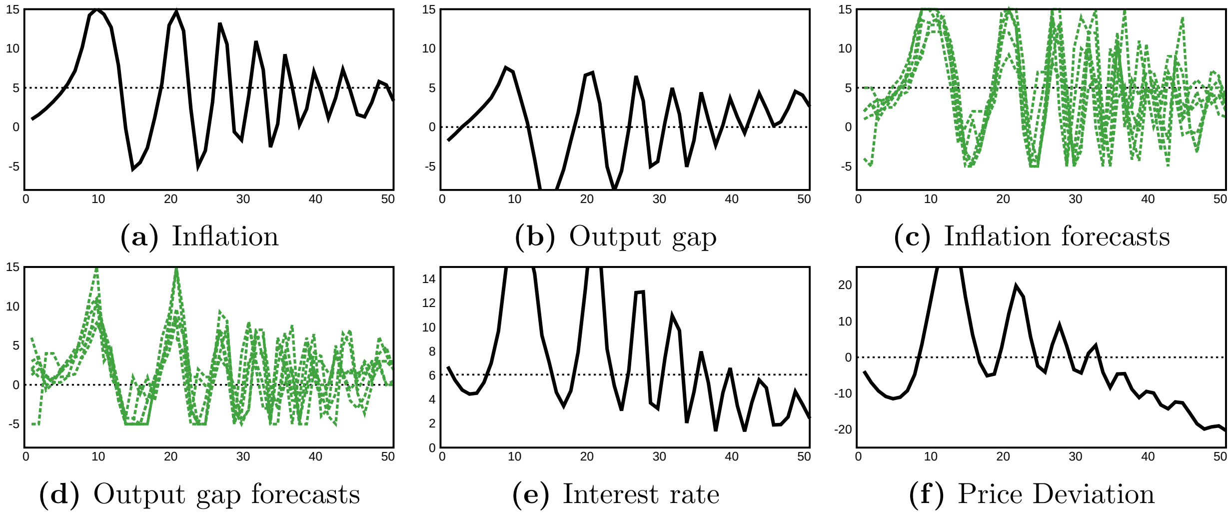


(a) Inflation (b) Output gap (c) Inflation forecasts

(d) Output gap forecasts (e) Interest rate (f) Price Deviation

Figure B.4.6: Group number 6 (PLT: Stable with No Guidance).

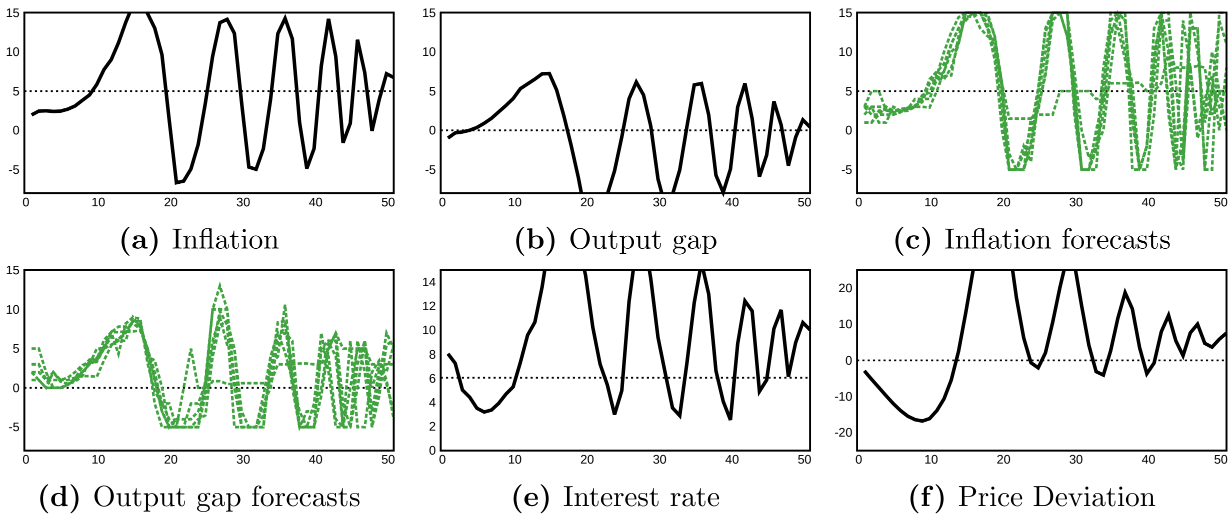
B.5 PLT: Unstable with No Guidance



(a) Inflation **(b)** Output gap **(c)** Inflation forecasts

(d) Output gap forecasts **(e)** Interest rate **(f)** Price Deviation

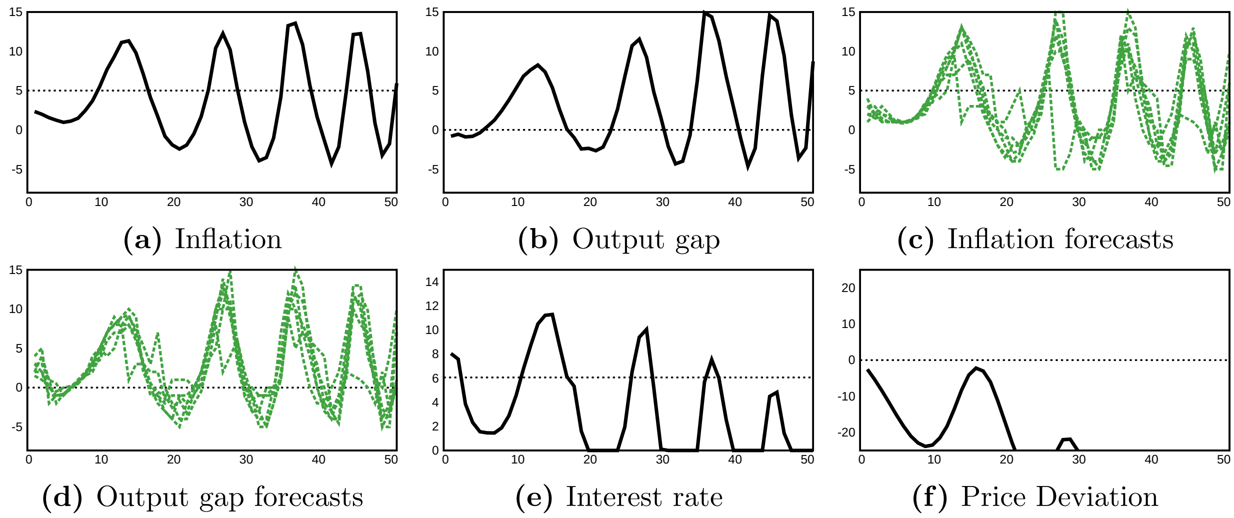
Figure B.5.1: Group number 1 (PLT: Unstable with No Guidance).



