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Expectations and perceived causality in fiscal policy: an experimental analysis using real world data

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Abstract

We generate observable expectations about fiscal variables through laboratory experiments using real world data from several European countries as stimuli. We estimate an econometric model of individual expectations for fiscal policy, which nests various theories of expectations–forming and encompasses both micro- and macro- economic lines of research on fiscal policy. Agents' expectations are found neither to be consistent with rational nor with purely adaptive expectations. Expectations follow an augmented-adaptive scheme, which embodies the 'spend and tax hypothesis' on the relationship between taxes and expenditure to a greater extent than in real world data. We relate this findings to current research on the effects of fiscal policy. Methodological implications of the present approach for experiments in macroeconomics are also discussed.

Keywords: Experiments, fiscal policy, expectations, causality, cointegration, panel data.

JEL classification: C91, D89, E62, H31.

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1 Introduction

Expectations on fiscal variables are crucial to understand the effect of fiscal policy on the private sector. Little is however known on the actual way people form expectations on fiscal variables. While many theoretic models are based on the hypothesis of rational expectations, empirical evidence is limited and indirect; this is partly due to the unobservability of expectations.

The standard approach is to empirically investigate predicted relations between observable variables, like relationships between fiscal variables and components of output, and from there to infer the effect which unobservables might have played. Examples of this approach range from classical tests of the Ricardian equivalence (see Seater, 1993, for a review), to more recent analyses of the so called 'anti-Keynesian' (i.e. expansionary) effects of fiscal adjustments (Giavazzi, Jappelli, and Pagano, 2000).

A problem in this approach, however, is that the identification of the effects of expectations is model-dependent, and model comparison is very hard. Moreover many unobserved correlated factors are typically at play in data collected from real economies. This makes identification of the effects of expectations quite difficult, because "economists cannot observe all the data that economic agents do" (Seater, 1993, p. 164).

The latter limitation is also relevant for expectation measures derived from opinion surveys[1]. Moreover surveys suffer from lack of economic incentives to reveal true opinions, so that for various reasons respondents "may express judgements that are different from the ones they choose to act upon" (Pesaran, 1987, p. 209).

A third approach is to measure expectations in a controlled experiment, as in some recent literature in monetary economics (Duffy, 1998, gives a survey). While this approach allows to implement the *ceteris paribus* condition as none of the other two (and correct for the lack of incentives of the survey approach), it suffers from the critique that the stimuli are given in situations that are far from the real economic world, thus questioning the validity of the connection between the lab and the real economy. This is the well-known problem of "parallelism" in experimental methodology (Smith, 1982; Plott, 1987).

In this paper, we study the process of forming expectations on fiscal policy, combining field and lab data to address the problem of parallelism. The approach innovates on existing literature in various respects. We list here few areas in which the paper gives original contributions.

First of all, unlike in most experiments, the stimuli are given sequentially, using realized annual time series of fiscal variables from 15 OECD countries. This experimental conditions are meant to make the experiment as close to reality as possible. Many time series of realized expectations are thus recorded.

A preliminary look at the data shows that agents' expectations deviate not only from perfect foresights, but are also outperformed by a model of purely adaptive expectations. Understanding the reasons and mechanics of this observation is one of the purposes of the paper.

Given the type of stimuli-response data of this experiment, there is in particular a need for new techniques to model both parts of the data. We develop a modeling strategy which

[1]For example, surveys conducted by Grun (1991) and Allers, de Haan, and de Kam (1998) found widespread evidence of misinformation on the conduct of government fiscal policy.

is consistent both with current practice in macro-econometrics and micro-econometrics. We assume that the joint Data Generating process (DGP) of stimuli and expectations data is a VAR; we next show how natural assumptions arising from the experimental design imply specific restrictions. Two subsystems are derived, one for the field data and one for the agents' expectations; we then discuss various possible econometric relationships between the subsystems. Various econometric results in the area are collected and we show how to analyse the field data first and subsequently the expectation data. The analysis allows for non-stationary behaviour both of field and expectation variables.

Many macroeconomic investigations use cointegration techniques and Granger causality tests to investigate the sustainability of fiscal policy and the type of causality between taxes and public expenditure[2]; the present two stage analysis contains this analysis as the first step.

The present approach encompasses many micro-models for the formation of expectations in the second step. We find that a major component of the process depends on past forecast errors. But as a major deviation from a purely adaptive model, we also observe a tendency of subjects to give greater weight to a degree of short-run causality running from public expenditure to taxes than what there is in the real world stimulus data.

Agents appear to have a presumption for a model of fiscal policy consistent with the so called 'spend and tax hypothesis', as advocated since the nineteenth century by the 'Italian School of Public Finance' (see Buchanan, 1960, and, more recently, by Barro, 1974, 1979, and Peacock and Wiseman, 1979).

A different perspective in which the lab subsystem can be analysed is in terms of general models of expectation forming. The evidence neither supports the 'rational expectation hypothesis', nor a purely adaptive scheme; rather, expectations fall within a class of so called 'augmented-adaptive models', introduced in the early eighties by various authors, see Pesaran (1987). These models then become the starting point for a growing literature of 'bounded rationality' (Sargent, 1993) and 'adaptive learning' in macroeconomics (see Evans and Honkapohja, 2001, for a comprehensive survey).

The VAR approach we take to analyse the data excludes non-linear behaviour in the DGP. This may be disputable, since discretionary interventions and exogenous shifts may introduce non linearities in fiscal policy (as for example documented for the US by Bohn, 1998, and Sarno, 2001). The latter case is of interest since it may also generate specific anti-Keynesian effects of fiscal policy (see e.g. the models surveyed in Giavazzi, Jappelli, and Pagano, 2000, and the empirical investigation conducted therein).

We test for nonlinearity and find that the VAR specification is robust against it. Conversely, we argue that evidence of agents inclination for a model where government expenditure Granger-causes taxes, may indirectly support an interpretation of anti-Keynesian effects based on the so called 'composition view' of fiscal adjustments (see, e.g., Alesina and Perotti, 1997, and Alesina, Ardagna, Perotti, and Schiantarelli, 2002).

The paper is organised as follows. Section 2 presents the setup of the experiment. Section 3 shows some preliminary evidence from the experiment. Section 4 develops the econometric approach to analyse both the stimulus and the expectations data. Section 5 discusses the empirical specification of the field and lab models. Inference results are pre-

[2]See, e.g., Trehan and Walsh (1991), Hakio and Rush (1991), Ahmed and Rogers (1995), as classical references; Payne (1998), Garcia and Henin (1999), as more recent examples.

sented in Section 6. Section 7 relates the results to current research on the anti-Keynesian effects of fiscal policy. The last section summarises and discusses the implications of the present approach for experiments in macroeconomics.

2 Experimental setup

The experiment has a time-structure, $t = 1, ..., n$; the setup nests a simple (two-periods) representative agent small economy. Participants are exposed to graphical representations of time series of fiscal variables, taken from various European countries data. The stimuli refer to taxes T_t, public expenditure G_t, public debt B_t, and change in the debt level $\Delta B_t = B_t - B_{t-1}$ at time t, all expressed as yearly percentage of GDP. Here and in the following Δ is the time difference. In this paper we focus on the relationship and the direction of perceived causality between taxes and expenditure, namely vector $x_t := (T_t, G_t)$.

Agents do not know which country and which period the series refer to. Utility in the experiment is derived from consumption over two subsequent periods:

$$u_t = \prod_{i=t}^{t+1} \gamma C_i + (1-\gamma) G_i \qquad \text{with } \gamma = 0.75 \tag{1}$$

subject to the budget constraint

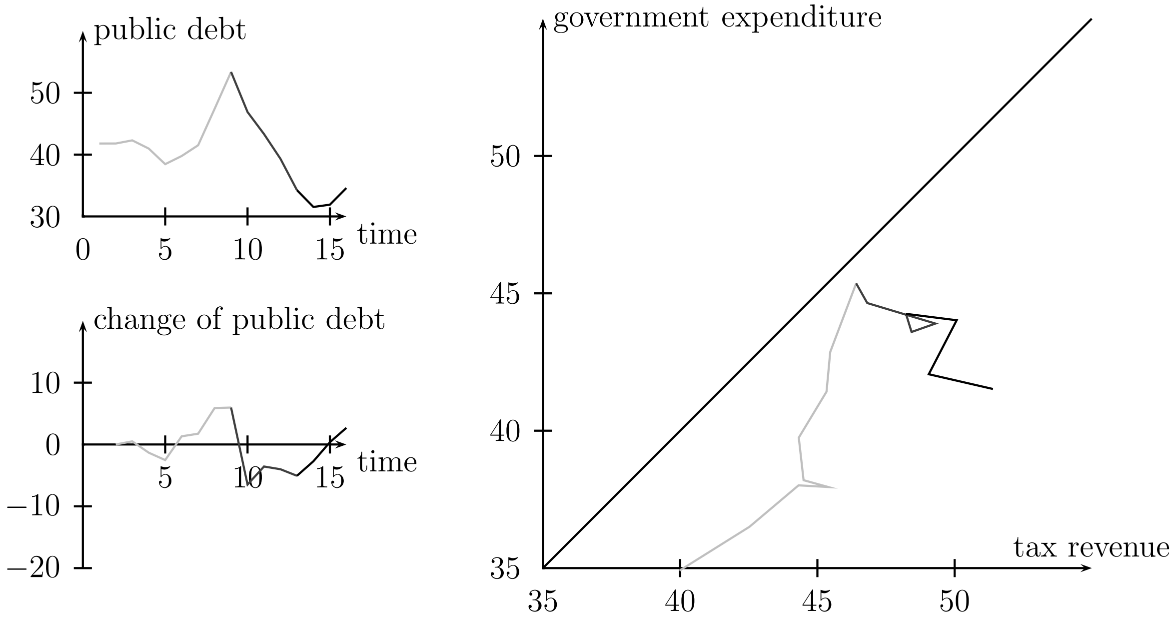
$$\sum_{i=t}^{t+1} \underbrace{(1 - C_i - T_i)}_{\text{savings}} \cdot (1+r)^{i-t} = 0 \qquad \text{with } r = 0.1\,. \tag{2}$$

Agents receive initial information on the first seven values of stimuli; for most countries the first available year was 1970. Let $t-1$ be the last available year and $X_{t-1} := (x_1, ..., x_{t-1})'$ the available information; for each subsequent year t agents forecast taxes and/or public expenditure. Two experimental treatments were performed: in one of the treatments participants forecast both T_t and G_t; in a second treatment participants forecast T_t only. Forecasts are indicated as $T_t^{E_i}$ and $G_t^{E_i}$, where i indicates agent i and E stands for expectation. Let $y_{i,t}$ indicate all the forecast of agent i that refer to time t; in the T_t and G_t treatment $y_{i,t} := (T_t^{E_i}, G_t^{E_i})'$ while $y_{i,t} := T_t^{E_i}$ in the T_t only treatment.

The interfaces used in the lab for the two treatments are shown in Fig. 1 and 2. With both interfaces, agents express forecasts clicking with the mouse directly into the diagrams.

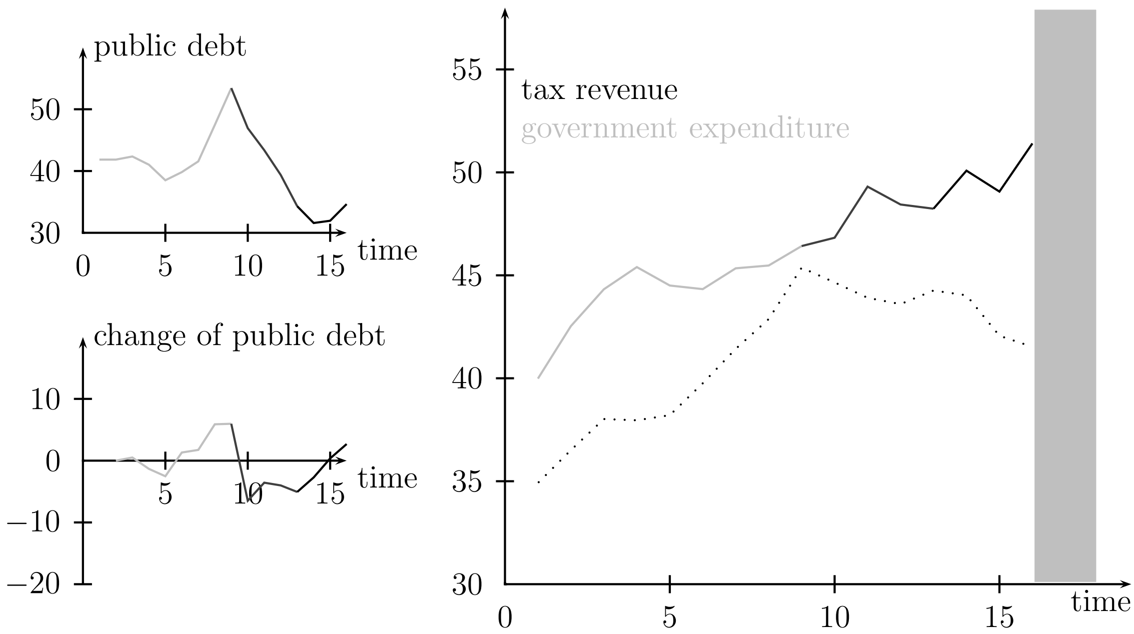
The time series of the stimuli are updated recursively each year after forecasts are made, so that subjects learn about realization of the stimuli as the economy moves on. More specifically, given subjects' forecasts $y_{i,t}$ for year t, the computer determines an optimal consumption level C_{t-1} for the current period given eq. (1) and (2). In period t, $x_t := (T_t, G_t)'$ become available and are communicated to the participant. The computer uses equation (2) to determine C_t and then uses equation (1) to calculate the participant's utility for period $t-1$. The participant's per minute wage is

$$w = 0.66 \cdot (u_t/u_t^*)^\eta \text{ where } \eta = \begin{cases} 12000 & T_t \text{ and } G_t \text{ treatment} \\ 15000 & T_t \text{ only treatment} \end{cases} \tag{3}$$



Values are given as percentage of GDP. Gray lines indicate past, black lines indicate recent years.

FIGURE 1: T_t and G_t treatment



Values are given as percentage of GDP. Gray lines indicate past, black lines indicate recent years.

FIGURE 2: T_t only treatment

Table 1: Summary of the experimental treatments

Country	Sample period	Participants T_t and G_t treatment	Participants T_t only treatment
Austria	1970-98	16	19
Belgium	1970-98	20	22
Denmark	1971-95	15	17
Finland	1970-98	12	15
France	1977-98	12	10
Germany	1970-98	11	14
Greece	1975-98	8	15
Ireland	1970-95	17	22
Italy	1970-98	14	17
Netherlands	1970-98	13	11
Norway	1970-98	15	16
Portugal	1970-98	10	13
Spain	1970-98	14	13
Sweden	1970-98	17	14
UK	1970-95	15	16

where u_t^* is the utility the participant would obtain with forecasting the true values. This transformation from utilities into wages is monotonic and, hence, does not affect the maximisation problem of the individual. The transformation, however, creates steeper incentives to make good forecasts.

Participants are payed this wage up to two minutes for each forecast. If a participant needs more time to complete a forecast only the first two minutes are paid[3].

Different agents participated in the two treatments. 27 took part in the T_t and G_t treatment and 28 in the T_t only treatment. Each agent made predictions for more than one country within each treatment. Table 1 summarises the parameters of the treatments, with the number of participants in the various conditions. Stimulus data were from 15 European countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden and UK[4].

For the majority of countries the sample period of stimulus data was 1970-98; few exceptions (Denmark, France, Greece, Ireland and UK) are due to limits in the availability of the fiscal time series. For all countries, expectations recording started from the seventh year of the stimulus (which was then 1977 for most countries). A representation of the stimulus data for the different countries is shown in Fig. 3 and Fig. 4.

The experiment was run in the experimental laboratory of the SFB 504 in Mannheim in December 2000. Experimental sessions were conducted individually. All 55 participants spent about 2 hours in the laboratory. They made, on average, 157 forecasts, and completed on average one forecast every 44 seconds. Instructions given to participants

[3] We have introduced this payment scheme to simultaneously encourage participants to think about their forecasts, but also to remain active.