(a) Inflation **(b)** Output gap **(c)** Inflation forecasts

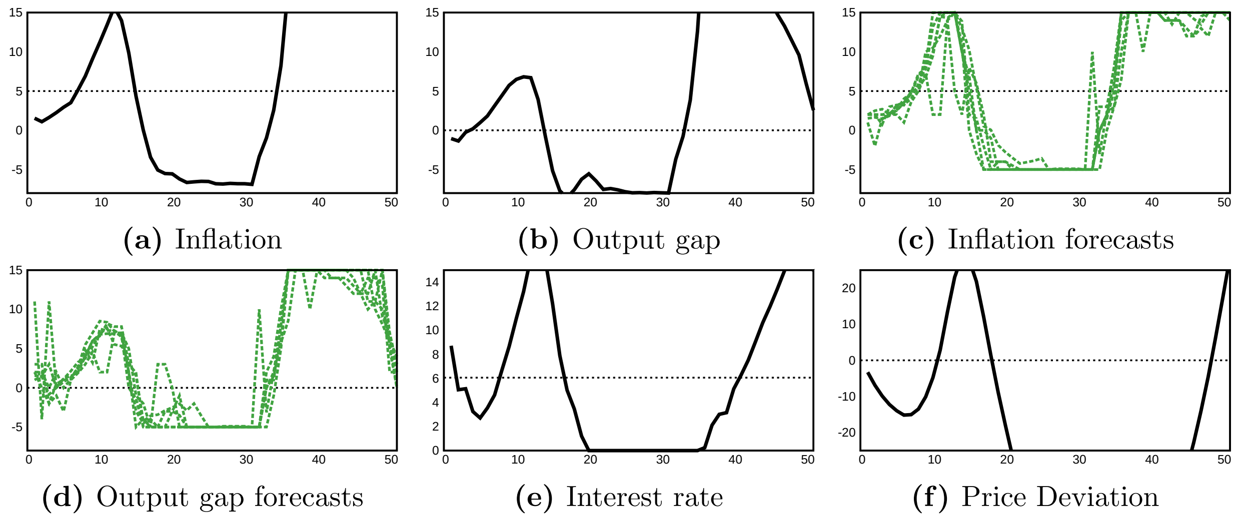
(d) Output gap forecasts **(e)** Interest rate **(f)** Price Deviation

Figure B.5.2: Group number 2 (PLT: Unstable with No Guidance).



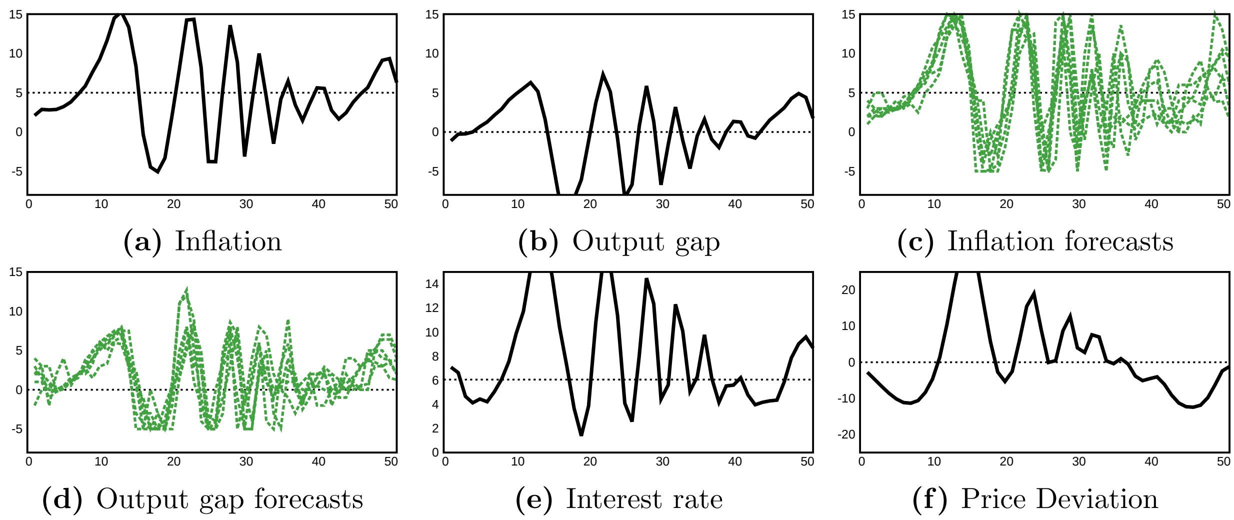
(a) Inflation (b) Output gap (c) Inflation forecasts (d) Output gap forecasts (e) Interest rate (f) Price Deviation

Figure B.5.3: Group number 3 (PLT: Unstable with No Guidance).



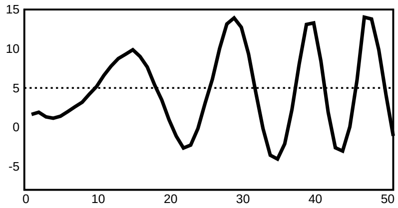
(a) Inflation (b) Output gap (c) Inflation forecasts (d) Output gap forecasts (e) Interest rate (f) Price Deviation

Figure B.5.4: Group number 4 (PLT: Unstable with No Guidance).

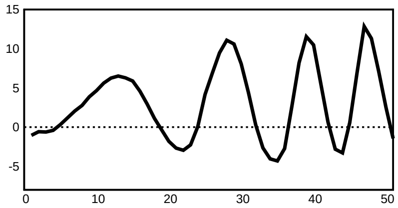


(a) Inflation (b) Output gap (c) Inflation forecasts (d) Output gap forecasts (e) Interest rate (f) Price Deviation

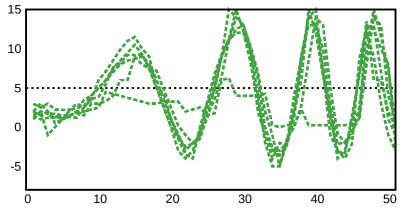
Figure B.5.5: Group number 5 (PLT: Unstable with No Guidance).



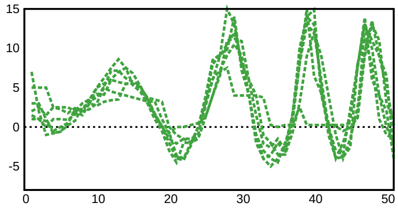
(a) Inflation



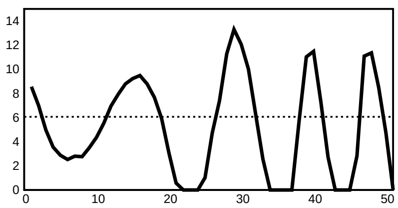
(b) Output gap



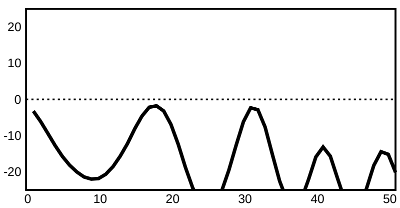
(c) Inflation forecasts



(d) Output gap forecasts



(e) Interest rate



(f) Price Deviation

Figure B.5.6: Group number 6 (PLT: Unstable with No Guidance).

C Estimated individual behavior

For every subject, we independently estimate the two-dimensional forecasting rule (8) with the algorithm discussed below. All the estimations are based on a straightforward two-dimensional ML approach (with BFGS maximization algorithm), while tests are performed with LR test on 5% significance level. We wrote the econometrics code in matrix algebra language Ox (Doornik, 2007). The code is available on request.

Variable selection algorithm **Start** with all coefficients in the coefficient pool.

1. Test significance of each individual coefficient, which was not yet thrown out of the coefficient pool. If all are significant, **stop**. Otherwise, go to point 2.

2. Test the joined significance of all coefficients, which were found insignificant in the previous step. If test rejects their joint significance, throw them all out of the pool and go to point 1. Otherwise go to point 3.

3. From the coefficients, which were found insignificant in point 1, select exactly one to be thrown out of the pool according to this criterion:

   - If no coefficient was so far thrown out from the pool at point 3; or if the last coefficient that was thrown out of the pool at point 3 was a coefficient from the output gap rule, select a coefficient from the inflation rule;
   - Otherwise, select a coefficient from the output gap rule;
   - For the relevant rule, throw one coefficient out of the pool which was deemed insiginificant in point 1, and which appears as first in the following enumeration (superscripts have been suppressed for the sake of brevity): α_3, β, γ (only if one of the two guidance treatments), δ, α_2, α_1, constant.

   Afterward, go back to point 1.

Remark that at no stage one throws out higher lags of the explained variables, as to make sure that there is no autocorrelation in the data. See also Table 4 for the average coefficients.

C.1 Treatment INF

Subject	Inflation forecasting rule						Output gap forecasting rule					
	c^{π}	α_1^{π}	α_2^{π}	α_3^{π}	β^{π}	δ^{π}	c^{υ}	α_1^{υ}	α_2^{υ}	α_3^{υ}	β^{υ}	δ^{υ}
Group 1												
11		0.553	0.43		0.995		2.41	0.305				−0.403
12		0.292				0.551	1.94	0.28			−0.601	−0.286
13			0.972		1.38				1.01		1.16	
14	0.528	0.874			1.24		1.06	−0.0197	0.693			−0.163
15	0.465	0.888			1.16		1.02	0.241	0.403			−0.159
16			0.994						1.02			
Mean	0.165	0.434	0.399	0	0.796	0.0918	1.07	0.134	0.521	0	0.0932	−0.168
(SD)	(0.235)	(0.368)	(0.44)	(0)	(0.575)	(0.205)	(0.9)	(0.142)	(0.423)	(0)	(0.525)	(0.145)
Group 2												
21	4.44				1.04		−0.958	0.201	0.528		1.23	0.205
22			1.01		1.01		−2.12		1.36		1.08	0.365
23	2.25	0.478			1.37		−0.098	0.264	0.532		1.29	0.0238
24	4.24				1.4		0.777	0.0913	0.00873		1.53	−0.102
25			0.997		0.642				0.964		0.742	
26	−0.898		−0.837			1.59	0.0146	0.00215	1.15		0.783	0.0255
Mean	1.67	0.0797	0.195	0	0.91	0.265	−0.397	0.0931	0.757	0	1.11	0.0863
(SD)	(2.11)	(0.178)	(0.644)	(0)	(0.479)	(0.594)	(0.92)	(0.105)	(0.451)	(0)	(0.278)	(0.154)
Group 3												

Table 5: Estimated individual rules for Treatment 1 (Inflation forecasting).

Subject	c^π	α_1^π	α_2^π	α_3^π	β^π	δ^π	c^v	α_1^v	α_2^v	α_3^v	β^v	δ^v
31			1.01						1.04			
32	0.335	0.929			1.26		1.24	0.182	0.486			−0.219
33			0.976				−0.113		0.99		1.03	
34			1.01				3.37					−0.558
35		0.995			1.18				1.11			
36			1						1.02			
Mean	0.0559	0.321	0.667	0	0.408	0	0.75	0.0304	0.774	0	0.172	−0.13
(SD)	(0.125)	(0.454)	(0.472)	(0)	(0.577)	(0)	(1.26)	(0.068)	(0.402)	(0)	(0.384)	(0.208)
Group 4												
41		1.01							0.95			
42		1.01						0.932				
43		1.01							0.907			
44		1.01						0.947				
45		1						0.977				
46		1.01						0.941				
Mean	0	1.01	0	0	0	0	0	0.633	0.309	0	0	0
(SD)	(0)	(0.00242)	(0)	(0)	(0)	(0)	(0)	(0.448)	(0.438)	(0)	(0)	(0)
Group 5												
51			1.03		1.08		6.29		−1.24	−1.08	0.814	
52			0.94		0.688			0.283	0.612		0.788	
53			0.992		1.63				0.849		2.01	
54			0.974		0.649		1.27		0.526		0.565	−0.159
55	1.59		0.998		1.63	−0.243	3.37	−0.0395	−0.422	−1.21	1.57	0.459

Table 5: Estimated individual rules for Treatment 1 (Inflation forecasting).

Subject	c^π	α_1^π	α_2^π	α_3^π	β^π	δ^π	c^v	α_1^v	α_2^v	α_3^v	β^v	δ^v
56			1		0.607				1.02		0.868	
Mean	0.265	0	0.989	0	1.05	−0.0405	1.82	0.0405	0.223	−0.383	1.1	0.05
(SD)	(0.592)	(0)	(0.0277)	(0)	(0.44)	(0.0905)	(2.33)	(0.109)	(0.798)	(0.543)	(0.511)	(0.192)
Group 6												
61		1.01							1.25			
62			0.997									
63	1.5	0.675			2.11		−1.06	0.417	0.899			0.179
64			0.998									
65	4.64						0.031		0.85			
66	1.37	0.701					−0.0455	0.349	0.9			
Mean	1.25	0.397	0.333	0	0.352	0	−0.178	0.128	0.65	0	0	0.0298
(SD)	(1.64)	(0.411)	(0.47)	(0)	(0.787)	(0)	(0.393)	(0.182)	(0.478)	(0)	(0)	(0.0667)

Table 5: (Cont.) Estimated individual rules for Treatment 1 (Inflation forecasting).

C.2 Treatment StrongNo

	Inflation forecasting rule						**Output gap forecasting rule**					
Subject	c^π	α_1^π	α_2^π	α_3^π	β^π	δ^π	c^v	α_1^v	α_2^v	α_3^v	β^v	δ^v
Group 1												
11			1.11			−0.0882	2.2		0.735			−0.286
12			1.18			−0.15			0.719			
13			0.992						0.944			

Table 6: Estimated individual rules for Treatment 2 (Stable price level targeting (no guidance)).

Subject	c^{π}	α_1^{π}	α_2^{π}	α_3^{π}	β^{π}	δ^{π}	c^{v}	α_1^{v}	α_2^{v}	α_3^{v}	β^{v}	δ^{v}
14			0.993						0.941			
15	1.03	0.796			1.17		1.58	0.209	0.736			−0.259
16			0.953				−8.72		1.28	0.699	1.02	0.847
Mean	0.171	0.133	0.87	0	0.195	−0.0397	−0.823	0.0349	0.892	0.117	0.17	0.0503
(SD)	(0.382)	(0.296)	(0.397)	(0)	(0.436)	(0.0589)	(3.64)	(0.0781)	(0.197)	(0.261)	(0.38)	(0.377)
Group 2												
21	3.35	0.308			2.5		0.0945	0.215	0.646		0.856	
22	4.96				0.89		7.62	0.136	1.08	−1.63	−0.0981	0.0959
23	6.06				1.03	−0.174	−3.53	−0.129	1.62	−0.84	1.76	1.26
24	2.43	0.818			1.2	−0.237	0.486	0.584	0.479		0.134	−0.0675
25		0.997						0.511	0.489			
26	5						0.452	0.569				
Mean	3.63	0.354	0	0	0.936	−0.0686	0.854	0.314	0.719	−0.411	0.443	0.214
(SD)	(2.01)	(0.41)	(0)	(0)	(0.844)	(0.0987)	(3.33)	(0.263)	(0.513)	(0.624)	(0.67)	(0.468)
Group 3												
31	5							−0.106	1.13			
32	5						0.105		1.05			
33			1									
34	1.72	0.171	0.473				3.49	0.812	0.0597			−0.562
35			0.999									
36	5.01						0.0569	0.541	0.234			
Mean	2.79	0.0285	0.412	0	0	0	0.608	0.208	0.413	0	0	−0.0937
(SD)	(2.29)	(0.0638)	(0.448)	(0)	(0)	(0)	(1.29)	(0.343)	(0.486)	(0)	(0)	(0.21)

Table 6: Estimated individual rules for Treatment 2 (Stable price level targeting (no guidance)).