[4] All stimulus data used in the experiment were taken from the OECD (2000) database “Fiscal Positions and Business Cycle”.

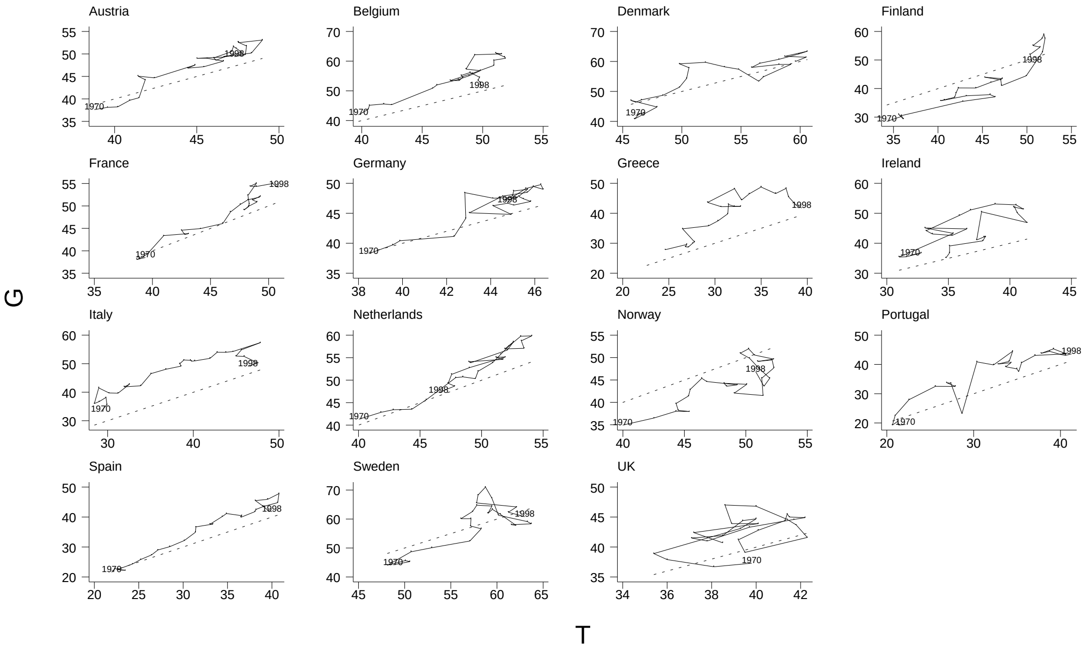


FIGURE 3: Stimulus data (as G over T)

are reported in Appendix B.

3 A preliminary look at the data

In this section we give a preliminary analysis of participants' expectations in the two treatments. Fig. 5-7 graph the expected changes for public expenditure and for taxes versus the actual changes of the two fiscal variables: namely, $\Delta G_t^{Ei} = G_t^{E_i} - G_{t-1}^{E_i}$ versus $\Delta G_t = G_t - G_{t-1}$ in the T_t and G_t treatment (Fig. 5); and $\Delta T_t^{Ei} = T_t^{E_i} - T_{t-1}^{E_i}$ versus $\Delta T_t = T_t - T_{t-1}$ in the T_t and G_t treatment and the T_t only treatment (Fig. 6 and 7, respectively). The diagrams show that, in both treatments and in regard to both fiscal variables, subjects' expectations depend on the past values of the variables to be forecasted: in particular, subjects seem to attach the largest weight to the last realized value.

As a first step to assess the extent to which subjects follow a 'pure' adaptive scheme, consider an hypothetical participant A who predicts the fiscal variables on the basis of the simplest first-order adaptive rule $T_t^{E_A} = T_{t-1}$ and $G_t^{E_A} = G_{t-1}$, for taxes and expenditure respectively.

For each country j, the adaptive scheme generates a mean square forecast error (MSFE) $m_{a,j} := \text{MSFE}(T_t^{E_A,j} - T_t^j) = \text{MSFE}(\Delta T_t^j)$ and similarly for G, where a stands for adaptive, j indicates the country, and $\text{MSFE}(x_t) := ((n-6)^{-1} \sum_{t=7}^{n} x_t^2)^{1/2}$.

Similar calculation are performed on the actual predictions of agent i; this de-

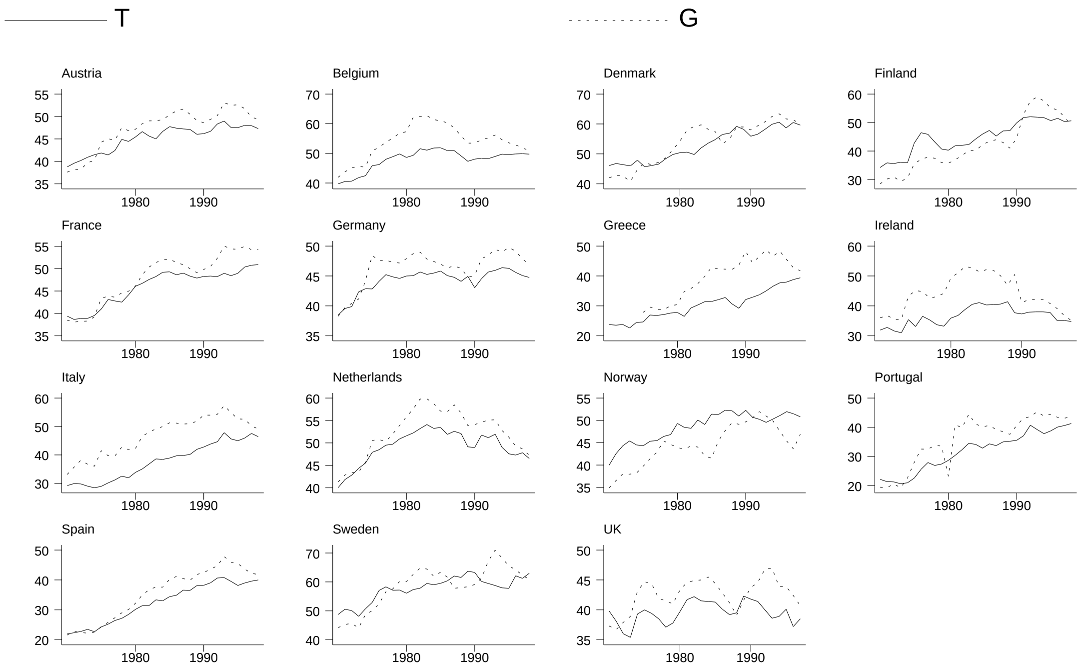
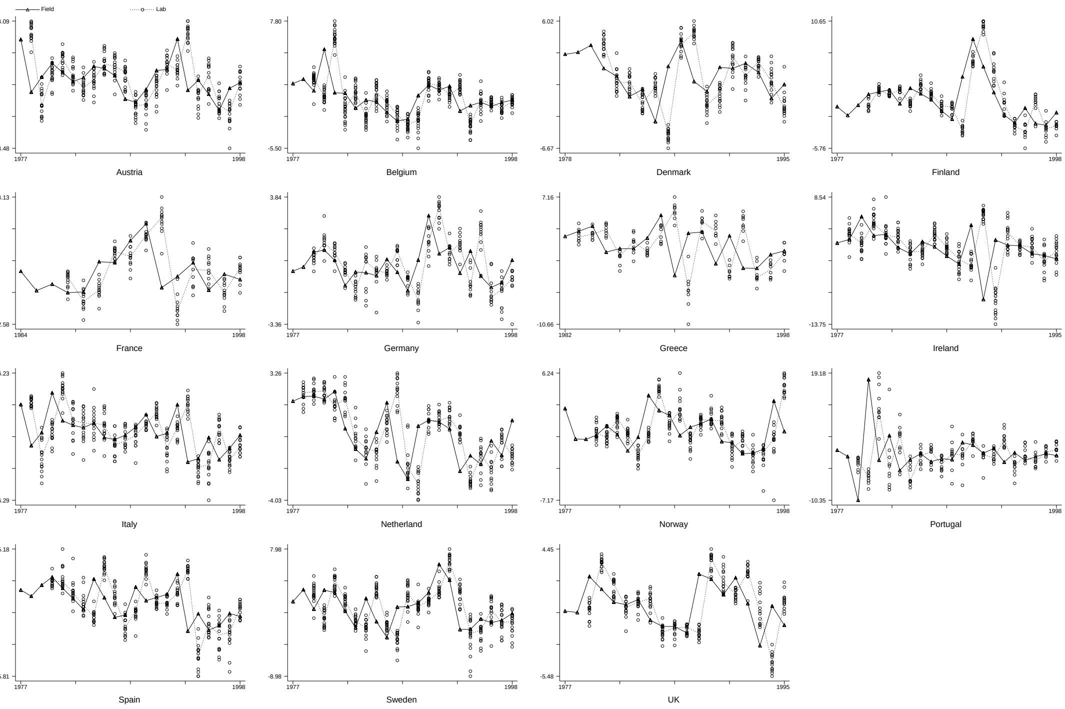
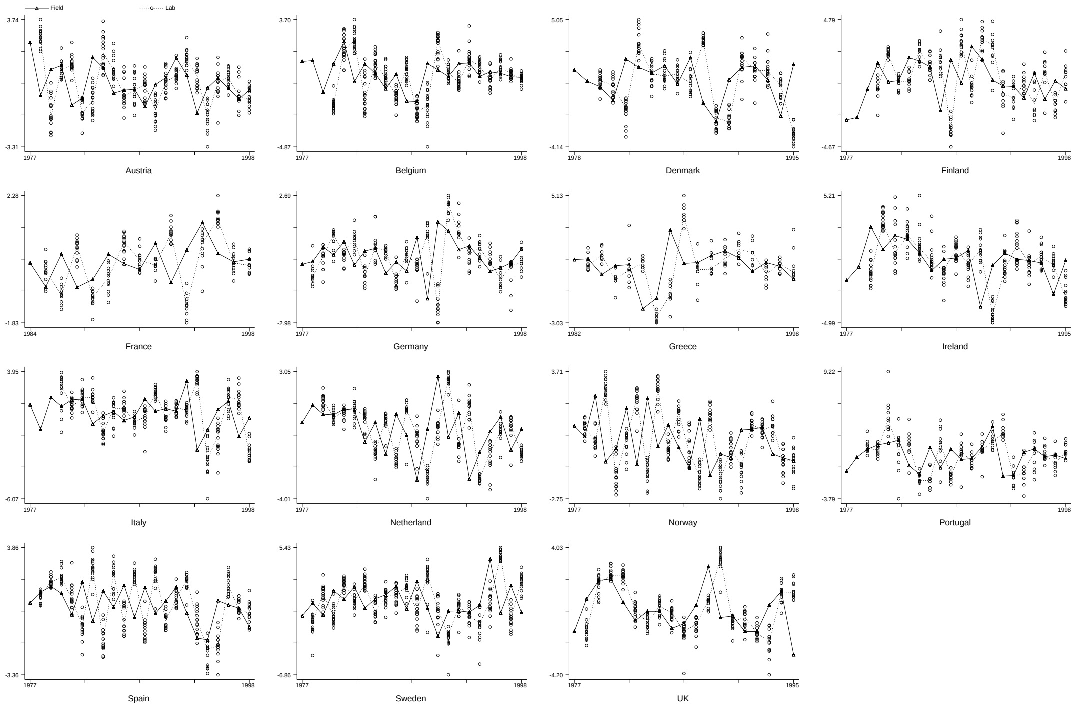


FIGURE 4: Stimulus data (as G and T over t)



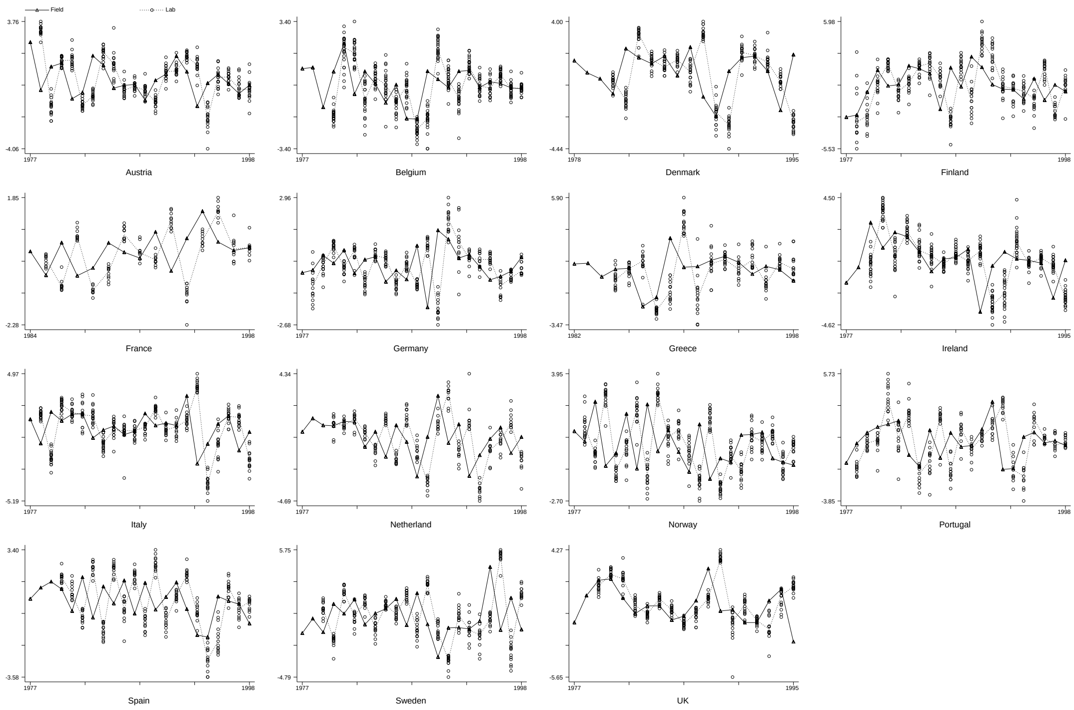
$\Delta G_t^{Ei} = G_t^{E_i} - G_{t-1}^{E_i}$ versus $\Delta G_t = G_t - G_{t-1}$ in the T_t and G_t treatment

FIGURE 5: Expected changes for public expenditure versus actual changes



$$\Delta T_t^{Ei} = T_t^{E_i} - T_{t-1}^{E_i} \text{ versus } \Delta T_t = T_t - T_{t-1} \text{ in the } T_t \text{ and } G_t \text{ treatment}$$

FIGURE 6: Expected changes for taxes versus actual changes in the T_t and G_t treatment



$$\Delta T_t^{Ei} = T_t^{E_i} - T_{t-1}^{E_i} \text{ versus } \Delta T_t = T_t - T_{t-1} \text{ in the } T_t \text{ only treatment}$$

FIGURE 7: Expected changes for taxes versus actual changes in the T_t only treatment

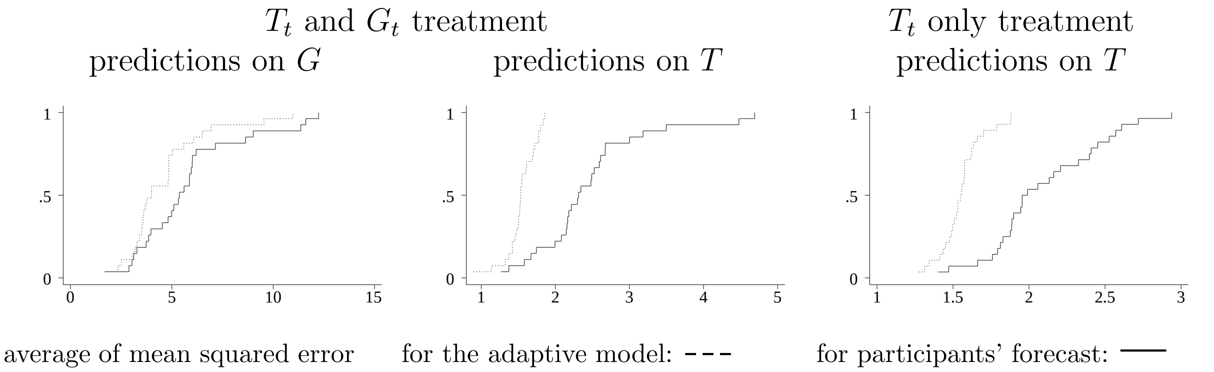


FIGURE 8: Cumulative distributions of the average mean squared errors of the adaptive model and of actual forecasts

fines $m_{i,j} := \text{MSFE}(T_t^{E_i,j} - T_t^j)$. Let $\{j_1, ..., j_{p_i}\}$ be the set indices of the countries predicted by agent i, where p_i is the number of these countries. We next calculate $\text{MSFE}_i = p_i^{-1} \sum_{c=1}^{p_i} \text{MSFE}_{i,j_c}$ and $\text{MSFE}_{a,i} = p_i^{-1} \sum_{c=1}^{p_i} \text{MSFE}_{a,j_c}$. This generates a set of values $\{\text{MSFE}_i\}_{i=1}^m$ for the actual average MSFE and a set $\{\text{MSFE}_{a,i}\}_{i=1}^m$ for the adaptive average MSFE. Fig. 8 shows the cumulative distributions of the mean squared errors of the adaptive model (dotted line) and of actual forecasts (solid line)[5].