Subject	c^π	α_1^π	α_2^π	α_3^π	β^π	δ^π	c^v	α_1^v	α_2^v	α_3^v	β^v	δ^v
Group 4												
41	2.16		0.565				2.25	0.223	0.534			−0.333
42			0.992						1.19			
43			1.01				0.411		0.66			
44	3.38	0.32			1.3		2.39	0.437	0.24			−0.343
45	3.11	0.383			2.72		4.44	0.37	0.307			−0.702
46	2.83	0.431					0.136	−0.0313	0.72			
Mean	1.91	0.189	0.428	0	0.671	0	1.61	0.167	0.608	0	0	−0.23
(SD)	(1.4)	(0.192)	(0.452)	(0)	(1.03)	(0)	(1.59)	(0.188)	(0.311)	(0)	(0)	(0.26)
Group 5												
51	1.48	0.347				0.293	−0.547	0.259	0.308			0.0807
52		0.63	0.382						0.267			
53	2.11	0.579			1.34		−0.104	−0.231	1.28			0.0364
54			1.01					0.357	0.71			
55			1.25		−1.21	−0.206	9.42		1.64	−2.52		0.53
56		−0.462	1.47					0.589				
Mean	0.599	0.182	0.685	0	0.021	0.0144	1.46	0.162	0.702	−0.419	0	0.108
(SD)	(0.867)	(0.38)	(0.587)	(0)	(0.736)	(0.145)	(3.57)	(0.27)	(0.585)	(0.937)	(0)	(0.191)
Group 6												
61	3.27	0.318			1.38		−3.24	0.0223	0.55	0.255	1.14	0.427
62	2.23	0.344			0.698	0.155	3	0.271	0.348		−0.0979	−0.435
63	1.8	0.612			0.908		−1.8	0.394	0.592		0.593	0.355
64			1.16		0.372	−0.176		0.398	0.401	0.253	0.662	−0.136

Table 6: Estimated individual rules for Treatment 2 (Stable price level targeting (no guidance)).

Subject	c^π	α_1^π	α_2^π	α_3^π	β^π	δ^π	c^v	α_1^v	α_2^v	α_3^v	β^v	δ^v
65			0.964						0.971		0.151	
66		0.359	0.923			−0.239	2.61		0.657			−0.386
Mean	1.22	0.272	0.507	0	0.559	−0.0433	0.0955	0.181	0.586	0.0847	0.408	−0.0291
(SD)	(1.29)	(0.215)	(0.513)	(0)	(0.495)	(0.13)	(2.22)	(0.179)	(0.202)	(0.12)	(0.432)	(0.332)

Table 6: (Cont.) Estimated individual rules for Treatment 2 (Stable price level targeting (no guidance)).

C.3 Treatment WeakNo

	Inflation forecasting rule						Output gap forecasting rule					
Subject	c^π	α_1^π	α_2^π	α_3^π	β^π	δ^π	c^v	α_1^v	α_2^v	α_3^v	β^v	δ^v
Group 1												
11			0.361		0.855	0.427	−0.958	−0.109	0.993	−0.585	0.683	0.614
12			0.284		0.445	0.256		−0.0777	0.748	−0.647	0.359	0.591
13	2.37			0.315	0.648	0.262	1.93	0.25	0.394	−0.183	0.515	−0.0118
14			−0.695	0.747	0.5	0.907		−0.255	0.898	−0.715	0.647	0.585
15	5.75		−2	1.76		1.14	3.08	−0.103	1.38	−1.43	−0.0866	0.634
16	4.95	0.181	−0.247	0.471			3.11	0.0278	0.414	−0.186	0.0468	−0.203
Mean	2.18	0.0301	−0.383	0.549	0.408	0.498	1.19	−0.0446	0.804	−0.624	0.361	0.368
(SD)	(2.41)	(0.0674)	(0.805)	(0.602)	(0.316)	(0.396)	(1.59)	(0.155)	(0.341)	(0.417)	(0.291)	(0.341)
Group 2												
21	2.14	−0.295	0.172	0.855		0.513	1.53	−0.355	1.65	−0.927	0.204	0.66
22	4.81	−0.372		0.859	0.65	0.437	3.37	0.292	0.544	−0.264	0.461	−0.0281

Table 7: Estimated individual rules for Treatment 3 (Unstable price level targeting (no guidance)).

Subject	c^{π}	α_1^{π}	α_2^{π}	α_3^{π}	β^{π}	δ^{π}	c^{v}	α_1^{v}	α_2^{v}	α_3^{v}	β^{v}	δ^{v}
23	2.24			0.645	0.348	0.623	2.01	0.0601	1.3	−0.825	0.289	0.466
24	4.69	0.544	−1.26	1.4		0.612	2.11	−0.0336	1.96	−1.95	−0.00253	1.17
25	2.16	0.694		0.226			3.57	0.627	0.291	−0.0239	−0.0589	−0.224
26	2.67	−0.368		0.615	1.09	0.611	2.43	−0.231	1.24	−0.62	0.675	0.368
Mean	3.12	0.0339	−0.181	0.767	0.348	0.466	2.5	0.06	1.16	−0.769	0.261	0.402
(SD)	(1.17)	(0.434)	(0.485)	(0.354)	(0.41)	(0.219)	(0.737)	(0.327)	(0.584)	(0.614)	(0.254)	(0.455)
						Group 3						
31	2.12	0.532			0.564		2.1	0.604	0.2	−0.276	0.503	−0.0353
32	0.592	−0.4	1.03		0.56	0.251	−0.314	−0.374	1.57	−0.911	0.483	0.779
33	1.15	0.165	0.18		0.776	0.241	1.21	0.169	0.18	0.0631	0.856	0.182
34	0.745	0.473					0.103	0.341	0.618	−0.716	0.0799	0.486
35	1.32	0.586			0.728		1.12	0.361	0.53	−0.459	0.712	0.218
36		−0.179	0.687		0.683	0.559	−0.474		0.698	−0.396	0.553	0.78
Mean	0.987	0.196	0.316	0	0.552	0.175	0.623	0.184	0.633	−0.449	0.531	0.402
(SD)	(0.658)	(0.374)	(0.401)	(0)	(0.259)	(0.204)	(0.923)	(0.31)	(0.464)	(0.311)	(0.24)	(0.307)
						Group 4						
41		0.32	0.47		0.587	0.118	−1.27	0.214	1.14	−0.953	0.367	0.761
42	0.66		0.589		0.268	0.258	−0.542	0.0292	1.46	−1.34	0.109	0.971
43		0.223	0.607				−0.419	0.334	0.801	−0.586	0.272	0.508
44			0.724		0.747	0.163	−1.3	−0.376	1.55	−1.05	0.418	1.02
45		0.26	0.522		0.748	0.142	0.57	0.793	0.134		0.317	−0.101
46		0.511	0.361		0.782			0.3	0.435		0.399	0.0399
Mean	0.11	0.219	0.546	0	0.522	0.114	−0.493	0.216	0.922	−0.655	0.314	0.534

Table 7: Estimated individual rules for Treatment 3 (Unstable price level targeting (no guidance)).

Subject	c^π	α_1^π	α_2^π	α_3^π	β^π	δ^π	c^v	α_1^v	α_2^v	α_3^v	β^v	δ^v
(SD)	(0.246)	(0.179)	(0.114)	(0)	(0.292)	(0.0912)	(0.662)	(0.351)	(0.518)	(0.513)	(0.104)	(0.434)
						Group 5						
51	5.5	0.352	−1.82	1.61	0.476	0.85	2.3	0.268	0.779	−0.578	0.6	0.159
52			−0.584	0.522	0.524	0.79		−0.141	0.371		0.417	0.088
53	6.69	−0.301	0.887		0.575	−0.459	4.45	−0.128	0.513	−0.0205	0.737	−0.247
54	3.58	0.229	−1.81	1.73	0.253	1.23	2.39	0.31	0.607	−0.531	0.37	0.198
55	1.31		0.759		0.347		0.605	0.0133	0.765	−0.137	0.3	0.177
56	4.55	0.251			0.45		2.78	−0.0786	0.595	−0.321	0.312	0.098
Mean	3.6	0.0884	−0.428	0.645	0.437	0.401	2.09	0.0405	0.605	−0.265	0.456	0.0789
(SD)	(2.32)	(0.217)	(1.1)	(0.752)	(0.108)	(0.591)	(1.46)	(0.183)	(0.141)	(0.23)	(0.16)	(0.151)
						Group 6						
61	1.76	0.586			0.892		1.53	0.278	0.519	−0.0833	0.854	−0.135
62	0.58		0.802		0.414		−0.00439	0.0818	0.624		0.486	0.18
63	1.54		0.575		0.905		0.949	−0.224	1.19	−0.543	1.08	0.338
64	1.34		0.741		0.738		1.75	−0.086	1.15	−0.225	0.541	−0.0832
65	0.811	0.731			0.31		1.14	0.659	0.218		0.228	−0.184
66	1.66		0.543		1.01		1.4	0.201	0.383	0.215	0.977	−0.266
Mean	1.28	0.219	0.443	0	0.711	0	1.13	0.152	0.68	−0.106	0.694	−0.0252
(SD)	(0.44)	(0.313)	(0.326)	(0)	(0.261)	(0)	(0.568)	(0.282)	(0.367)	(0.235)	(0.299)	(0.213)

Table 7: (Cont.) Estimated individual rules for Treatment 3 (Unstable price level targeting (no guidance)).

C.4 Treatment StrongGuid

	Inflation forecasting rule							Output gap forecasting rule						
Subject	c^π	α_1^π	α_2^π	α_3^π	β^π	δ^π	γ^π	c^υ	α_1^υ	α_2^υ	α_3^υ	β^υ	δ^υ	γ^υ
							Group 1							
11	−1.61		1.3				−0.44	4.53	0.5	−1.36		−0.618	−0.704	−2.63
12	0.973		0.798					−1.17	0.399	0.236		1.26	0.247	
13	4.93				0.936			8.71	0.119	0.933	−1.77	−0.179	0.032	0.497
14	−4.14		1.76				−1	5.23	0.475	−1.65		−0.365	−0.84	−2.89
15			0.977					2.26		−0.728			−0.377	−2.17
16		0.626	0.355				−0.365		−0.268					−2.06
Mean	0.0255	0.104	0.865	0	0.156	0	−0.301	3.26	0.204	−0.428	−0.294	0.0158	−0.274	−1.54
(SD)	(2.74)	(0.233)	(0.58)	(0)	(0.349)	(0)	(0.361)	(3.33)	(0.28)	(0.906)	(0.658)	(0.595)	(0.399)	(1.3)
							Group 2							
21	2.07	0.507					−0.632	2.41	0.329	−0.665		0.041	−0.268	−1.4
22	4.28							0.609	0.577					
23		0.917					−0.684		0.901					
24			0.876				−0.574		0.467	0.276		0.61	0.0544	
25		0.314	0.663		0.874			−0.765		0.265			0.126	−1.61
26		0.833					−1.24		0.626					−0.821
Mean	1.06	0.429	0.257	0	0.146	0	−0.521	0.376	0.483	−0.0207	0	0.109	−0.0147	−0.638
(SD)	(1.63)	(0.363)	(0.368)	(0)	(0.326)	(0)	(0.427)	(0.994)	(0.277)	(0.312)	(0)	(0.225)	(0.122)	(0.68)
							Group 3							
31			1.01					0.568	0.229	0.48			−0.0745	0.379
32	6.89	−0.213			1.08	−0.138	−0.986	1.35	−0.105	1.12		−0.446	−0.18	1.25
33	6.83				1.28	−0.29		−12.4	−0.293	2.39	1.41	1.05	0.909	0.387
34	2.63	0.499						0.0161	0.491	0.477				
35		0.995			0.573			−2.51		1.12			0.426	

Table 8: Estimated individual rules for Treatment 4 (Stable price level targeting with guidance).

Subject	c^π	α_1^π	α_2^π	α_3^π	β^π	δ^π	γ^π	c^υ	α_1^υ	α_2^υ	α_3^υ	β^υ	δ^υ	γ^υ
36[!]	4.95				1.08				0.0954	−0.769		1.36	0.00826	−2.78
Mean	3.55	0.214	0.168	0	0.669	−0.0715	−0.164	−2.16	0.0695	0.802	0.235	0.328	0.181	−0.126
(SD)	(2.88)	(0.411)	(0.375)	(0)	(0.519)	(0.11)	(0.367)	(4.71)	(0.249)	(0.947)	(0.526)	(0.648)	(0.376)	(1.26)
Group 4														
41		0.241	0.644		0.767	0.0835				0.551				−1.2
42	2.88	0.358			1.43			9.54		3.84	−3.13	0.886	1.07	5.35
43*		0.477				0.358	−0.332		−0.271	−2.25	1.57		−1.1	−5.12
44	−5		3.13	−3.48	0.603	−0.904	−5.99	13	0.244	5.35	−4.19	0.628	1.44	8.94
45	4.08				1.18	0.137		2.77	0.429	−0.546	0.426	−0.0214	−0.677	−1.27
46	1.43	−0.381	0.977		0.47	0.0886		3.88	0.0909	1.73	−0.796	0.507	0.0931	2.01
Mean	0.565	0.116	0.792	−0.58	0.74	−0.0395	−1.05	4.86	0.082	1.45	−1.02	0.333	0.138	1.45
(SD)	(2.89)	(0.282)	(1.11)	(1.3)	(0.466)	(0.402)	(2.21)	(4.83)	(0.218)	(2.56)	(2.01)	(0.358)	(0.893)	(4.64)
Group 5														
51		0.629	0.365							0.828				
52			0.976							0.844				
53	4.94				1.5			−0.802	0.251	−0.923	0.592	1.63	−0.355	−2.83
54			1.01							0.828		0.25		
55[!]	3.66					0.195			−0.267	1.91	−1.07	0.534	0.855	0.961
56	1.27	0.303	0.429				−0.479	0.293	0.212	−0.0945		0.665		−1.12
Mean	1.64	0.155	0.464	0	0.251	0.0325	−0.0798	−0.0849	0.0325	0.565	−0.0797	0.514	0.0834	−0.498
(SD)	(1.97)	(0.239)	(0.409)	(0)	(0.561)	(0.0727)	(0.178)	(0.338)	(0.17)	(0.882)	(0.493)	(0.559)	(0.369)	(1.2)
Group 6														
61	5							0.0388	0.0711	0.692				
62			0.996							1				
63			0.994						0.969					
64		0.986					−0.815	0.147	0.402	0.755				

Table 8: Estimated individual rules for Treatment 4 (Stable price level targeting with guidance).

Subject	c^π	α_1^π	α_2^π	α_3^π	β^π	δ^π	γ^π	c^υ	α_1^υ	α_2^υ	α_3^υ	β^υ	δ^υ	γ^υ
65			0.989				−0.65	1.9	0.35	0.406			−0.277	
66	5.12	0.547			−0.998	−0.427		2.48	0.379	−0.648		−0.00864	−0.37	−1.82
Mean	1.69	0.256	0.496	0	−0.166	−0.0712	−0.244	0.762	0.362	0.368	0	−0.00144	−0.108	−0.304
(SD)	(2.39)	(0.383)	(0.496)	(0)	(0.372)	(0.159)	(0.349)	(1.03)	(0.313)	(0.552)	(0)	(0.00322)	(0.155)	(0.68)

Table 8: (Cont.) Estimated individual rules for Treatment 4 (Stable price level targeting with guidance).