We find a somehow puzzling result: in both treatments the MSFE of the actual forecasts are significantly larger than the MSFE of the adaptive model. The evidence is particularly strong in regard to the predictions for taxes[6].

While the evidence may witness the complexity of the task involved in the experiment, it shouldn't be dismissed lightly. It may be taken as a *prima facie* evidence that subjects may in fact have a model of the real world in mind, though not necessarily the right model.

Indeed there is a rapidly growing literature on "bounded rationality" in macroeconomics (Sargent, 1993), dedicated to the search and understanding of the behavioural foundation of the process of expectations formation. This literature started from the dissatisfaction with the standard definition of rational expectations (Pesaran, 1987), while focusing on so called schemes of augmented-adaptive behaviour as learning models. Starting from the 1980s, these schemes have spawned a very large literature analysing the conditions for, and the forms of, convergence to rational expectations equilibria in the context of self-referential general equilibrium economies (see Evans and Honkapohja, 2001, for a comprehensive account of this literature). There are also various experiments[7] conducted

[5]Note that, although the first order adaptive model is the same for each participants, participants play different sets of countries. Therefore also the mean squared error of the adaptive model differs among participants.

[6]A paired t-test conducted on the average differences between mean squared errors finds: $t = 3.3979$ with a p–value of 0.0022, in the case of expectations for expenditure; $t = 6.7094$ with a p–value less than 0.0001 in the case of expectations for taxes in the T_t and G_t treatment; and $t = 8.5284$ with a p–value less than 0.0001, in the case of expectations for taxes in the T_t only treatment.

[7]See, e.g., Marimon and Sunder (1993), for a classical references, and Bernasconi and Kirchkamp (2000) for a more recent study.

in standard artificial setups corroborating and providing insights for the theoretical literature.

In the partial equilibrium context of the present experiment, the question of convergence is clearly of a lesser interest. Conversely, there may be other behavioural aspects in the process of expectations forming which cannot be fully investigated within a *theoretical* general equilibrium economy; but which may be relevant in *real* economies depending of the context and of the objects of expectation.

The experiment described above allows to take a more general behavioural approach, since (unlike in standard setups) in the present experiment the DGP underlying the stimuli data is real, though not known. The latter characteristic, while providing experimental conditions similar to the ones in the real world, requires the econometric analysis of the responses as well as of the treatment data. In the remaining body of the paper, we develop a joint model of stimuli and of expectation data, through which we discuss the meaning and implications of different expectations schemes (rational, adaptive, augmented-adaptive), consider and estimate properties of field data, check how these features are perceived by subjects in the experiment, and possibly provide some interpretations of agents' poorer performance relatively to the first-order adaptive scheme.

4 Modelling the experiment

This section discusses the joint modelling of the stimuli and of expectation data. In order to simplify the analysis we specify a model on each single country separately. This choice corresponds to a limited information context in simultaneous systems of equations. In a complete system, i.e. one containing all country-specific subsystems, one could envisage several effects (variance components) associated with each individual, which are now discarded in the analysis.

While the limited information context leaves room for improvement in efficiency for estimation and testing, it delivers more robust inference, i.e. consistent estimates even under misspecification of some other country specific subsystem. This appears highly desirable.

Each individual i provides forecasts $y_{i,t}$ on the basis of the knowledge of the history of stimuli $X_{t-1} := (x_1, \, ..., \, x_{t-1})'$, where $x_t = (T_t, G_t)'$. Let m indicate the number of individuals, $i = 1, ..., m$. Recall that $y_{i,t} = (T_t^{E_i}, G_t^{E_i})'$ in the T_t and G_t treatment and $y_{i,t} = T_t^{E_i}$ in the T_t only treatment. Let $z_{i,t} := (y'_{i,t}, x'_t)'$ be the data vector involved in the prediction for agent i at time t. Let $Z_{i,t-1}$ indicate the history of $z^j_{i,s}$ up to time $t-1$, $Z_{i,t-1} := (z_{i,1}, ..., z_{i,t-1})'$, which represents the relevant information set available to individual i in the expectation formation for the next period.

Consider also the vector $w_t := (y'_t, x'_t)' := (y'_{1,t}, y'_{2,t} \cdots, y'_{m,t}, \, x'_t)'$ containing all predictions performed by all agents at time $t-1$ along with the variables to be predicted. The prediction variables are grouped in the vector $y_t := (y'_{1,t}, y'_{2,t} \cdots, y'_{m,t})'$. Let also $W_{t-1} := (w'_1, ..., w'_{t-1})'$ indicate the complete history of stimuli and predictions of all agents. We next state restrictions on the DGP of the joint process $\{w_t\}_{t=1}^{\infty}$ that are consistent with the experimental setup.

4.1 Assumptions

Given the sequential structure of the experiment, we decompose the probability measure of the stochastic process $\{w_t\}_{t=1}^{\infty}$ sequentially, as in Engle, Hendry, and Richard (1983), into the product of $\mathcal{L}(w_t|W_{t-1})$. Here and in the following $\mathcal{L}(\cdot|W_{t-1})$ indicates conditional probability given W_{t-1}. This allows to define the DGP of the process by its transition probabilities.

We assume that the DGP for w_t can be taken to be a Vector Autoregressive process (VAR), $A(L)w_t = \mu + \epsilon_t$ where ϵ_t are i.i.d. $N(0, \Omega)$ across t and $A(L) = \sum_{\ell=0}^{k} A_\ell L^\ell$ is the autoregressive polynomial in the lag operator L, $A_0 := I$, the identity matrix. This assumption is summarised as follows.

Assumption 1 *The law of w_t conditional on W_{t-1}, $\mathcal{L}(w_t|W_{t-1})$ is Gaussian with moments*

$$E(\Delta w_t|W_{t-1}) = \mu + \Pi w_{t-1} + \sum_{\ell=0}^{k-1} \Gamma_\ell \Delta w_{t-\ell} \qquad V(w_t|W_{t-1}) = \Omega.$$

where $\Pi := -A(1)$, $\Gamma_\ell := -\sum_{i=\ell+1}^{k} A_i$, and μ is a vector of constants.

Several remarks are in order here. First of all, assumption 1 states that the DGP of the variables observed in the field x_t is nested within a VAR assumption for w_t. It should be noted that this excludes non-linear behaviour in x_t, which (as anticipated in the introduction) is viewed as disputable by some (see e.g., Bohn, 1998, Giavazzi, Jappelli, and Pagano, 2000, and references therein). We consider the issue of nonlinearity in some details in Section 7.

The assumption of normality may appear also restrictive. It is adopted here for convenience and can be dropped when one resorts to time-asymptotics. We note, however, that for moderate temporal sample size this assumption is hard to test and reject.

Mostly important, we emphasise that most panel data models do not start with a VAR as a reference model, but rather directly from a collection of single equations, one of each individual. This is not advisable in the present context, for various reasons. Firstly, w_t contains the stimuli, which are likely to have obvious interactions. As suggested above, the econometric analysis of the stimuli is just as important as the one of the responses, and hence a multivariate approach for the modelling of x_t is mandatory. Moreover, the present VAR approach allows to view the links between the information set $Z_{i,t-1}$ and the prediction $y_{i,t}$ directly as parameters of the joint model and it includes the univariate standard regression model as a special case.

Obviously, starting with a VAR as reference model, while very general, leaves room for too many parameters; in the present case, it also permits variables in the field to be influenced by data in the experiment, an issue which we address in the next assumption.

Assumption 2 *The DGP of the stimuli x_t conditional on W_{t-1} does not depend on past prediction variables y_s for any $s = 1, ...t-1$, i.e. $\mathcal{L}(\Delta x_t|W_{t-1}) = \mathcal{L}(\Delta x_t|X_{t-1})$.*

Under assumption 2, y_t does not Granger-cause x_t (see e.g. Engle, Hendry, and Richard, 1983). This assumption makes sense in this experimental setting, where the stimuli were generated by natural experiments well before the lab experiment was performed. The assumption makes also transparent that the VAR model we are considering here is cast in a partial equilibrium context, in which, in particular, the perceived laws of motion for taxes and public expenditure have no feedback on the respective actual laws of motion.

In the following, blocks of the Π, Γ_ℓ and Ω matrices corresponding to the various components of w_t are indicated with the subscripts 1, ..., m, x conformably with $w_t := (y'_{1,t}, y'_{2,t}, ..., y'_{m,t}, x'_t)'$. The subscript y is used to group the first m blocks of prediction variables together: $\Gamma_{\ell,1x}$ is e.g. the block of coefficients of $x_{t-\ell}$ in the expression for $E(\Delta y_{1,t}|W_{t-1})$, while Π_{xy} is the block of coefficients of $(\Delta y'_{1,t-1}, ...\Delta y'_{m,t-1})'$ in the expression for $E(\Delta x_t|W_{t-1})$[8].

Under Assumption 1, it is well known that Assumption 2 holds if and only if $\Pi_{xy} = 0$ and $\Gamma_{\ell,xy} = 0$ for all $\ell = 1, .., k-1$. This translates Assumption 2 into a parametric restriction, which is later exploited in model specification.

We next wish to incorporate information on the relation among the prediction variables $y_{i,t}$ across agents. Given the experimental setup, it is natural to assume that forecasts are independent across agents, given the public information available.

Assumption 3 *Let j be different from i;*

a) the DGP of the forecast $\mathcal{L}(\Delta y_{i,t}|W_{t-1})$ does not depend on the forecast made by other agents, i.e. on $y_{j,s}$ for any time in the past $s = 1, ...t-1$.

b) Moreover $\Delta y_{i,t}$ and $\Delta y_{j,t}$ are independent conditionally on W_{t-1}.

This assumption formalises the experimental setup where individual forecasts are performed independently of each other. Under Assumption 1, observe that Assumption 3 *a*) holds if and only if $\Pi_{yy} = \text{diag}(\Pi_{11}, ..., \Pi_{mm})$, $\Gamma_{\ell,yy} = \text{diag}(\Gamma_{\ell,11}, ..., \Gamma_{\ell,mm})$ for all $\ell = 1, .., k-1$; while Assumption 3 *b*) holds if and only if $\Omega_{yy} = \text{diag}(\Omega_{11}, ..., \Omega_{mm})$. Again this translates Assumption 3 into parametric restrictions, which are later exploited in model specification.

The structure implied by the three Assumptions above can be used to derive two sub-systems, a field system for the stimuli x_t, and a lab system for the prediction variables y_t. This is done in the following Proposition.

Proposition 4 *Let Assumption 1 and 2 hold; then*

- *the field sub-system DGP for x_t, $\mathcal{L}(\Delta x_t|W_{t-1}) = \mathcal{L}(\Delta x_t|X_{t-1})$, is Gaussian with variance matrix Ω_{xx} and mean*

$$E(\Delta x_t|X_{t-1}) = \mu_x + \Pi_{xx} x_{t-1} + \sum_{\ell=1}^{k-1} \Gamma_{\ell,xx} \Delta x_{t-\ell}. \tag{4}$$

- *If moreover Assumption 3 holds, the lab sub-system DGP for y_t given the past, $\mathcal{L}(\Delta y_t|W_{t-1})$, is Gaussian with independent components, i.e. $\mathcal{L}(\Delta y_t|W_{t-1})$ can be*

[8]Note that the conditional expectation operator $E(\cdot|W_{t-1})$ and the prediction performed by the agents do not necessarily coincide.

decomposed in the product of $\mathcal{L}(\Delta y_{i,t}|W_{t-1})$ *for* $i = 1, ..., m$*, where* $\mathcal{L}(\Delta y_{i,t}|W_{t-1}) = \mathcal{L}(\Delta y_{i,t}|Z_{i,t-1})$ *is Gaussian with variance* Ω_{ii} *and conditional mean*

$$\begin{aligned} E(\Delta y_{i,t}|W_{t-1}) &= E(\Delta y_{i,t}|Z_{i,t-1}) = \\ &= \mu_i + (\Pi_{ii} : \Pi_{ix})z_{i,t-1} + \sum_{\ell=1}^{k-1}(\Gamma_{\ell,ii} : \Gamma_{\ell,ix})\Delta z_{i,t-\ell}. \end{aligned} \tag{5}$$

and $\Omega_{yy} = \mathrm{diag}(\Omega_{11}, ..., \Omega_{mm})$*. Recall that* $z_{i,t} := (y'_{i,t}, x'_t)'$*.*

Proof. The results hold by standard properties of the Gaussian distribution. ■

The Proposition clarifies that the model nests a marginal VAR for x_t, which will be the basis for the analysis of stimuli data. Moreover, y_t is a VARX where the stimuli x_t act as exogenous variables.

Two issues of the greatest interest here concern the process of expectations forming and the issue of cointegration and direction of causality between fiscal variables as occurring in the field and as perceived in the lab. These are analysed in the following subsections.

4.2 Expectation schemes

The restricted VAR discussed in the previous section has implications regarding the formation of expectations. In this section we illustrate rational, adaptive and augmented-adaptive expectations within the present context.

We start from rational expectations. The optimisation problem given trough equations (1) and (2) implies a quadratic loss function. For a quadratic loss function and a given information set the optimal predictor is given by conditional expectations (Muth, 1960). Expectations are called rational if they coincide with the ones formed under the DGP (see e.g. Pesaran, 1987). One can then calculate rational expectations by computing the conditional expectations of x_t given the relevant information set.

The implied specific form of rational expectations is repeated in the following proposition.

Proposition 5 (Rational expectations) *Let Assumptions 1 and 2 hold; the rational expectation on* Δx_t *given any of the information sets* X_{t-1}*,* W_{t-1}*,* Z^i_{t-1} *is given by*

$$\begin{aligned} g(X_{t-1}) &:= E(\Delta x_t|W_{t-1}) = E(\Delta x_t|X_{t-1}) = E(\Delta x_{t+1}|Z_{i,t-1}) = \\ &\quad \mu_x + \Pi_{xx}x_{t-1} + \sum_{\ell=1}^{k-1}\Gamma_{\ell,xx}\Delta x_{t-\ell}. \end{aligned}$$

Proof. Under Assumption 2, the information contained in W_{t-1} or $Z_{i,t-1}$ in excess of the past history of x (X_{t-1}) is irrelevant, so that the various conditional expectations coincide. The marginal DGP for x_t is Gaussian with the above conditional expectations (see eq. (4) in Proposition 4). ■

Let a superscript 1 indicate the first component of a vector; $y^1_{i,t}$, the first component in $y_{i,t}$, is a representative expectation variable, and assume that $y^1_{i,t}$ represents a forecast of x^1_t, the first component in x_t. The form of the rational expectations on proposition 5 provides the yardstick to measure the degree of rationality present in actual forecasts. In particular, for rational expectations to hold one expects to find $E(\Delta y^1_{i,t}|Z_{i,t-1}) = g^1(X_{t-1})$, i.e. that the observed expectations are rational *on average*. If observed expectations were *exactly* rational one would expect $\Delta y_{i,t} = g(X_{t-1})$ almost surely; we here allow for some idiosyncratic error in the observed expectations, and take $E(\Delta y^1_{i,t}|Z_{i,t-1}) = g^1(X_{t-1})$ as a test of rational expectations. Deviations from this equality are taken as departure from rationality of expectations.