C.5 Treatment WeakGuid

		Inflation forecasting rule						**Output gap forecasting rule**						
Subject	c^π	α_1^π	α_2^π	α_3^π	β^π	δ^π	γ^π	c^υ	α_1^υ	α_2^υ	α_3^υ	β^υ	δ^υ	γ^υ
							Group 1							
11*		0.487	0.457			0.589	−0.0781	−5.73				0.554	0.937	−0.258
12*!		0.491	0.384	−0.308	0.258	0.39	−0.203		0.405			0.493	0.214	−0.158
13*!		−0.478	1.31	−0.28	0.592	0.181				0.517		1.02	0.232	
14!	13.7	0.258	−1.95	3.09	0.456		0.674		−0.000506	1.19	−0.81	0.56	0.716	0.000803
15!		−0.186	0.698		0.313	0.196	−0.0579		−0.213	0.937	−0.565	0.549	0.535	
16		0.501	0.189		−0.109	0.266	−0.19	−0.852	0.444	−0.156			0.404	−0.234
Mean	2.28	0.179	0.182	0.417	0.252	0.27	0.0243	−1.1	0.106	0.415	−0.229	0.529	0.506	−0.108
(SD)	(5.11)	(0.38)	(1.02)	(1.2)	(0.243)	(0.184)	(0.299)	(2.09)	(0.238)	(0.509)	(0.332)	(0.295)	(0.259)	(0.113)
							Group 2							
21*!		0.106	0.906	−0.2	1.15	−0.0797			0.448	0.432	−0.157	0.356	0.0823	
22	2.56	0.639	0.205				−0.0583	−11.1	0.102	−2.21	1.31	−0.144	1.19	−0.75
23*!		−0.368	1.59		0.758	−0.696	0.337		0.462	2.28	−1.09			0.486
24	1.3		0.765		1.07			7.72	0.374	2.21	−1.28	0.441	−0.364	0.402

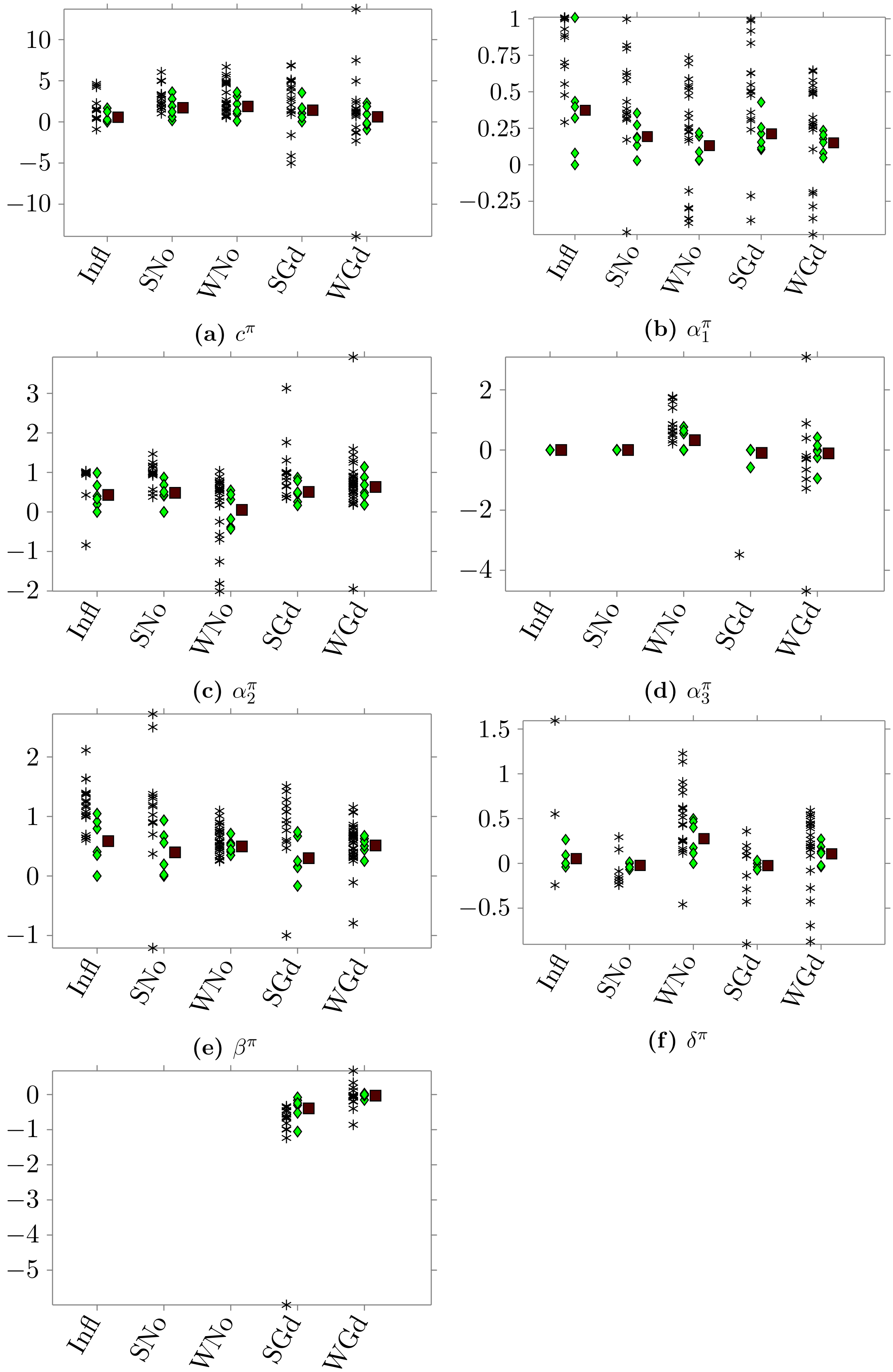
Table 9: Estimated individual rules for Treatment 5 (Unstable price level targeting with guidance).

Subject	c^π	α_1^π	α_2^π	α_3^π	β^π	δ^π	γ^π	c^υ	α_1^υ	α_2^υ	α_3^υ	β^υ	δ^υ	γ^υ
25!	1.65		0.919		0.461		−0.0334		0.183	−0.329	−0.526	−0.0641	1.2	−0.474
26*		0.544	0.876	−1.28	−0.794	0.551	−0.401	2.83	0.373	0.801			−0.403	0.264
Mean	0.917	0.154	0.877	−0.246	0.441	−0.0374	−0.026	−0.089	0.323	0.53	−0.291	0.0982	0.285	−0.0121
(SD)	(0.99)	(0.344)	(0.402)	(0.466)	(0.673)	(0.362)	(0.214)	(5.63)	(0.135)	(1.54)	(0.852)	(0.219)	(0.668)	(0.457)
							Group 3							
31*!			1.45	−0.969	1.08	−0.276	−0.0893				0.67	0.961	−0.193	−0.0591
32		−0.197	0.497		0.644	0.546		−14	−0.179	−2.83	2.3	0.524	0.835	−0.586
33!	7.48	0.484	0.721		0.564	−0.872	0.114		0.09	−0.981	1.05	0.96	−0.474	−0.137
34*!		0.324			0.362	0.447	−0.0799		0.166	0.71	−0.743	0.347	0.66	−0.0511
35	0.863	0.514	0.254		0.398			3.94	0.525	0.499		0.353	−0.435	0.102
36	−13.9	0.29	3.92	−4.69	0.723		−0.862	−1.51	0.491	−1.52	1.56	0.647	−0.595	−0.198
Mean	−0.929	0.236	1.14	−0.944	0.628	−0.0257	−0.153	−1.92	0.182	−0.687	0.805	0.632	−0.0338	−0.155
(SD)	(6.39)	(0.256)	(1.32)	(1.71)	(0.238)	(0.471)	(0.324)	(5.63)	(0.254)	(1.24)	(0.993)	(0.254)	(0.567)	(0.214)
							Group 4							
41	−1.26		0.522		0.299	0.478	−0.0491	−2.24	−0.119	1.32	−1.07	0.217	1.12	−0.0599
42			0.671		0.556	0.223		−0.488		1.15	−0.727	0.37	0.663	
43		0.647	0.192		0.462		−0.0378	−1.4	0.451		0.331	0.411		−0.0669
44	−2.3	0.577			0.659	0.417	−0.0788	−0.286	0.64	−0.3	0.632	0.266	−0.378	−0.0637
45	1.07		0.76		0.412			1.15	−0.184	1.13	−0.346		0.275	0.011
46	0.675		0.784		0.64				−0.301	1.47	−0.819	0.482	0.636	
Mean	−0.303	0.204	0.488	0	0.505	0.186	−0.0276	−0.542	0.0812	0.797	−0.333	0.291	0.386	−0.0299
(SD)	(1.15)	(0.289)	(0.295)	(0)	(0.127)	(0.202)	(0.0302)	(1.07)	(0.344)	(0.685)	(0.62)	(0.157)	(0.487)	(0.0338)
							Group 5							
51	−0.679	0.275		0.391	0.598	0.437		−0.81	0.118	1.22	−0.885	0.3	0.71	
52	−1.35		0.728		0.706	0.222	−0.0283	−1.85	−0.164	1.55	−1.11	0.233	0.91	−0.00805
53			0.589		0.469	0.315	−0.0107	−1.61		0.73	−0.358	0.288	0.651	−0.0293

Table 9: Estimated individual rules for Treatment 5 (Unstable price level targeting with guidance).

Subject	c^{π}	α_1^{π}	α_2^{π}	α_3^{π}	β^{π}	δ^{π}	γ^{π}	c^{υ}	α_1^{υ}	α_2^{υ}	α_3^{υ}	β^{υ}	δ^{υ}	γ^{υ}
54	1.07	0.241	1.25	−0.653	0.69	−0.424		0.956	0.182	−0.796	1.46	0.463	−0.658	−0.0348
55		−0.285	1.01		0.326	0.156				0.651		0.312	0.102	
56		0.263	0.531		0.676	0.0858	−0.0126	−0.51		1.16	−0.732	0.53	0.574	
Mean	−0.16	0.0822	0.684	−0.0437	0.577	0.132	−0.0086	−0.638	0.0227	0.753	−0.27	0.354	0.382	−0.012
(SD)	(0.738)	(0.202)	(0.393)	(0.307)	(0.138)	(0.273)	(0.0102)	(0.951)	(0.109)	(0.756)	(0.853)	(0.105)	(0.525)	(0.0145)
							Group 6							
61	1.55		0.517		0.862	0.151	−0.0771	4.23	−0.0461	1.44	−0.696	1.05	0.173	0.0849
62			0.213		0.804	0.524	−0.0684	5.36		1.61	−0.873	0.742		0.202
63	1.32		0.639		0.651			−6.28	0.0755	−0.745	0.777	0.877	0.563	−0.3
64	2.3	0.287	0.327		0.826		−0.0372	6.91	0.744	0.436	0.181	0.656	−0.895	0.149
65	4.96			0.878	0.552		0.2	7.15	−0.222	2.52	−1.42	0.26	0.132	0.272
66	1.19		0.834		0.351			−3.17	−0.255	0.708	−0.322	0.388	0.85	−0.141
Mean	1.89	0.0478	0.422	0.146	0.674	0.112	0.00291	2.37	0.0494	0.994	−0.392	0.661	0.137	0.0442
(SD)	(1.53)	(0.107)	(0.276)	(0.327)	(0.18)	(0.192)	(0.0931)	(5.18)	(0.332)	(1.03)	(0.717)	(0.27)	(0.544)	(0.201)

Table 9: (Cont.) Estimated individual rules for Treatment 5 (Unstable price level targeting with guidance).



(a) c^{π}

(b) α_1^{π}

(c) α_2^{π}

(d) α_3^{π}

(e) β^{π}

(f) δ^{π}

(g) γ^{π}

Figure C.1: Distribution of estimated individual inflation forecasting rules. Stars denote individual rules (if significant), diamonds indicate group averages and squares denote average in treatment.

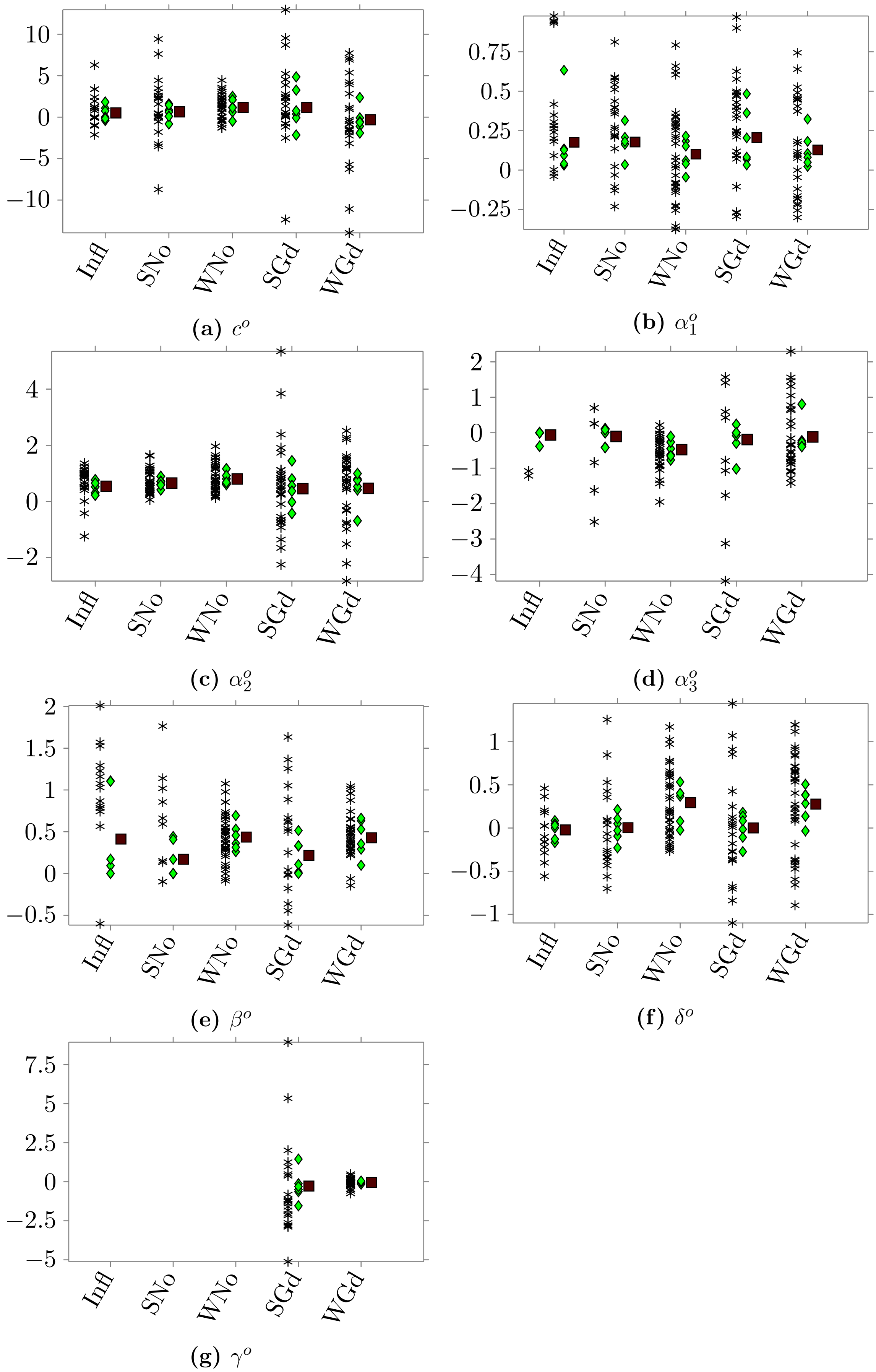


Figure C.2: Distribution of estimated individual output gap forecasting rules. Stars denote individual rules (if significant), diamonds indicate group averages and squares denote average in treatment.

D Stability under naive expectations

With the noise switched off, *ie.*, $\varepsilon_t^c = \varepsilon_t^\pi = 0$, and under naive expectations

$$(10) \qquad \begin{pmatrix} \pi_{t+1}^e \\ c_{t+1}^e \end{pmatrix} = \begin{pmatrix} \pi_{t-1} \\ c_{t-1} \end{pmatrix},$$

the model becomes a deterministic non-linear 2D system under the inflation target rule and a 3D system under the PLT Taylor rule. Since the full employment steady state can only be found numerically, and since we want to avoid log-linearization of the system, we decided to analyze the model with numerical methods. To be specific, one can easily find the analytical expression for the relevant Jacobian matrix, and next use numerical algorithm to find the eigenvalues of the Jacobian at the steady state.[7] Note that, regardless of the monetary policy, the system has an additional ZLB steady state, which is always a saddle.