One alternative formation process of expectations is the adaptive scheme, as originated in the 1950s by the works of Cagan (1956), Friedman (1957) and Nerlove (1958). We employ here the following definition.

Definition 6 (Adaptive expectations) *An adaptive scheme is any* bivariate *transfer function of the form*

$$E(\Delta y^1_{i,t}|Z_{i,t-1}) = a(L)y^1_{i,t-1} + b(L)x^1_t + c$$

where $a(L)$ and $b(L)$ are finite scalar polynomials of the lag operator L, and c is a constant.

We emphasise the bivariate nature of the adaptive scheme[9]: in particular, under adaptive expectations, one would expect that only past values of the forecasted variable x^1_t and of its forecast $y^1_{i,t}$ enter in the expectation process for $y^1_{i,t}$. Thus, if other variables enter in the estimated equation for $\Delta y^1_{i,t}$, this is evidence against a purely adaptive scheme and possibly in favour of a more general class of models known as augmented-adaptive.

Definition 7 (Augmented-adaptive expectations) *An augmented-adaptive scheme is any* multivariate *transfer function of the form*

$$E(\Delta y^1_{i,t}|Z_{i,t-1}) = C(L)z_{i,t-1} + c$$

where $C(L) := \sum_{\ell=1}^{p} C_\ell L^\ell$ is a finite order matrix polynomial of the lag operator L, and c is a constant, $z_{i,t} := (y'_{i,t}, x'_t)'$.

As noted in Section 3, augmented-adaptive schemes are also referred to as boundedly rational learning models (see, e.g. Pesaran, 1987 and Sargent, 1993). We are interested in them here since they nest both rational and simple adaptive schemes; therefore they offer the natural setting to test for both types of expectations processes.

The next section discusses cointegration and causality restrictions on the subsystems (4), (5).

4.3 Cointegration and causality

In the following, we enquire the possibility of cointegration (CI) in the vector w_t under Assumptions 1 and 2, and state the expected long run properties of stimuli and predictions. The integration properties of the series do not interfere with the analysis of the degree of rationality of expectations, but rather offer additional opportunities in the study of expectation formation.

The following proposition states CI restrictions, and focuses on the Equilibrium Correction Mechanisms (ECM) (see Hendry, 1995) of the two subsystems.

[9]See Pesaran (1987) for many variations nested within this general definition.

Proposition 8 *Let w_t be at most $I(1)$ with CI rank equal to r; this implies $\Pi = \alpha\beta'$, with α and β full column rank matrices with rank r. Under Assumptions 1, 2, the CI space β and the adjustment coefficients α can be represented as follows*

$$\begin{aligned} \alpha\beta' &= \begin{pmatrix} \alpha_{y1} \\ 0 \end{pmatrix} \beta'_{1w} + \alpha_{w2} \begin{pmatrix} 0 & \beta'_{2x} \end{pmatrix} \\ &= \begin{pmatrix} \alpha_{y1} & \alpha_{y2} \\ 0 & \alpha_{x2} \end{pmatrix} \begin{pmatrix} \beta'_{1y} & \beta'_{1x} \\ 0 & \beta'_{2x} \end{pmatrix} = \begin{pmatrix} \alpha_{y1}\beta'_{1y} & \alpha_{y1}\beta'_{1x} + \alpha_{y2}\beta'_{2x} \\ 0 & \alpha_{x2}\beta'_{2x} \end{pmatrix}, \end{aligned} \tag{6}$$

where the 2 blocks of columns in α and β have full rank equal to r_1, r_2, and $r = r_1 + r_2$. Hence

- *the ECM terms in the autonomous VAR system for x_t are $\alpha_{x2}\beta'_{2x}x_t$, while the ones that appear in the VARX subsystem for y_t are $\alpha_{y1}\beta'_{1w}w_t + \alpha_{y2}\beta'_{2x}x_t$;*
- *the CI rank of the autonomous VAR system x_t is equal to r_2;*
- *under Assumptions 3 $\alpha_{y1}\beta'_{1y}$ has a block-diagonal structure of the form $\alpha_{y1} = \mathrm{diag}(\alpha_{11}, ..., \alpha_{mm})$, $\beta_{y1} = \mathrm{diag}(\beta_{11}, ..., \beta_{mm})$.*

Proof. Mosconi and Giannini (1992) prove (6), see also Johansen (1995), section 5.6. Note that we exclude I(2) behaviour. Under Assumptions 3 one has that $\Pi_{yy} = \mathrm{diag}(\Pi_{11}, ..., \Pi_{mm})$, which can be decomposed into $\alpha_{y1}\beta'_{1y}$ with block-diagonal structure of the form $\alpha_{y1} = \mathrm{diag}(\alpha_{11}, ..., \alpha_{mm})$, $\beta_{y1} = \mathrm{diag}(\beta_{11}, ..., \beta_{mm})$ where $\Pi_{ii} = \alpha_{ii}\beta'_{ii}$. ■

Proposition 8 clarifies that the analysis of the autonomous VAR for the stimuli allows to make inference on part of the cointegrating space, the one spanned by β_{x2}. We observe that the structure of the restricted joint VAR allows the expectation variables to possibly respond to the disequilibrium errors $\beta'_{2x}x_t$ in any way, including the one characterising the ECM in the field, with coefficients α_{x2}. This behaviour would be consistent with rational expectations.

The ECM of the expectation variables possibly contains r_1 additional CI vectors. One such CI vector could be of the form $y^1_{i,t} - x^1_t$, i.e. could describe the expectation error. Adjustment to this expectation error is expected in an adaptive scheme.

The comparison of the field and expectation sub-systems allows to evaluate the presence and direction of causality, both in the real-world data and in their perception by the agents in the expectations data. Significant coefficients on taxes within the equation for spending are taken as evidence of causality from taxes to spending, and vice versa.

It can be stressed that in the lab sub-system one can also investigate the presence and direction of causality from the field data to the expectation variables. This is of particular interest in order to evaluate possible differences between the perceived and real directions of causality in the field and in the lab.

In the next section we illustrate in greater details the type of cointegrating and causal relationships which may be expected between and within the two models. We do it while summarising the various steps of the econometric analysis performed on the data.

5 Empirical specification and inference

The econometric specification described in the previous sections allows to perform the empirical analysis in two stages: the first one on the field sub-system, the second one on the expectation data.

5.1 Specification of the field model (stimuli)

Visual inspection (see Section 2) and evidence in the literature suggest that the stimuli data $x_t := (T_t, G_t)'$ are integrated of order 1, I(1). Because x_t contains the ratio of taxes and expenditure to total GDP, $x_t := (T_t, G_t)'$, we expect the system x_t not to contain a linear trend.

A natural parametrisation of the sub-system is then

$$\Delta x_t = \alpha_{x2}(\beta_{2x}' x_{t-1} + \rho) + \sum_{\ell=1}^{k-1} \Gamma_{\ell,xx} \Delta x_{t-\ell} + \epsilon_{xt}, \tag{7}$$

where $\mu_x = \alpha_{x2} \cdot \rho$ has been assumed to exclude linear trends (see Johansen, 1995).

Versions of this basic model have been analysed quite extensively in the empirical time series analysis on fiscal policy. Two issues have been considered with particular attention: the sustainability of fiscal policy and the direction of causality between fiscal variables.

Since Trehan and Walsh (1991) and Hakio and Rush (1991), a classical method to address the first issue investigates cointegration between taxes and public expenditure inclusive of interest payments: in short, cointegration tests of sustainability are based on the idea that solvency requires the budget deficit to be stationary[10]. We follow a standard procedure to test for cointegration.

We start determining the lags order k of the field VAR: for each country, we begin with $k = 5$ and then restrict the order eliminating lags which are not statistical significant and checking for absence of correlation in the residuals. The Johansen (1995) procedure is used to test for the rank r_2 of the system, and possibly to estimate the cointegrating vector β_{2x}. We use the LR trace test for $H_0 : r_2 = 0$ *versus* $H_1 : r_2 = 1$, and exclude the case of a stationary system $r_2 = 2$, where both taxes and expenditure are stationary in levels. This assumption is justified by previous studies and informal inspection of the graphs of the series; see Fig. 3 and 4 with stimulus data in Section 2.

We rely on standard n-asymptotic tables, despite the limited time span of the data set. This reflects the unavailability of finite sample size quantiles, and it is also consistent with the inference agents could possibly perform in the experiment.

[10]Quintos (1995) clarifies that stationarity is in fact a strong solvency condition. In particular, he shows that the No Ponzi Game on public deficits is satisfied when the budget is integrated of order one and therefore distinguishes between strong and weak forms of solvency (on this, see also Bergman, 2001). We also note that, empirically, it has been proved difficult to accept sustainability in most countries (see references in Bohn, 1998, for the US; and see, e.g., Manasse, 1996, and the results section below for international evidence). Recently, Bohn (1998), and Sarno (2001) have adopted econometric approach which allow for nonlinearity in the adjustment process of fiscal policy; and have reach results supporting sustainability.

For the countries for which $r_2 = 1$, we estimate the CI vector in the form $\beta'_{2x} x_t = T_t + \gamma G_t$ imposing the normalisation to 1 of the coefficient of taxes, and testing whether the corresponding spending parameter $\gamma = -1$. The ML estimate $\widehat{\gamma}$ of γ is later used in the analysis of the lab sub-system[11].

The second empirical issue analysed within equation (7) concerns the direction of causality between taxes and public expenditure. This is also a classical theme in public finance. We here recall four fundamental hypotheses on the relationships between government expenditures and revenues.

1. The 'tax and spend hypothesis': it is the idea that taxes proceed spending. This has been advocated by the Leviathan State writers (Buchanan, 1977; Buchanan and Wagner, 1978), and as an implication of improvements in the technological capacity of raising revenues, which according to Friedman (1978) will always lead to expenditure increases, and never to budget cuts.

2. The 'spend and tax hypothesis': according to this view politicians and public servants manage to systematically convince the public of the benefits of additional public spending, which may only be achieved through tax increases. This story is the most 'behavioural'. For Buchanan (1960), its foundations are rooted in the theory of fiscal illusion, dating back to the nineteenth century 'Italian School of Public Finance'. Peacock and Wiseman (1979) embrace this view. This hypothesis is also implied by Barro's models of both Ricardian equivalence (Barro, 1974) and tax-smoothing (Barro, 1979) with exogenous public spending[12].

3. Bidirectional causality: this follows when taxes and expenditure are simultaneously determined according to the standard economic calculus of weighting the marginal costs and the marginal benefits of public services (Musgrave, 1966; Meltzer and Richard, 1981).

4. Lack of causality: this may sometimes also arise when taxes and public expenditure are decided upon by distinct institutional authorities (Hoover and Sheffrin, 1992).

Tests of the presence and direction of causality can be based on the field sub-model (7). In particular, when the series in $x_t := (T_t,\, G_t)'$ are cointegrated, it is well known that at least one between T_t and G_t adjusts to disequilibrium with respect to the long run relation. The four cases above corresponds to vector α_{x2} of the forms $(0, \star)'$, $(\star, 0)'$, $(\star, \star)'$ and $(0, 0)'$ (with $\star$ indicating a non-zero coefficient), and provide tests of Granger long-run causality. Similarly short run-causality can be simply checked looking for significant off-diagonal coefficients in the matrices $\Gamma_{\ell,xx}$. Mixed results have been obtained regarding causality, see, e.g., Garcia and Henin (1999) and Payne (1998).

Again here, we emphasise that in the present paper we are *not* interested in testing for causality (or for sustainability of fiscal policy) per se; but we are interested in whether and how properties of fiscal policy found in the stimuli are perceived in the lab-subsystems of expectations variables.

[11]Note that the generated regressor bias has no effect on the n-asymptotics for the lab sub-system, because $\widehat{\gamma}$ is superconsistent, $\widehat{\gamma} - \gamma = O_p(n^{-1})$ compared to the $n^{1/2}$ consistency of the parameters of stationary variables.

[12]In the former case, one may expect causality to hold especially in the long-run.

5.2 Specification of the lab model (expectations)

Under assumptions 1, 2, and 3, the lab sub-system can be decomposed into m individual sub-systems of the form

$$\Delta y_{i,t} = \mu_i + \alpha_{i1}\beta'_{1z_i}\begin{pmatrix} y_{i,t-1} \\ x_{t-1} \end{pmatrix} + \alpha_{i2}(\beta'_{2x}x_{t-1}) + \sum_{\ell=1}^{k-1}(\Gamma_{\ell,ii} : \Gamma_{\ell,ix})\begin{pmatrix} \Delta y_{i,t-\ell} \\ \Delta x_{t-\ell} \end{pmatrix} + \epsilon_{yt}, \quad (8)$$

where $y_{i,t} := (T_t^{E_i}, G_t^{E_i})'$ in the T_t and G_t treatment or $y_{i,t} := T_t^{E_i}$ in the T_t only treatment, and $x_t := (T_t, G_t)'$. In the following we illustrate the inference procedure only for $y_{i,t} := (T_t^{E_i}, G_t^{E_i})'$, with obvious modifications for the T_t only treatment. Equation (8) shows how the expectation variables may react to the field disequilibrium error $\beta'_{2x}x_{t-1}$, which is labelled $_{\text{ECM}}TG$. Additional CI relations may exist through the term $\alpha_{i1}\beta'_{1z_i}$ which is a 2×4 matrix of rank $r_{1i} \leq 2$.

Inference on the number of additional CI vectors r_{1i} can be performed for fixed values of the ECM term $_{\text{ECM}}TG$ obtained in the marginal field system[13]. In this paper we take a different and simpler approach. The hypothesis of adaptive behaviour in the formation of expectation suggests to calculate the expectation errors $(T_t^{E_i} - T_t,\ G_t^{E_i} - G_t)'$ as a possible choice of extra CI relations $\beta'_{1z_i}(y'_{i,t-1},\ x'_{t-1})'$. Because these extra relations do not contain any parameter to be estimated, it is simple to inspect the implied time-series of the forecast errors in order to infer if they are stationary or I(1). This can be done visually or through univariate unit root tests. Both the tests and the graphical analysis[14] suggest that the forecast errors are stationary.

This leads us to conclude that the sub-system (8) could be rewritten as follows

$$\begin{pmatrix} \Delta T_t^{E_i} \\ \Delta G_t^{E_i} \end{pmatrix} = \mu_i + \alpha_i \begin{pmatrix} T_{t-1}^{E_i} - T_{t-1} \\ G_{t-1}^{E_i} - G_{t-1} \\ T_{t-1} + \widehat{\gamma} G_{t-1} \end{pmatrix} + \sum_{\ell=1}^{k-1}(\Gamma_{\ell,ii} : \Gamma_{\ell,ix})\begin{pmatrix} \Delta y_{i,t-\ell} \\ \Delta x_{t-\ell} \end{pmatrix} + \widehat{\varepsilon}_{yt}, \quad (9)$$

where $\alpha_i := (\alpha_{i1} : \alpha_{i2})$ is the adjustment coefficient, $\widehat{\varepsilon}_{yt} := \varepsilon_{yt} - \alpha_{i2}(\widehat{\gamma} - \gamma)G_{t-1}$. Eq. (9) involves only stationary variables and delivers standard $n^{1/2}$ asymptotics for $(\mu_i, \alpha_i, \Gamma_{\ell,ii}, \Gamma_{\ell,ix}, \Omega_{ii})$ (see Johansen, 1995, chapter 13.5).

The analysis of eq. (9) permits to discriminate among the different expectation formation processes detailed in Section 4.2. In particular, if subject i has rational expectations, one would expect the equations for $\Delta y_{i,t}$ to collapse to the specification of the marginal system Δx_t. This can be checked by testing if the coefficients of the variables that are present in (9) and not in (7) are equal to zero.