Inflation targeting rule Consider the DSGE model with the inflation-based Taylor rule (2). The full employment steady state is stable with real eigenvalues given by $\lambda_1^{INF} = 0.28679$ and $\lambda_2^{INF} = 0.88583$.

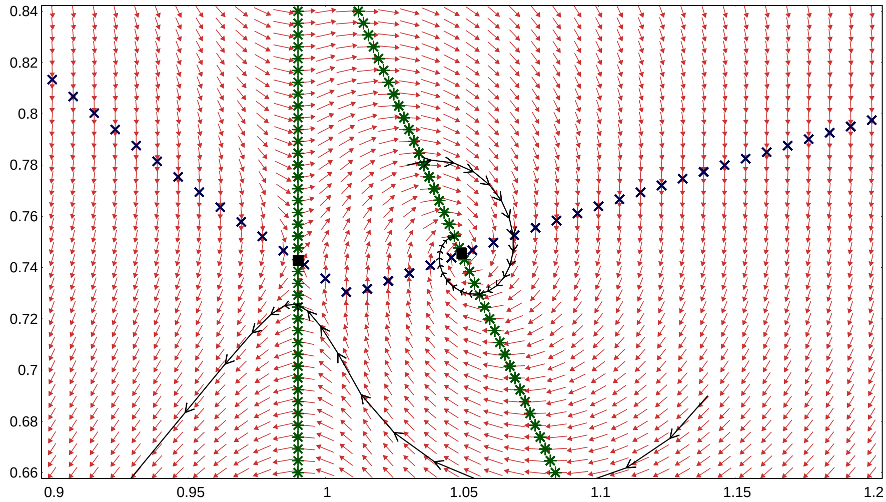
PLT rules Consider our DSGE model with the PLT-based Taylor rule (3). If the PLT Taylor rule is parametrized with $(\psi_P, \psi_y) = (0.25, 1)$ (weak rule), the system in the full employment steady state has one real eigenvalue $\lambda_1^{PLWe} = 0.21162$ and two conjugate complex eigenvalues $\lambda_{23}^{PLWe} = 1.0770 \pm 0.20153i$ with modulus equal to $|\lambda_{23}^{PLWe}| = 1.0957$. Therefore, the full employment steady state is unstable. On the other hand, if the PLT Taylor rule is parametrized with $(\psi_P, \psi_y) = (3, 2)$, the system in the full employment steady state has one real eigenvalue $\lambda_1^{PLSt} = -0.48274$ and two complex conjugate eigenvalues $\lambda_{23}^{PLSt} = 0.85067 \pm 0.52406i$ with modulus equal to $|\lambda_{23}^{PLSt}| = 0.99914$, which means that the full employment steady state is stable, but close to the edge of stability.

These results can be visualized by phase plots (Figure D.1) and sample time paths. A clear differencebetween the three monetary policy treatments can be observed. Under inflation targeting (Figure D.1a), smooth dynamics emerge. If the system is initialized close enough to the full employment steady state (such as in $(\pi_1, c_1)^1 = (1.03, 0.78)$), it gradually converges to this equilibrium. On the other hand, if the system starts too far away (such as in $(\pi_1, c_1)^2 = (1.14, 0.69)$), it bounces of the convergent region and falls into an inflation-output contraction spiral.

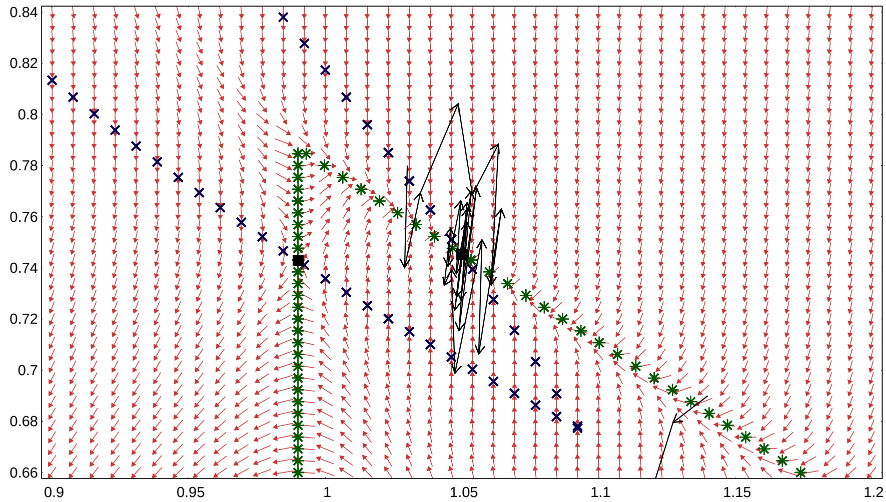
The dynamics, which appear under the two PLT Taylor rules, are only remotely similar to those from the inflation rule treatment. Under the strong PLT Taylor rule (Figure D.1b), the two initial points have the same long-run outcome as under the inflation Taylor rule. The stable initialization $(\pi_1, c_1)^1 = (1.03, 0.78)$ seems to be initially more irregular, but it gradually converges. The unstable initialization $(\pi_1, c_1)^2 = (1.14, 0.69)$ diverges immediately, without

[7] These results were confirmed by a simple finite elements approximation algorithm.

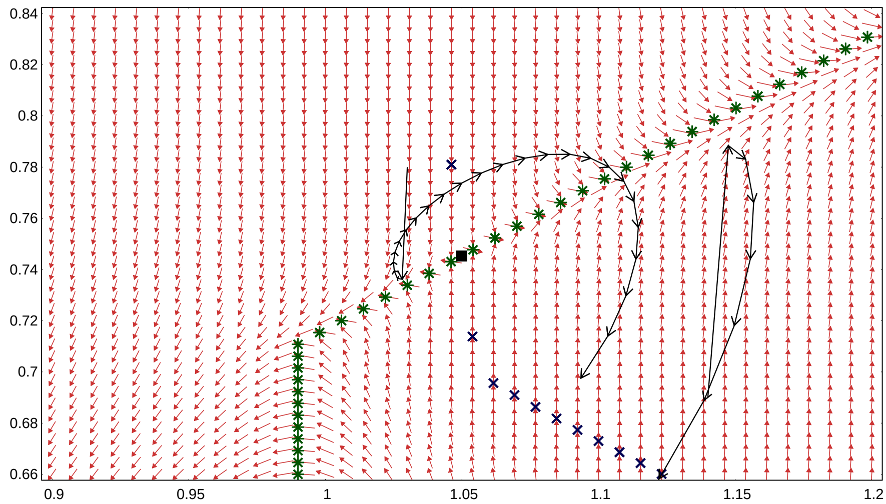
the transitory dynamics as under the inflation rule. Finally, under the weak PLT Taylor rule (Figure D.1c), the dynamics are highly unstable and both initializations eventually diverge from the steady state.



(a) Inflation target Taylor rule – stable dynamics



(b) Strong PLT Taylor rule – stable dynamics



(c) Weak PLT Taylor rule – unstable dynamics

Figure D.1: Phase plots of the experimental economy under three different Taylor rules and naive expectations. The state space is $\pi_t \times c_t$. Notice that under PLT rules the system is actually 3D, so these phase plots are projections with $P_0 = \bar{P}_0$. Red arrows denote the direction of the system at any point. Blue and green points denote manifolds with stable inflation and consumption respectively. The black points denote the steady state. Finally, black arrows denote two sample paths that, for each Taylor rule, start at $(\pi_1, c_1)^1 = (1.03, 0.78)$ and $(\pi_1, c_1)^2 = (1.14, 0.69)$.