Of specific interest is to investigate whether and how the long-run adjustment in the conditional model α_{i2} relate to the one in the marginal model α_{x2}, since this coefficient indicates if agents perceive and adjust to the actual cointegration characteristics in the data.

[13]Paruolo (2001) has derived the asymptotics of LR trace test for CI rank when some CI relation are known. These results are not directly applicable here because the ECM term $_{\text{ECM}}TG$ has been estimated in the field sub-system and because (8) is a sub-system.

[14]Both are not reported for brevity.

On the contrary if expectations are adaptive, one would expect only Δx_t^1 to enter the equation for $\Delta y_{i,t}^1$, where a superscript 1 indicates one stimulus variable and the corresponding forecast. If other variables appear in the equation for $\Delta y_{i,t}^1$, this is consistent with an augmented-adaptive scheme. Again this can be tested via zero restrictions on coefficients.

Finally, questions of perceived causality between taxes and public expenditure can be addressed by inspection of parameters in (9), which nest causality links from $x_{t-\ell}$ and $y_{i,t-\ell}$ to $y_{i,t}$. In particular the off-diagonal elements in the $\Gamma_{\ell,ix}$ matrices and the α_{i2} coefficients determine the direction of causality from the field to the lab, while the off-diagonal elements in the $\Gamma_{\ell,ii}$ matrices and the α_{i1} coefficients regulate the ones from the past expectations on present expectations. Causal links in αs pertain adjustment to the long run equilibrium and are termed 'long run causality' links, while the ones in Γs are called 'short run causality' links.

The individual lab sub-systems (9) may be estimated one at the time or jointly. Joint estimation under some homogeneity restriction allows to exploit the panel dimension m of the data to increase efficiency. In the empirical analysis we assumed all individual-specific parameters to be equal across agents, $(\mu_i, \alpha_i, \Gamma_{\ell,ii}, \Gamma_{\ell,ix}, \Omega_{ii}) = (\mu_*, \alpha_*, \Gamma_{\ell,*}, \Gamma_{\ell,*x}, \Omega_{**})$, obtaining the maximal reduction in number of parameters[15].

6 Empirical evidence

The result of the cointegration analysis of the stimulus data are given in Table 2. We find that two lags (that is, models with one lagged difference) are enough to characterise the dynamic structure of the series for most of the countries considered in the experiments (exceptions are Austria, $k = 3$; Finland, $k = 5$; Italy, $k = 4$; and Portugal, $k = 3$). For 9 countries (Austria, Finland, Germany, Italy, Netherlands, Norway, Portugal, Sweden and UK), we find that taxes and public expenditures are cointegrated; for 6 (Belgium, Denmark, France, Greece, Ireland and Spain) we find that they are not. Among the former and consistently with the general evidence reported in the literature (see, e.g. Manasse, 1996), we found that the condition for stationarity of the budget $\widehat{\gamma} = -1$ is rejected for most countries. In fact, it is accepted only for Italy, somehow surprisingly given that Italy is notoriously considered a country with very easy public spending[16].

Table 3 summaries the main findings of the inference on both the field and lab systems in the two experimental treatments. (The complete parameter estimates are given in Appendix A). In considering the results, recall that in the T_t only treatment, in which agents forecast taxes, expectations on $G_t^{E_i}$ are not available. Thus, inference results on the lab system for the T_t only treatment is limited to the equation for $\Delta y_t^1 = \Delta T_{t+1}^{Ei}$.

The first part of the table reports, for the field and for the lab, the coefficients of responses to the field error correction term $\beta_{2x}'(T_t, G_t)'$ (also indicated with ${}_{\text{ECM}}TG$). Consider first the field evidence (the first column in the Table). Among the nine countries

[15] We also performed a general to specific strategy; the selected models did not give substantial differences with respect to the results for the homogeneous case.

[16] Notice, however, that the hypothesis of no-cointegration for Italy was rejected only marginally with a p-value of 0.09.

Table 2: Results of cointegration analysis on stimulus data

Country (sample period)	VAR order	$H_0(r_2 = 0)$ *versus* $H_1(r_2 = 1)$	Rank	Cointegrating Vector (β'_{2x}, ρ)	Test of the homogeneity condition $\widehat{\gamma} = -1$
Austria (1970-98)	$k = 3$	42.5^{***}	$r = 1$	$(1; -0.739; -10.385)$	-13.23^{***}
Belgium (1970-98)	$k = 2$	9.05	$r = 0$		
Denmark (1971-95)	$k = 2$	15.92	$r = 0$		
Finland (1970-98)	$k = 5$	27.99^{***}	$r = 1$	$(1; -0.565; -21.436)$	-28.29^{***}
France (1970-98)	$k = 2$	15.92	$r = 0$		
Germany (1976-98)	$k = 2$	19.40^{*}	$r = 1$	$(1; -0.572; -17.863)$	-4.32^{**}
Greece (1970-98)	$k = 2$	14.37	$r = 0$		
Ireland (1970-98)	$k = 2$	16.67	$r = 0$		
Italy (1970-98)	$k = 4$	18.19^{*}	$r = 1$	$(1; -0.892; 0)$	-1.72
Netherlands (1970-98)	$k = 2$	20.47^{**}	$r = 1$	$(1; -0.606; -17.630)$	-13.51^{***}
Norway (1970-98)	$k = 2$	18.42^{*}	$r = 1$	$(1; -1.051; 0)$	-3.52^{**}
Portugal (1970-98)	$k = 3$	49.12^{***}	$r = 1$	$(1; -1.177; 13.667)$	-2.09^{*}
Spain (1970-98)	$k = 2$	16.10	$r = 0$		
Sweden (1970-98)	$k = 2$	18.18^{*}	$r = 1$	$(1 : -0.950; 0)$	-2.13^{*}
UK (1970-98)	$k = 2$	23.42^{**}	$r = 1$	$(1; -0.922; 0)$	-9.18^{***}

Legend: *, **, *** denote rejection at, in the order, 10%, 5%, 1% significance level.

Table 3: Summary of inference results

	Vectors of responses to ${}_{\text{ECM}}TG$: $T_t+\widehat{\gamma}G_t$			Vectors of responses to $({}_{\text{ECM}}T^ET,\ {}_{\text{ECM}}G^EG)'$: $\beta'_{w1}\cdot(y_{t-1},\ x_{t-1})'$		Direction of short run causality inferred from $\Gamma_{l,xx}$ and $\Gamma_{\ell,ix}$		
	Field α_{x2}	T_t and G_t treatment α_{i2}	T_t only treatment α_{i2}	T_t and G_t treatment α_{i1}	T_t only treatment α_{i1}	Field	T_t and G_t treatment	T_t only treatment
Austria	$(0, 1.31)$	$(0, 0)$	$(0, *)$	$((-0.95, 0), (0, -0.73))$	$((-0.94, *), *)$	$T \leftrightarrow G$	$T \leftarrow G$	$T \leftarrow G$
Belgium				$((-0.73, 0), (0, -0.58))$	$((-0.93, *), *)$	$T \leftarrow G$	$T \leftarrow G$	$T \leftarrow G$
Denmark				$((-0.60, 0.1), (0, -0.54))$	$((-0.69, *), *)$		$T \leftarrow G$	$T \leftarrow G$
Finland	$(-0.96, 0)$	$(0, 0)$	$(-0.15, *)$	$((-0.68, 0.22), (0.58, -0.40))$	$((-0.87, *), *)$	$T \leftarrow G$	$T \leftrightarrow G$	$T \leftarrow G$
France				$((-0.74, 0), (0, -0.83))$	$((-0.70, *), *)$	$T \leftarrow G$	$T \leftarrow G$	$T \leftarrow G$
Germany	$(-1.01, 0)$	$(0, 0)$	$(0, *)$	$((-0.96, 0.1), (0, -0.64))$	$((-0.93, *), *)$		$T \leftarrow G$	$T \leftarrow G$
Greece				$((-0.86, 0), (0, -0.90))$	$((-0.87, *), *)$			$T \leftarrow G$
Ireland				$((-0.66, 0), (0, -0.89))$	$((-0.67, *), *)$		$T \leftarrow G$	$T \leftarrow G$
Italy	$(-0.16, 0)$	$(-0.11, 0)$	$(0, *)$	$((-0.63, 0), (0, -0.66))$	$((-0.85, *), *)$		$T \leftarrow G$	$T \leftarrow G$
Netherlands	$(-0.62, 0)$	$(0, 0)$	$(0, *)$	$((-0.51, 0), (0, -0.63))$	$((-0.80, *), *)$			$T \leftarrow G$
Norway	$(0,\ 0.31)$	$(0,\ 0.09)$	$(0, *)$	$((-0.67, 0), (0.16, -0.65))$	$((-0.73, *), *)$	$T \rightarrow G$	$T \rightarrow G$	$T \leftarrow G$
Portugal	$(0.29,\ 0.67)$	$(0,\ 0.32)$	$(0, *)$	$((-0.67, 0), (0.42, -0.50))$	$((-0.76, *), *)$	$T \leftrightarrow G$	$T \leftarrow G$	$T \leftarrow G$
Spain				$((-0.90, 0.08), (0, -0.62))$	$((-0.54, *), *)$		$T \leftarrow G$	$T \leftarrow G$
Sweden	$(0, 0.28)$	$(0,\ 0.08)$	$(0, *)$	$((-0.79, 0), (0, -0.75))$	$((-0.67, *), *)$	$T \rightarrow G$		$T \leftarrow G$
UK	$(0, 0.44)$	$(-0.06, 0)$	$(-0.07, *)$	$((-0.77, 0), (0.29, -0.73))$	$((-0.79, *), *)$		$T \rightarrow G$	$T \leftarrow G$

for which cointegration between taxes and expenditure was found, expenditure is long-run adjusting to taxes in four cases (Austria, Norway, Sweden and UK); taxes are adjusting to expenditure in others four (Finland, Germany, Italy and Netherlands); and in one country (Portugal) there is bidirectional adjustment.

Results from the experiments show that subjects fail to perceive the CI characteristics of the field data. First of all, in regards to both experimental treatments, we note that in many cases the lab responses α_{i2} to ${}_{\mathrm{ECM}}TG$ are not significantly different from zero and even when they are, α_{i2} are in any case quite small[17].

Consider now the direction of perceived long-run causality. In the T_t and G_t treatment, in which subjects forecasted both taxes and expenditure, subjects do not perceive any long run adjustment in four countries (Austria, Finland, Germany and Netherlands); in one case (UK), they perceive adjustment in the wrong direction; and in other four cases, they seem to correctly perceive the adjustment process (from expenditure to taxes in Italy, and from taxes to expenditure in Norway, Portugal and Sweden). In the T_t only treatment, we don't know how participants perceive the dynamics of the series of public expenditure. Notice, however, that out of the six countries in which adjustment in the field was from expenditure to taxes, only in the case of Finland participants seem to correctly perceive the direction of causality. In the case of UK, again subjects perceive a wrong direction.

The last part of table 3 shows the results of tests on Granger causality between taxes and expenditure, as it can be inferred from inspection of the off-diagonal coefficients of matrix $\Gamma_{l,xx}$ and from $\Gamma_{\ell,ix}$ for the field and lab systems, respectively. Field evidence shows that in 8 countries (Denmark, Germany, Greece, Ireland, Italy, Netherlands, Spain, UK), causality runs in neither direction; in 3 (Belgium, Finland and France), causality runs from expenditure to taxes; in 2 (Norway and Sweden), from taxes to expenditure; and in 2 (Austria and Portugal), causality is bidirectional.

Lab evidence indicates that subjects have a quite different perception regarding Granger causality between taxes and expenditure. In particular, with reference to both experiments, we find that there is an overwhelming tendency of subjects perceiving a causality running from expenditure to taxes: in the T_t and G_t treatment, this holds for 9 countries over 15; in the T_t only treatment, it holds for all the 15 countries. Moreover, we note that the short-run adjustments coefficients are not negligible (see estimates reported in Appendix A).

Several remarks are in order regarding this evidence. Firstly, it shows (more than the weak evidence on cointegration) that the model of expectations forming which best describes the data is of an augmented-adaptive type. Subjects expectations are not for this, however, closer to be perfect, than what it would be implied by a purely adaptive model.

In fact, the evidence may also contribute to explain the relative poorer performance of participants in the experiments relative to a purely adaptive agent, as reported in Section 3. The middle part of Table 2 shows the estimates of the vector α_{y1} describing how individual react in the long run to errors in the process of expectations forming $\beta'_{1z_i}(y'_{i,t-1}, x'_{t-1})' = (T_t^{E_i} - T_{t-1}, G_t^{E_i} - G_{t-1})'$ (also denoted $({}_{\mathrm{ECM}}T^E T, {}_{\mathrm{ECM}}G^E G)'$). While it is clear that subjects in the experiments react adaptively to errors, they do so differently

[17]Compare also the standard deviation of the estimated parameters, reported in the Tables 1-15 for the individual countries in Appendix A.

from a purely adaptive agent. In the latter case, one should find $\alpha_{i1} = I_2$, an identity matrix of order 2. For all countries and in both experimental treatments we have that the estimated diagonal parameters of α_{i1} are typically less than 1[18]. In this regard, it is perhaps of some interest to notice that in the T_t and G_t treatment, for which Table 2 shows that subjects indeed perceive a good deal of exogeneity in public expenditure, the relative expectations seem also closer to those of a purely adaptive agents than in the case of tax expectations (see Fig. 8 in Section 3).

The evidence of the direction in which subjects perceive causality, namely from taxes to expenditure regardless of what occurs in the field, is also of interest. In particular, it is consistent with the "spend and tax hypothesis", which among the four classical views recalled in Section 5.1 was accounted as the most behavioural. The evidence may also have implication for theories studying the effects of fiscal policy. We come back to such point at the end of the next section.

7 Misspecification tests for nonlinearity and anti-Keynesian effects

The VAR approach pursued in the previous sections works under the maintained hypothesis of a linear process for the time series considered. As intuition and some current literature has documented (see Bohn, 1998, and Sarno, 2001), this hypothesis may conflict with the fact that fiscal policy is subject to various possible structural shifts and discretionary interventions, which may introduce nonlinearity in fiscal policy.

We have controlled for misspecification biases due to nonlinearity in the field systems by way of standard RESET tests. We haven't found evidence of misspecification for the spans of data given as stimulus to subjects in the experiment.

When the field systems are correctly specified, still a question of interest concerns the response of the private sector's expectations to situations in which, at some point in time, some relevant shifts in the conduct of fiscal policy is observed. As emphasised by some recent literature, under such conditions, a large intervention on the fiscal variables, perhaps addressed to correct disequilibrium in the public budget, may be perceived by the public as to imply lower taxation in the future, and therefore generate an expansion in economic activity, rather than a contraction as predicted by a standard Keynesian perspective.

Proposed originally by the Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung 1981, this view has been made popular by Giavazzi and Pagano (1990), who brought to the attention of the profession the astonishing expansionary fiscal consolidations occurred in the mid 1980s in Denmark and Ireland. Various subsequent literature has been developed on the circumstances and conditions under which nonlinear effects of fiscal policy are more or less likely to occur[19].

[18] This is also confirmed by formal t-tests (see in particular the standard deviations reported in Appendix A).

[19] Developments in this field include Bertola and Drazen (1993), who focus on adjustments when public expenditure reaches critical levels; and Sutherland (1997), who looks at critical debt levels. These studies also emphasise the potential importance of political announcements or constraints for expectations to

Taking a pragmatic approach on the issue, Giavazzi, Jappelli, and Pagano (2000) have defined periods of 'large and persistent' fiscal contractions and fiscal expansions as situations in which, for at least two consecutive years, the budget balance as a percentage of GDP increase or decrease, respectively, by at least 1,5 point per year. Looking at two panels of OECD and non-OECD data, the study reports widespread evidence of nonlinear effects of fiscal policy.

However, as noted in the introduction, a problem with this approach is that a link between the observed nonlinear effects of fiscal policy and the role of expectations can only be inferred, but not really tested[20].

We control for the possibility of nonlinear effects in the present experiment introducing dummies in the equation (9) for expected taxes. Two dummies are introduced on the intercept: one (d_{CONTR}) activated in periods of "sizeable and persistent" fiscal contractions, and the other (d_{EXP}) activated in periods of "sizeable and persistent" fiscal expansions. According to the view, we should expect the coefficients on d_{CONTR} to be negative and that on d_{EXP} to be positive[21].

Table 4 reports the periods in which the two dummies were activated, with the related evidence. (A fuller account of the evidence in Appendix A).

We counted 11 episodes of fiscal expansions (in 10 countries, with Sweden counting for two), and 10 episodes of fiscal contractions (in 7 countries, with Ireland counting for two and Sweden for three). In none of these episodes we find evidence consistent with the predictions: in fact, almost always the dummies are non significant, in few cases they appear with the wrong sign. The above evidence thus rejects the hypothesis of nonlinear responses of expectations to 'large and persistent' changes in fiscal policy *per se*.

Conversely, the results reported in the previous section of subjects' expectations consistent with the "tax and spend hypothesis" may give indirect support to a different interpretation of anti-Keynesian effects, which emphasizes the importance of the "composition" of fiscal adjustments. As especially argued by Alesina and Perotti and various coauthors (see, e.g., Alesina and Perotti, 1997, and various references also quoted in Alesina, Ardagna, Perotti, and Schiantarelli, 2002), this view suggests that in periods of fiscal distress, only those adjustments that heavily rely on public expenditure cuts (better if in government consumption, wage bill and transfers) may generate an expansion in economic activity.

The reason is that only such adjustments may succeed in signalling to the public a real determination to correct the budget, so to actually induce expectations of lower taxation in the future. On the contrary, fiscal interventions based on tax increases will most likely be perceived as an easy way out by the private sector. Note that this theory is rooted in a supply-side interpretation of the effects of fiscal policy (see e.g. Alesina, Ardagna, Perotti, and Schiantarelli, 2002) and does not require " 'special —

actually trigger nonlinear anti-Keynesian effects. Perotti (1999) has also a model in which fiscal policy generates nonlinear effects, though in this latter case nonlinearities are not due to expectations, but to distortionary taxation (as also in Blanchard, 1990) and credit constraints.

[20] An other problem is that heterogeneity in the cross-country panel can itself generate non-linearity (see Kamps, 2001).

[21] This would in particular signal a negative and positive change in the drift of agents' expectations following periods of "large and persistent" fiscal contraction and fiscal expansion, respectively.

Table 4: Evidence on expectations in episodes of "large and persistent" fiscal adjustments

Country	Fiscal Expansions			Fiscal Contractions		
	Episodes	Evidence on d_{EXP}		Episodes	Evidence on d_{CONTR}	
		T_t and G_t treatment	T_t only treatment		T_t and G_t treatment	T_t only treatment
Belgium	'80-81	not signif.	not signif.			
Denmark	'80-82	wrong sign (-)	not signif.	'83-86	wrong sign (+)	not signif.
Finland	'91-93;	not signif.	not signif.	'88-89	not signif.	not signif.
France	'92-93	not signif.	not signif.			
Greece	'88-90	not signif.	not signif.	'96-97	not signif.	not signif.
Ireland	'78-80	wrong sign (-)	not signif.	'83-84; '88-87	not signif	not signif
Norway	'91-92	not signif.	not signif.	'94-96	not signif.	not signif.
Spain	'81-82	not signif.	not signif.	'97-96	not signif.	not signif.
Sweden	'78-79; '91-93	not signif.	not signif.	'83-84; '86-87; 94-96	not signif.	wrong sign (+)
UK	'92-93	wrong sign (-)	not signif.			

i.e. nonlinear — theories' for large versus small changes if fiscal policy" (p. 586).

While the results of the previous section are obviously silent on the supply-side architecture underlying this view, the evidence clearly supports the argument that expectations of lower taxation in the future may only be induced by public expenditure cuts.

8 Conclusions

In a famous taxonomy of the goal which may be pursued in the laboratory, Roth (1987) suggests three categories to classify experiments in economics: the first is "speaking to theorists", the second is "searching for facts and meaning", the third is "whispering in the ears of princes". The experiment described in the previous pages has especially pursued the second goal, in a field — that of expectations on fiscal policy — in which very little was apparently known.

We have now a better idea on how expectations on fiscal variables may be formed: we have developed an econometric approach for the process of expectations forming, which coherently arises from the DGP of the field stimuli; we have distinguished between long-run and short-run effects, both of the stimuli and of past expectations; we found that subjects behave adaptively, though they do not adjust perfectly to past expectation errors, not even in the long run; we found that subjects follow an augmented-adaptive model, which has revealed some innate inclination for subjects to believe that more public expenditure requires more taxes; we found that this is a short-run causal relationship holding regardless of the actual causal relationship between taxes and expenditure in the field.

We believe that the latter is an interesting result, which may also have important policy implications. We in particular noticed that it underlines a theory of anti-Keynesian effect of fiscal policy based on the so called "composition view". We have also tested whether subjects' expectations respond nonlinearly to large discretionary changes in fiscal policy; but we haven't found sign of such a behavior. This does not necessarily mean that nonlinear effects of fiscal policy may not be relevant in the field; it however means that if nonlinear effects occur, they might not be simply imputed to general characteristics of fiscal policy *per se*, but may need other catalyzing factors, which may be political events, announcements, perhaps news from the press or media broadcasting.

One may possibly find a way to control for some of such factors in richer experimental setups, which give information on political events or announcements from historical records, as additional stimulus data; likewise, experiments giving more disaggregated information regarding the composition of the public budget can provide more specific evidence on the "composition view" of fiscal policy.

From a more general viewpoint, the results presented in this experiment credits the dissatisfaction of many with the rational expectation hypothesis. We noticed that it motivates much current research on the behavioral foundation of models of expectations forming. The present approach provides a method to obtain observable expectations which hinges directly on the way in which people may behave in the field.

Indeed, from a methodological perspective, the main novelty of the present approach is the idea of using field and laboratory data complementarily. Experimental economics has grown substantially over the last two or three decades, as it is now a well-acknowledged method through which decision theorists, game theorists and microeconomists have tested and refined theoretical models in their respective fields of interest.

Relatively few experiments have instead been conducted in the field of macroeconomics. The reason, probably, is that macroeconomists deal with real world questions to a much greater degree than other economists, in the belief that laboratory experiments cannot really answer such type of questions. "When an engineer wants to find out how the temperature affects material's conductivity, she builds an experiment in which she changes the temperature, makes sure that everything else remains the same, and looks at the change in conductivity. But macroeconomists who want to find out, for example, how changes in the money supply affect aggregate activity cannot perform such controlled experiments; they cannot make the world stop while they ask the central bank to change the money supply" (Blanchard, 1997).

The approach pursued in this paper suggests that it is not necessary to make the world stop to test macroeconomic models experimentally; but that using real world data as stimulus for subjects in the experiments, it may be possible get evidence on interesting and practically important macroeconomic issues.

References

Ahmed, S., and J. H. Rogers, 1995, Government Budget Deficits and Trade Deficits: Are Present Value Constraints Satisfied in Long-Term Data?, *Journal of Monetary Economics*, 36, 351–74.

Alesina, A., S. Ardagna, R. Perotti, and F. Schiantarelli, 2002, Fiscal policy, profits and investment, *American Economic Review*, pp. 571–589.

Alesina, A., and R. Perotti, 1997, Fiscal Adjustments in OECD Countries: Composition and Macroeconomic Effects, *International Monetary Fund Staff Papers*, 44, 210–48.

Allers, M., J. de Haan, and F. de Kam, 1998, Using Survey Data to Test for Ricardian Equivalence, *Public Finance Review*, 26, 565–82.

Barro, R. J., 1974, Are Government Bonds Net Wealth?, *Journal of Political Economy*, 82, 1095–1117.

——— , 1979, On the Determination of the Public Debt, *Journal of Political Economy*, 87, 940–71.

Bergman, M., 2001, Testing Government Solvency and the No Ponzi Game Condition, *Applied Economics Letters*, 8, 27–29.

Bernasconi, M., and O. Kirchkamp, 2000, Why do monetary policies matter? An experimental study of saving and inflation in an overlapping generations model, *Journal of Monetary Economics*, 46, 315–343.

Bertola, G., and A. Drazen, 1993, Trigger Points and Budget Cuts: Explaining the Effects of Fiscal Austerity, *The Americal Economic Review*, 83(1), 11–26.

Blanchard, O. J., 1990, Comment to Giavazzi and Pagano, *NBER Macroeconomics Annual*, pp. 111– 116.

——— , 1997, *Macroeconomics*. Prentice Hall, New Jersey, USA.

Bohn, H., 1998, The behavior of US public debt and deficits, *Quarterly Journal of Economics*, 113, 949–963.

Buchanan, J. M., 1960, *Fiscal theory and political economy*. The University of North Carolina Press, Chaple Hill.

——— , 1977, *Democracy in deficit*. Academic Press, New York.

Buchanan, J. M., and R. Wagner, 1978, Dialogues concerning fiscal religion, *Journal of Monetary Economics*, pp. 626–627.

Cagan, P., 1956, The Monetary Dynamics of Hyperinflation, in *Studies in the Quantity Theory of Money*, ed. by M. Friedman. University of Chicago Press.

Duffy, J., 1998, Monetary Theory in the Laboratory, *Federal Reserve Bank of St. Louis Review*, 80, 9–26.

Engle, R. F., D. F. Hendry, and J.-F. Richard, 1983, Exogeneity, *Econometrica*, 51, 277–304.

Evans, G. W., and S. Honkapohja, 2001, *Learning and expectations in macroeconomics*. Frontiers of Economic Research. Princeton and Oxford: Princeton University Press.

Friedman, M., 1957, *The Theory of the Consumption Function*. Princeton University Press, Princeton, New Jersey.

——— , 1978, The limitations of tax limitations, *Policy Review*, pp. 7–14.

Garcia, S., and P.-Y. Henin, 1999, Balancing Budget through Tax Increases or Expenditure Cuts: Is It Neutral?, *Economic Modelling*, 16, 591–612.

Giavazzi, F., T. Jappelli, and M. Pagano, 2000, Searching for non-linear effects of fiscal policy: evidence from industrial and developing countries, *European Economic Review*, 44, 1259–1289.

Giavazzi, F., and M. Pagano, 1990, Can severe fiscal contraction be expansionary? Tales of two small European countries, *NBER Macroeconomics Annual*, pp. 75–111.

Grun, D., 1991, What people know and what economists think they know: surveys on Ricardian equivalence, *Australian Economic Papers*, 30, 1–9.

Hakio, C., and M. Rush, 1991, Is the budget deficit too large?, *Economic Enquiry*, 29, 449–445.

Hendry, D. F., 1995, *Dynamic econometrics*. Advanced Texts in Econometrics. New York and Oxford: Oxford University Press.

Hoover, K. D., and S. M. Sheffrin, 1992, Causation, Spending, and Taxes: Sand in the Sandbox or Tax Collector for the Welfare State?, *American Economic Review*, 82, 225–48.

Johansen, S., 1995, *Likelihood-based inference in cointegrated vector autoregressive models*. Advanced Texts in Econometrics. Oxford and New York: Oxford University Press.

Kamps, C., 2001, Fiscal Consolidation in Europe: Pre- and Post-Maastricht, Discussion Paper 1028, Kieler Arbeitspapier.

Manasse, P., 1996, Are Taxes Too Low?, *Journal of Economic Dynamics and Control*, 20, 1263–88.

Marimon, R., and S. Sunder, 1993, Indeterminacy of Equilibria in a Hyperinflationary World: Experimental Evidence, *Econometrica*, 61, 1073–1107.

Meltzer, A. H., and S. F. Richard, 1981, A Rational Theory of the Size of Government, *Journal of Political Economy*, 89, 914–27.

Mosconi, R., and C. Giannini, 1992, Non-causality in Cointegrated Systems: Representation Estimation and Testing, *Oxford Bulletin of Economics and Statistics*, 54, 399–417.

Musgrave, R. A., 1966, Principles of budget determination, in *Public finance: selected readings*, ed. by H. Camson, and W. Henderson. Random House, New York.

Muth, J. F., 1960, Optimal properties of exponentially weighted forecasts, *Journal of the American Statistical Association*, 55, 299–306.

Nerlove, M., 1958, Adaptive expectations and Cobweb phenomena, *Quarterly Journal of Economics*, 72, 227–240.

Paruolo, P., 2001, LR tests for cointegration when some cointegrating relations are known, *Statistical Methods and Applications - Journal of the Italian Statistical Society*, 10, 123–137.

Payne, J. E., 1998, The Tax-Spend Debate: Time Series Evidence from State Budgets, *Public Choice*, 95, 307–20.

Peacock, A. T., and J. Wiseman, 1979, Approaches to the Analysis of Government Expenditure Growth, *Public Finance Quarterly*, 7, 3–23.

Perotti, R., 1999, Fiscal policy in good times and bad, *Quarterly Journal of Economics*, 114, 1399–1436.

Pesaran, M. H., 1987, *The limits to rational expectations*. Oxford and New York: Blackwell.

Plott, C. F., 1987, Dimensions of parallelism: some policy applications of experimental methods, in *Laboratory Experimentation in Economics: Six Points of View*, pp. 193–219. Cambridge University Press, Cambridge; New York and Sydney.

Quintos, C. E., 1995, Sustainability of the Deficit Process with Structural Shifts, *Journal of Business and Economic Statistics*, 13, 409–17.

Roth, A. E., 1987, Laboratory Experimentation in Economics, in *Advances in economic theory: Fifth World Congress*, ed. by T. F. Bewley, pp. 269–99. Cambridge University Press.

Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung, 1981, *Vor Kurskorrekturen — Zur finanzpolitischen und währungspolitischen Situation im Sommer 1981* Special Report of July 4, 1981.

Sargent, T. J., 1993, *Bounded Rationality in Macroeconomics.* Clarendon-Oxford University Press, Oxford.

Sarno, L., 2001, The behavior of US public debt: a nonlinear perspective, *Economics Letters*, 74, 119–125.

Seater, J. J., 1993, Ricardian Equivalence, *Journal of Economic Literature*, 31, 142–90.

Smith, V. L., 1982, Microeconomic Systems as an Experimental Science, *American Economic Review*, 72, 923–55.

Sutherland, A., 1997, Fiscal crises and aggregate demand: can high public debt reverse the effects of fiscal policy, *Journal of Public Economics*, 65, 147–162.

Trehan, B., and C. E. Walsh, 1991, Testing Intertemporal Budget Constraints: Theory and Applications to U.S. Federal Budget and Current Account Deficits, *Journal of Money, Credit, and Banking*, 23, 206–23.

A Appendix - Country results

A.1 Summary Austria

Sample period	Field k=3; r=1; CV=(1; -0.730; -10.385) 1970-98		Lab. - Treatments: "T and G" n. of subjects: 16 1977-98		"T only" n. of subjects: 19 1977-98
Dependent	ΔT_t	ΔG_t	ΔT^E_t	ΔG^E_t	ΔT^E_t
const			0.237 (5.30)***	0.172 (3.08)**	0.162 (5.29)***
ΔT^E_{t-1}					
ΔT^E_{t-2}					
ΔG^E_{t-1}			-0.071 (-2.09)**		
ΔG^E_{t-2}					
ΔT_{t-1}	-0.562 (-2.52)*	-0.751 (-2.12)*	0.207 (2.96)**		0.170 (2.73)**
ΔT_{t-2}					
ΔT_{t-3}					
ΔT_{t-4}					
ΔG_{t-1}		0.355 (2.04)*		0.513 (7.76)***	0.210 (7.13)***
ΔG_{t-2}	0.318 (2.00)*	0.705 (2.52)*	0.123 (2.32)**		
ΔG_{t-3}					
ΔG_{t-4}					
$_{\text{ECM}}TG$		1.308 (3.11)**			
$_{\text{ECM}}TT^E$			-0.949 (-17.12)***		-0.938 (-19.88)***
$_{\text{ECM}}GG^E$				-0.726 (-13.39)***	
d_{EXP} (not incl.)					
d_{CONTR} (not incl.)					
adj. R^2	0.17	0.23	0.75	0.75	0.88

Legend: k= var order; r= rank; CV= cointegration vector (T ;G; const);
*, **, *** denote, in the order, 5%, 1%, 0.1% significance level

A.2 Summary Belgium

	Field		Lab. - Treatments:		
	k=2; r=0; no CV		"T and G" n. of subjects: 20		"T only" n. of subjects: 22
Sample period	1970-98		1977-98		1977-98
Dependent	ΔT_t	ΔG_t	ΔT_t^E	ΔG_t^E	ΔT_t^E
const			0.231 (4.92)***		0.186 (5.81)***
ΔT_{t-1}^E			-0.100 (-2.77)**		
ΔT_{t-2}^E			-0.074 (-2.77)**		-0.065 (-2.99)**
ΔG_{t-1}^E				-0.133 (-4.22)***	
ΔG_{t-2}^E					
ΔT_{t-1}			0.552 (6.79)**		0.199 (3.99)***
ΔT_{t-2}					
ΔT_{t-3}					
ΔG_{t-1}	0.261 (2.43)**	0.372 (2.08)**	0.101 (3.62)***	0.829 (13.28)***	0.24 (11.25)***
ΔG_{t-2}					
ΔG_{t-3}					
$_{\text{ECM}}TG$					
$_{\text{ECM}}TT^E$			-0.731 (-10.89)***		-0.925 (-22.29)***
$_{\text{ECM}}GG^E$				-0.573 (-10.71)***	
d_{EXP} '80-81					
d_{CONTR} (not incl.)					
adj. R^2	0.11	0.13	0.79	0.79	0.82

Legend: k= var order; r= rank; CV= cointegration vector (T ;G; const);
*, **, *** denote, in the order, 5%, 1%, 0.1% significance level

A.3 Summary Denmark

	Field		Lab. - Treatments:		
	k=2; r=0; no CV		"T and G" n. of subjects: 15		"T only" n. of subjects: 17
Sample period	1971-97		1978-97		1978-97
Dependent	ΔT_t	ΔG_t	ΔT_t^E	ΔG_t^E	ΔT_t^E
const					
ΔT_{t-1}^E			-0.208		-0.086
			(-4.47)***		(-2.80)**
ΔT_{t-2}^E					-0.061
					(0.022)**
ΔG_{t-1}^E				-0.171	
				(-3.82)***	
ΔG_{t-2}^E				-0.062	
				(-2.09)*	
ΔT_{t-1}			0.672		0.572
			(6.85)***		(7.11)***
ΔT_{t-2}					
ΔT_{t-3}					
ΔT_{t-4}					
ΔG_{t-1}			0.297	0.929	0.110
			(4.48)***	(10.33)***	(5.05)***
ΔG_{t-2}					
ΔG_{t-3}					
ΔG_{t-4}					
$_{\text{ECM}}TG$					
$_{\text{ECM}}TT^E$			-0.602		-0.687
			(-8.03)***		(-9.86)***
$_{\text{ECM}}GG^E$			0.089	-0.537	
			(2.11)*	(-6.58)***	
d_{EXP}			-0.494		
'80-82			(-2.04)*		
d_{CONTR}			0.760		
'83-86			(2.84)**		
adj. R^2	-	-	0.82	0.82	0.89

Legend: k= var order; r= rank; CV= cointegration vector (T ;G; const);
*, **, *** denote, in the order, 5%, 1%, 0.1% significance level

A.4 Summary Finland

	Field		Lab. - Treatments:		
	k=5; r=1;		"T and G"		"T only"
	CV=(1; -0.565; -21.436)		n. of subjects: 12		n. of subjects: 15
Sample period	1975-98		1977-98		1977-98
Dependent	ΔT_t	ΔG_t	ΔT^E_t	ΔG^E_t	ΔT^E_t
const					
ΔT^E_{t-1}			-0.229	-0.263	
			(-2.51)*	(-3.75)***	
ΔT^E_{t-2}			-0.160		
			(-2.43)*		
ΔG^E_{t-1}					
ΔG^E_{t-2}				-0.100	
				(-2.92)**	
ΔT_{t-1}	0.847		0.623	0.789	0.430
	(4.00)***		(4.84)***	(4.72)***	(6.81)***
ΔT_{t-2}	0.514		0.259		
	(2.08)*		(2.29)*		
ΔT_{t-3}			0.228		
			(2.46)*		
ΔT_{t-4}	0.528				
	(2.18)*				
ΔG_{t-1}		0.872	0.140	0.882	0.100
		(4.68)***	(3.02)**	(12.32)***	(3.68)***
ΔG_{t-2}	-0.666	-0.468			
	(-3.28)**	(-2.48)*			
ΔG_{t-3}			-0.166		
			(-4.82)***		
ΔG_{t-4}	-0.309				
	(-1.76)				
$_{\text{ECM}}TG$	-0.953				-0.148
	(-3.75)***				(-3.44)**
$_{\text{ECM}}TT^E$			-0.681	0.584	-0.872
			(-6.07)***	(4.25)***	(-19.43)***
$_{\text{ECM}}GG^E$			0.217	-0.395	
			(5.59)***	(-6.62)***	
d_{EXP} '91-93					
d_{CONTR} '88-89					
adj. R^2	0.36	0.43	0.79	0.82	0.80

Legend: k= var order; r= rank; CV= cointegration vector (T ;G; const);
*, **, *** denote, in the order, 5%, 1%, 0.1% significance level

A.5 Summary France

	Field		Lab. - Treatments:		
	k=2; r=0; no CV		"T and G" n. of subjects: 12		"T only" n. of subjects: 10
Sample period	1972-98		1984-98		1984-98
Dependent	ΔT_t	ΔG_t	ΔT_t^E	ΔG_t^E	ΔT_t^E
const			0.160 (3.85)***		
ΔT_{t-1}^E					
ΔT_{t-2}^E					
ΔG_{t-1}^E					
ΔG_{t-2}^E					
ΔT_{t-1}			0.475 (4.89)***		0.415 (4.17)***
ΔT_{t-2}					
ΔT_{t-3}					
ΔT_{t-4}					
ΔG_{t-1}	0.358 (3.27)**	0.444 (2.53)*	0.124 (3.28)**	0.514 (7.32)***	0.180 (4.94)**
ΔG_{t-2}					
ΔG_{t-3}					
ΔG_{t-4}					
$_{\text{ECM}}TG$					
$_{\text{ECM}}TT^E$			-0.739 (-11.10)***		-0.700 (-10.60)***
$_{\text{ECM}}GG^E$				-0.825 (-12.55)***	
d_{EXP} '92-93					
d_{CONTR} (not incl.)					
adj. R^2	0.04	-0.01	0.79	0.82	0.83

Legend: k= var order; r= rank; CV= cointegration vector (T ;G; const);
*, **, *** denote, in the order, 5%, 1%, 0.1% significance level

A.6 Summary Germany

Sample period	Field k=2; r=1; CV=(1; -0.572; -17.863) 1976-98		Lab. - Treatments: "T and G" n. of subjects: 11 1977-98		Lab. - Treatments: "T only" n. of subjects: 14 1977-98
Dependent	ΔT_t	ΔG_t	ΔT_t^E	ΔG_t^E	ΔT_t^E
const			0.169 (4.28)***	0.278 (3.86)***	0.099 (3.67)***
ΔT_{t-1}^E				0.169 (2.87)**	
ΔT_{t-2}^E					
ΔG_{t-1}^E				-0.131 (-2.38)*	
ΔG_{t-2}^E					
ΔT_{t-1}			0.192 (2.06)*		0.127 (1.99)*
ΔT_{t-2}					
ΔT_{t-3}					
ΔT_{t-4}					
ΔG_{t-1}			0.171 (2.99)**	0.756 (6.37)***	0.207 (6.81)***
ΔG_{t-2}					
ΔG_{t-3}					
ΔG_{t-4}					
$_{\text{ECM}}TG$	-1.01 (-5.26)***				
$_{\text{ECM}}TT^E$			-0.962 (-13.58)***		-0.927 (-17.89)***
$_{\text{ECM}}GG^E$			0.098 (2.42)*	-0.639 (-7.66)***	
d_{EXP} (not incl.)					
d_{CONTR} (not incl.)					
adj. R^2	0.57	-	0.78	0.69	0.82

Legend: k= var order; r= rank; CV= cointegration vector (T ;G; const);
*, **, *** denote, in the order, 5%, 1%, 0.1% significance level

A.7 Summary Greece

	Field		Lab. - Treatments:		
	k=2; r=0;		"T and G"		"T only"
	no CV		n. of subjects: 8		n. of subjects: 15
Sample period	1977-98		1982-98		1982-98
Dependent	ΔT_t	ΔG_t	ΔT_t^E	ΔG_t^E	ΔT_t^E
const	0.566 (2.26)*		0.525 (5.05)***	0.458 (5.05)***	0.529 (6.94)***
ΔT_{t-1}^E					-0.186 (-3.64)***
ΔT_{t-2}^E					-0.126 (-3.61)***
ΔG_{t-1}^E					
ΔG_{t-2}^E					
ΔT_{t-1}			0.389 (3.82)***		0.238 (2.46)*
ΔT_{t-2}					
ΔT_{t-3}					
ΔT_{t-4}					
ΔG_{t-1}				0.400 (4.32)***	0.109 (3.84)***
ΔG_{t-2}					
ΔG_{t-3}					
ΔG_{t-4}					
$_{\text{ECM}}TG$					
$_{\text{ECM}}TT^E$			-0.861 (-10.28)***		-0.869 (-10.38)***
$_{\text{ECM}}GG^E$				-0.896 (-11.26)***	
d_{EXP} '88-90					
d_{CONTR} '96-97					
adj. R^2	-	-	0.78	0.84	0.82

Legend: k= var order; r= rank; CV= cointegration vector (T ;G; const);
*, **, *** denote, in the order, 5%, 1%, 0.1% significance level

A.8 Summary Ireland

Sample period	Field k=2; r=0; no CV 1972-97		Lab. - Treatments: "T and G" n. of subjects: 17 1977-95		Lab. - Treatments: "T only" n. of subjects: 22 1977-95
Dependent	ΔT_t	ΔG_t	ΔT^E_t	ΔG^E_t	ΔT^E_t
const			0.601 (5.87)***	0.404 (3.48)**	0.311 (5.94)***
ΔT^E_{t-1}			-0.108 (-2.01)*		-0.098 (-3.08)**
ΔT^E_{t-2}					
ΔG^E_{t-1}					
ΔG^E_{t-2}					
ΔT_{t-1}			0.553 (5.90)***		0.344 (5.76)***
ΔT_{t-2}					
ΔT_{t-3}					
ΔT_{t-4}					
ΔG_{t-1}			0.080 (2.27)*	0.234 (3.54)***	0.159 (9.28)***
ΔG_{t-2}					
ΔG_{t-3}					
ΔG_{t-4}					
$_{\text{ECM}}TG$					
$_{\text{ECM}}TT^E$			-0.662 (-8.88)***		-0.670 (-11.84)***
$_{\text{ECM}}GG^E$				-0.894 (-15.71)***	
d_{EXP} '78-80			-0.743 (-2.43)*		
d_{CONTR} '83-84; '88-87					
adj. R^2	-	-	0.68	0.77	0.78

Legend: k= var order; r= rank; CV= cointegration vector (T ;G; const);
*, **, *** denote, in the order, 5%, 1%, 0.1% significance level

A.9 Summary Italy

	Field		Lab. - Treatments:		
	k=4; r=1; CV=(1; -0.892; 0)		"T and G" n. of subjects: 14		"T only" n. of subjects: 17
Sample period	1974-98		1977-98		1977-98
Dependent	ΔT_t	ΔG_t	ΔT_t^E	ΔG_t^E	ΔT_t^E
const					0.158 (2.77)**
ΔT_{t-1}^E			-0.203 (-3.34)**		
ΔT_{t-2}^E			-0.145 (-4.33)***		
ΔG_{t-1}^E				-0.151 (-2.69)**	
ΔG_{t-2}^E					
ΔT_{t-1}			0.705 (9.58)***		0.359 (5.02)***
ΔT_{t-2}			0.279 (3.59)***		
ΔT_{t-3}					
ΔT_{t-4}					
ΔG_{t-1}			-0.155 (-3.55)***	0.541 (6.47)***	0.133 (4.35)***
ΔG_{t-2}				0.220 (3.04)**	
ΔG_{t-3}		0.587 (3.77)***			
ΔG_{t-4}					
$_{\text{ECM}}TG$	-0.155 (-3.53)***		-0.111 (-5.67)***		
$_{\text{ECM}}TT^E$			-0.629 (-9.09)***		-0.853 (-17.10)***
$_{\text{ECM}}GG^E$				0.659 (-9.52)***	
d_{EXP} (not incl.)					
d_{CONTR} (not incl.)					
adj. R^2	0.09	0.33	0.83	0.71	0.84

Legend: k= var order; r= rank; CV= cointegration vector (T ;G; const);
*, **, *** denote, in the order, 5%, 1%, 0.1% significance level

A.10 Summary Netherlands

	Field		Lab. - Treatments:		
	k=2; r=1;		"T and G"		"T only"
	CV=(1; -0.606; -17.630)		n. of subjects: 13		n. of subjects: 11
Sample period	1970-98		1977-98		1977-98
Dependent	ΔT_t	ΔG_t	ΔT_t^E	ΔG_t^E	ΔT_t^E
const				0.170 (2.73)**	0.281 (5.23)*
ΔT_{t-1}^E			-0.165 (-4.11)***		-0.112 (-3.35)***
ΔT_{t-2}^E					
ΔG_{t-1}^E			0.122 (3.55)****		
ΔG_{t-2}^E					
ΔT_{t-1}			0.402 (5.59)***		0.301 (3.23)**
ΔT_{t-2}					
ΔT_{t-3}					
ΔT_{t-4}					
ΔG_{t-1}	0.368 (2.91)**	0.478 (2.78)**		0.534 (8.52)***	0.175 (4.05)**
ΔG_{t-2}					
ΔG_{t-3}					
ΔG_{t-4}					
$_{\text{ECM}}TG$	-0.622 (-2.27)*				
$_{\text{ECM}}TT^E$			-0.516 (-9.09)***		-0.795 (-9.88)***
$_{\text{ECM}}GG^E$				-0.628 (-11.39)***	
d_{EXP} (not incl.)					
d_{CONTR} (not incl.)					
adj. R^2	0.32	0.22	0.77	0.77	0.88

Legend: k= var order; r= rank; CV= cointegration vector (T ;G; const);
*, **, *** denote, in the order, 5%, 1%, 0.1% significance level

A.11 Summary Norway

	Field		Lab. - Treatments:		
	k=2; r=1;		"T and G"		"T only"
	CV=(1; -1.051; 0)		n. of subjects: 15		n. of subjects: 16
Sample period	1970-98		1977-98		1977-98
Dependent	ΔT_t	ΔG_t	ΔT_t^E	ΔG_t^E	ΔT_t^E
const				0.345	
				(3.87)***	
ΔT_{t-1}^E			-0.063	-0.190	
			(-2.01)*	(-2.29)*	
ΔT_{t-2}^E				-0.218	
				(-3.32)*	
ΔG_{t-1}^E				-0.108	
				(-2.42)*	
ΔG_{t-2}^E					
ΔT_{t-1}		-0.461	0.469		0.388
		(-1.97)*	(6.37)***		(6.43)***
ΔT_{t-2}					
ΔT_{t-3}					
ΔT_{t-4}					
ΔG_{t-1}		0.489		0.605	0.164
		(3.09)**		(7.11)***	(7.49)***
ΔG_{t-2}					
ΔG_{t-3}					
ΔG_{t-4}					
$_{\text{ECM}}TG$		0.308		0.093	
		(3.79)***		(2.44)*	
$_{\text{ECM}}TT^E$			-0.669	0.156	-0.731
			(-10.42)***	(1.99)*	(-15.32)***
$_{\text{ECM}}GG^E$				-0.651	
				(-9.40)***	
d_{EXP} '91-92					
d_{CONTR} '94-96					
adj. R^2	-	0.40	0.81	0.77	0.81

Legend: k= var order; r= rank; CV= cointegration vector (T ;G; const);
*, **, *** denote, in the order, 5%, 1%, 0.1% significance level

A.12 Summary Portugal

	Field		Lab. - Treatments:		
	k=3; r=1; CV=(1; -1.177; 13.667))		"T and G" n. of subjects: 10		"T only" n. of subjects: 13
Sample period	1970-98		1977-98		1977-98
Dependent	ΔT_t	ΔG_t	ΔT_t^E	ΔG_t^E	ΔT_t^E
const			0.833 (5.50)***		0.176 (2.24)***
ΔT_{t-1}^E			-0.121 (-2.20)*		-0.173 (3.05)
ΔT_{t-2}^E					
ΔG_{t-1}^E				-0.266 (-3.87)***	
ΔG_{t-2}^E					
ΔT_{t-1}		-0.591 (-2.62)*	0.354 (2.93)**		0.407 (4.25)***
ΔT_{t-2}	-0.436 (-2.36)*	-0.481 (-2.67)*			0.161 (2.23)*
ΔT_{t-3}					
ΔT_{t-4}					
ΔG_{t-1}	0.297 (4.14)***	0.375 (3.99)***	0.147 (5.49)***	0.543 (5.99)***	0.081 (6.53)***
ΔG_{t-2}	0.168 (2.77)**	0.374 (5.30)***	0.059 (2.08)*	0.159 (2.07)*	
ΔG_{t-3}					
ΔG_{t-4}					
$_{\text{ECM}}TG$	0.288 (3.59)***	0.666 (6.58)***		0.321 (3.69)***	
$_{\text{ECM}}TT^E$			-0.673 (-8.24)***	0.420 (3.31)**	-0.758 (-9.05)***
$_{\text{ECM}}GG^E$				-0.497 (-6.23)***	
d_{EXP} (not incl.)					
d_{CONTR} (not incl.)					
dum80		-12.294 (-12.62)***			
adj. R^2	0.25	0.94	0.64	0.60	0.81

Legend: k= var order; r= rank; CV= cointegration vector (T ;G; const);
*, **, *** denote, in the order, 5%, 1%, 0.1% significance level

A.13 Summary Spain

	Field		Lab. - Treatments:		
	k=2; r=0; no CV		"T and G" n. of subjects: 14		"T only" n. of subjects: 13
Sample period	1970-98		1977-98		1977-98
Dependent	ΔT_t	ΔG_t	ΔT_t^E	ΔG_t^E	ΔT_t^E
const	0.654 (3.80)***	0.704 (2.68)**	0.391 (5.91)***		0.179 (2.82)**
ΔT_{t-1}^E					-0.165 (-4.41)***
ΔT_{t-2}^E					-0.072 (-2.28)*
ΔG_{t-1}^E					
ΔG_{t-2}^E				-0.085 (-2.51)*	
ΔT_{t-1}			0.524 (6.54)***		0.687 (7.40)***
ΔT_{t-2}					
ΔT_{t-3}					
ΔT_{t-4}					
ΔG_{t-1}			0.113 (2.64)**	0.772 (10.83)***	0.186 (5.15)***
ΔG_{t-2}					
ΔG_{t-3}					
ΔG_{t-4}					
$_{\text{ECM}}TG$					
$_{\text{ECM}}TT^E$			-0.904 (-16.39)***		-0.542 (-7.79)***
$_{\text{ECM}}GG^E$			0.077 (2.54)*	-0.624 (-11.39)***	
d_{EXP} '81-82					
d_{CONTR} '96-97					
adj. R^2	-	-	0.83	0.74	0.83

Legend: k= var order; r= rank; CV= cointegration vector (T ;G; const);
*, **, *** denote, in the order, 5%, 1%, 0.1% significance level

A.14 Summary Sweden

	Field		Lab. - Treatments:		
	k=2; r=0;		"T and G"		"T only"
	CV=(1; -0.950; 0)		n. of subjects: 17		n. of subjects: 14
Sample period	1970-98		1977-98		1977-98
Dependent	ΔT_t	ΔG_t	ΔT_t^E	ΔG_t^E	ΔT_t^E
const			0.223 (3.21)**		
ΔT_{t-1}^E					-0.074 (-2.48)*
ΔT_{t-2}^E					
ΔG_{t-1}^E				-0.092 (-2.32)*	
ΔG_{t-2}^E					
ΔT_{t-1}		-0.553 (-2.32)*	0.360 (5.35)***		0.539 (7.35)***
ΔT_{t-2}					
ΔT_{t-3}					
ΔT_{t-4}					
ΔG_{t-1}		0.423 (2.69)**		0.590 (8.15)***	0.134 (5.30)***
ΔG_{t-2}					
ΔG_{t-3}					
ΔG_{t-4}					
$_{\text{ECM}}TG$		0.276 (3.30)***		0.080 (3.87)***	
$_{\text{ECM}}TT^E$			-0.786 (-15.58)***		-0.671 (-10.21)***
$_{\text{ECM}}GG^E$				-0.750 (-11.01)***	
d_{EXP} '78-79; '91-93					
d_{CONTR} '83-84; '86-87; '94-96					0.387 (2.84)**
adj. R^2	-	0.35	0.73	0.77	0.86

Legend: k= var order; r= rank; CV= cointegration vector (T ;G; const);
*, **, *** denote, in the order, 5%, 1%, 0.1% significance level

A.15 Summary UK

	Field		Lab. - Treatments:		
	k=2; r=0; CV=(1; -0.922; 0)		"T and G" n. of subjects: 15		"T only" n. of subjects: 16
Sample period	1972-97		1977-95		1977-95
Dependent	ΔT_t	ΔG_t	ΔT^E_t	ΔG^E_t	ΔT^E_t
const			0.229 (4.80)***		0.180 (4.09)***
ΔT^E_{t-1}				-0.117 (-2.33)*	-0.096 (-2.37)*
ΔT^E_{t-2}					
ΔG^E_{t-1}					
ΔG^E_{t-2}					
ΔT_{t-1}			0.467 (6.91)***	0.276 (2.43)*	0.546 (6.37)***
ΔT_{t-2}					
ΔT_{t-3}					
ΔT_{t-4}					
ΔG_{t-1}		0.385 (2.33)*		0.591 (8.37)*	0.094 (2.96)**
ΔG_{t-2}					
ΔG_{t-3}					
ΔG_{t-4}					
$_{\text{ECM}}TG$		0.435 (2.98)**	-0.068 (-2.14)*		-0.070 (-2.69)**
$_{\text{ECM}}TT^E$			-0.770 (-13.97)***	0.289 (3.06)**	-0.785 (-10.36)***
$_{\text{ECM}}GG^E$				-0.726 (-12.28)***	
d_{EXP} '92-93			-0.778 (-3.12)**		
d_{CONTR} (not incl.)					
adj. R^2	-	0.34	0.83	0.84	0.85

Legend: k= var order; r= rank; CV= cointegration vector (T ;G; const);
*, **, *** denote, in the order, 5%, 1%, 0.1% significance level

B Instructions to the experiment

1. Please read the instructions carefully. Only if you have understood them well you can successfully participate in the experiment and gain money.

2. **Thereafter** fill in the questionnaire at the screen.

Welcome to the strategy experiment

Welcome to the strategy experiment

This strategy experiment is financed by the University of Mannheim and the German research council.

The instructions are simple, and if you carefully pay attention to it and decide deliberately, you will win a considerable amount of money, which is disbursed to you at the end of the game.

The payment is dependent on your success. In the experiment you forecast the development of public expenditures and taxation in several European countries. For that purpose there are past data about budget debt, annual change of budget debt, government expenditure and taxes made available for you. Dependent on the quality of your forecast you receive a payment for each period.

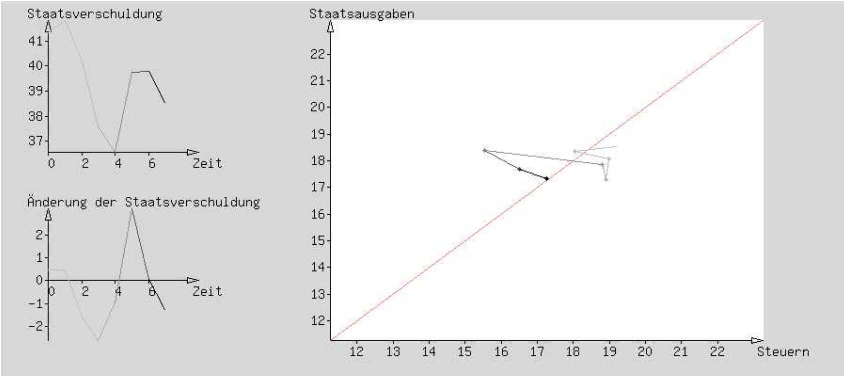
Please note that we do not have any interest in paying less money than you are entitled to. We must return all the money, which we do not disburse to you, to the German research council.

Please note that we will not deceive you in this experiment. Everything you read in these instructions is correct. You may take this for granted, but actually there are occasionally experiments in psychology, where experiment participants are deceived about parts of the experiment. This is not the case in economic experiments like this. In the beginning we explain exactly the rules to you, and we will also adhere to them.

Rules

You will play several rounds in turns. In each round it is your task to forecast the development of two variables. These variables refer to the development of government expenditure and taxes in several European states between 1950 and 2000. Which states you play in each case will be specified randomly and is not made known to you. These data are shown graphically.

Top of the screen

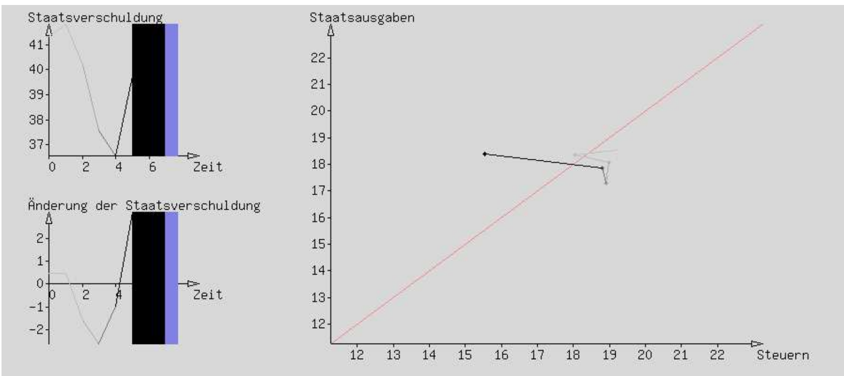


On the left you can see the development of the budget debt and annual change of budget debt, each in per cent of the gross national product. The horizontal axis shows time in years. You may use this data to obtain a reference point how government expenditure and taxes will change in the future. Current periods are shown in black, past periods are shown in gray.

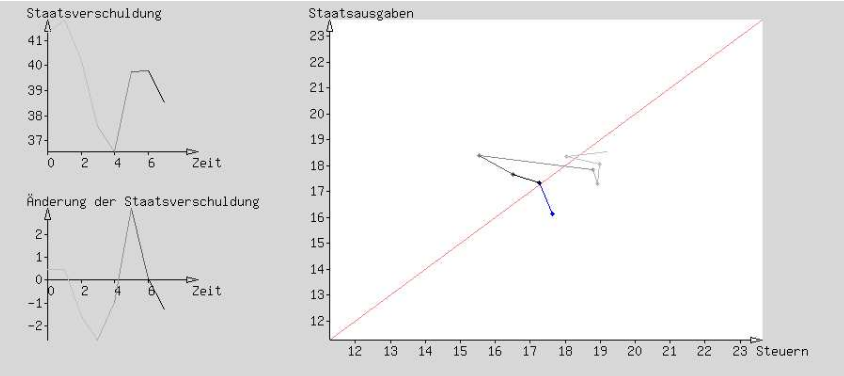
On the right you can see the government expenditure and taxes, again as percentage share of the gross national product. The vertical axis shows government expenditure, the horizontal axis shows taxes. Government expenditure is higher than taxes above the red diagonal; below, government expenditure is lower than taxes. Past periods are shown in a lighter shade of gray than current periods.

Partial representation of the past development You can present yourself also only one part of the past periods to get a better overview.

In order to do so click on the diagrams budget debt and annual change of budget debt. In these diagrams the range to the right of your click is covered black. Also in the diagram of government expenditure and taxes the covered periods are not shown. Each click onto the black range of the diagrams budget debt and annual change of budget debt uncovers one period after another. A click on the blue range uncovers all periods.



Forecasts In order to make a forecast about the development of government expenditure and taxes, click onto the white range. Your forecast is shown in blue.



If you are content with your forecast, please confirm it by clicking on confirm forecast. If you want to correct your forecast, please click on delete forecast.

Payment Given your forecast the computer determines a consumption decision, which would be optimal for a person who lives in the period. From your consumption-decisions you derive a certain utility. This utility is compared with the utility you would have obtained if you had forecasted the true future development of taxes and government expenditure.

You receive a wage of 0.45€ per minute for a correct forecast. Worse forecasts result in smaller wages.

It is worth to spend some time to make a good forecast. Example: You need 2 minutes in order to make a very good forecast and therefore receive wages of 0.45€ per minute. Your income in the 2 minutes is thus 0.90€.

Another person, who makes forecasts for e.g. 4 periods in these 2 minutes, which are not so good, may only receive a wage of 0.10€ per minute for each forecast. The income of this person in the 2 minutes is thus only 0.20€.

You should settle your forecast within 2 minutes. If you need more time for a forecast, you are paid only for the first 2 minutes.

A warning on the left side will remind you, as soon as you need more than 2 minutes.

Furthermore you get a list about the income of your past forecasts on the left side.

Duration of the experiment The experiment takes 90 minutes, regardless whether you made many or few forecasts in this time. That requires, however, that you take yourself at least 20 seconds time for each forecast on the average. If you take yourself less time, you are finished with the experiment sooner, but earn fewer money, accordingly.

Should you have any questions, you now have the opportunity to ask them. In addition, you can ask questions at any time during the experiment.

Appendix to the instructions

To determine your payoff we use the following model. **It is not necessary to understand this model to participate successfully in the experiment.** The model is shown only in case you want to control us.

In two subsequent periods you consume c_0 and c_1 and pay taxes t_0, t_1. You save the remaining part:

$$s_i = 1 - c_i - t_i \tag{10}$$

Your total income in each period is $Y = 1$ (note that all values are relative to the gross domestic product Y).

We call government expenditure g_i. Then your utility in two subsequent periods is

$$u = \sum_{i=0}^{1} \gamma c_i + (1-\gamma) g_i \tag{11}$$

In your case $\gamma = 0.75$.

Your budget restriction is

$$\sum_{i=0}^{1} s_i \cdot (1+r)^i = 0 \tag{12}$$

with an interest rate $r = 0.1$.

Based on your forecast for t_1 and g_1 we determine your optimal consumption c_0.

In the next period t_1 und g_1 are realised. Your actual consumption c_1, and, hence, your utility u, follows from the budget restriction. This utility is compared with the utility u^* that you could have obtained with the correct forecast for t_1 and g_1. Your wage is $(u/u^*)^\eta$. In your case $\eta = 12000$. This normalisation does not change your utility maximisation problem.

Nr.	Author	Title
03-04	Oliver Kirchkamp Rosemarie Nagel	No imitation - on local and group interaction, learning and reciprocity in prisoners´dilemma experiments
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03-02	Peter Albrecht	Risk Based Capital Allocation
03-01	Peter Albrecht	Risk Measures
02-51	Peter Albrecht Ivica Dus Raimond Maurer Ulla Ruckpaul	Cost Average-Effekt: Fakt oder Mythos?
02-50	Thomas Langer Niels Nauhauser	Zur Bedeutung von Cost-Average-Effekten bei Einzahlungsplänen und Portefeuilleumschichtungen
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Nr.	Author	Title
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Nr.	Author	Title
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Nr.	Author	Title
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