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THE "EXPECTATIONS VIEW" ON FISCAL POLICY AN EXPERIMENT USING REAL WORLD DATA

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The "Expectations view" on fiscal policy
An experiment using real world data

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First outline

Abstract

To understand the effect of fiscal policy on the private sector we have to comprehend how expectations about fiscal variables are formed. However, little is known about the way people form expectations about fiscal variables: no undercutting theory exists, not to say empirical evidence. The problem is that "expectations are unobservable" (Bertola and Drazen [BD93, p.16]).

We generate observable expectations using a combination of laboratory experiments and real world data from several European countries. Based upon these observable expectations we develop a model of formation of expectations. We fit real world data and study the effect of fiscal policies. We show that we can study the relationship between private consumption and government consumption.

JEL: C91, D89, E62, H31

Keywords: Fiscal expectations, experiments, Antikeynesian

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1 Introduction

There is an overgrowing resurgence of interest in the macroeconomic literature concerning the effects of fiscal policy on the private sector. Under profound reexamination is in particular the Keynesian perspective of a set of simple relationships between public sector budgeting and economic activity, like for example the idea that a cut in government deficit will depress private consumption and output. A first serious attack against this textbook approach came in the early eighties from the German Council of Economic Experts [Sac81], expressing what came to be known as the "German view" on fiscal policy (see Fels and Froelich [FF86], and Hellwig and Neumann [HN87]). Very broadly, that was the view that a fiscal contraction may be expansionary, rather than contractionary, through the benign impact it may generate on expectations, when in particular the contraction is understood by the public as to signal lower taxation in the future.

Subsequent developments of this idea, to constitute a body of theories expressing a more articulated "Expectations view", came in the nineties through the contribution of several authors, including Blanchard [Bla90], Drazen [Dra90], Bertola and Drazen [BD93], Sutherland [Sut97] and Perotti [Per99], among others, whose purpose was to shed light on the circumstances and conditions under which Antikeynesian effects, also referred to as non-linear effects of fiscal policy, are more likely or less likely to occur. In Section 2 we will provide a review of this literature, focusing in particular on Bertola and Drazen's [BD93] and Sutherland's [Sut97] contributions, which together offer a clear-cutting perspective on the view.

Anticipating briefly, Bertola and Drazen [BD93] develop a model in which government spending follows an upwards stochastic process with positive drift, which infinitely living consumers expect to be sharply cut when it reaches a critical level, though the exact critical level is not known. Under such fiscal framework, Bertola and Drazen show that with rational expectations a simple optimising consumers' behaviour gives rise to a variety of responses to the dynamics of government spending, including some consistent with the Antikeynesian view. Sutherland [Sut97] proposes a complementary model, which concentrates on the effect of government debt in an environment with consumers with a finite lifetime. In the model, debt evolves stochastically and consumers expect that when the ratio of public debt to income reaches a threshold, it will trigger a major stabilisation. The model predicts that when the level of debt is low, fiscal policy has the standard "Keynesian" effect, with more taxes depressing private consumption. Vice versa, when public debt is high and near the threshold, a moderate increase in taxation may be perceived by the current generation as a relief from a major stabilisation within their lifetime, and therefore it may stimulate private consumption.

Parallel to the theoretical literature, and in many respects anticipating and corroborating its developments, several fiscal episodes contradicting conventional wisdom were brought to the attention of the profession during the 1990's by various investigations: these include the now classic paper by Giavazzi and Pagano [GP90] focusing on the astonishing expansionary fiscal consolidations experienced by Denmark and Ireland in the mid 1980's; the study of the same authors [GP96] on the symmetric Swedish experience in the early 1990's; and a number of other analyses which documented the evidence of Antikeynesian effects, which apparently happened in other European as well as non-European countries (see e.g. Alesina and Perotti [AP96]; Alesina and Ardagna [AA98]; Perotti [Per99]; and Giavazzi, Jappelli and Pagano[GJP00]). Besides to the experiences of Denmark and Ireland, which between 1983-87 and 1987-89, respectively, corrected the cyclical adjusted deficit, mainly through public expenditure cuts, by respectively 9.5 and 7.2 percent of GDP relative to the year before the consolidation, and notwithstanding experienced a cumulative increase in private consumption by 17,8% in Denmark and 14,5% in Ireland, other major episodes of expansionary consolidations have been documented, in particular, for Belgium between 1983 and 1989, Portugal in 1984-86, Sweden in 1983-89, Canada in 1986-88, and Italy in 1989-92 (see e.g. Alesina and Perotti [AP96]). Minor episodes have been also reported for other well-developed countries, including Germany (1981-83), U.K. (1981-82, 1989-90, and 1994-96), Australia (1986-88), Austria (1995-96), among others; and, more recently, also for developing countries (see Giavazzi, Jappelli and Pagano[GJP00]).

Besides to confirm that fiscal policy may indeed generate non-linear effects, the empirical literature also helped dissecting the circumstances in which either standard or Antikeynesian effects are more likely to occur: Non-linear effects seem to be associated with the size and the persistence of the fiscal impulse (Giavazzi and Pagano [GP96], and Giavazzi, Jappelli and Pagano [GJP00]); also the composition of the fiscal adjustments seems to be important (see e.g. Alesina and Ardagna [AA98]), with cuts in public sector wages and social security benefits being apparently more effective for the occurrence of expansionary fiscal consolidation than tax increases, though less agreed are the reasons why that should be so; even less clear is the importance of the public debt, with Perotti [Per99] finding that a high or rapidly growing public debt is positively correlated with non-linear effects, while Giavazzi, Jappelli and Pagano [GJP00] rejecting such association.

Unfortunately we do not find a clear link between evidence and theory yet, in particular when it comes to the role expectations play in the various fiscal episodes investigated. That is hardly surprising, given that economists typically rely on observable data, while expectations are unobservable. The standard approach in these cases, also pursued by the empirical studies quoted above, is to empirically investigate predicted relations between observable variables, like relationships between fiscal variables and output components, generally private consumption, and from there to infer the effect which unobservables might have played.

Given, however, the central role that expectations play in the "Expectations view" on fiscal policy, we believe that something more is requested here to evaluate the theory. In this paper we aim to contribute to three issues.

First of all, we provide a method to obtain observable expectations, which is based on laboratory experiments. We use field fiscal data from several European countries, including those where the most impressive Antikeynesian episodes were observed, to generate and register subjects' expectations for future fiscal variables. Participants in the experiment are exposed to graphical representations of time series of fiscal variables for a given period and country on a computer screen. Subjects, which are not aware of the exact period or country, then describe graphically their expectations for taxes and/or public expenditure for the next year. Given these expectations the experimental software computes the optimal decision and, based on actual realisations of taxes and/or public expenditure in the next year, communicates payoff to the subjects. Optimal decision and payoffs are based on a simple overlapping generation economy. Then the economy moves on, fiscal variables are updated to the next period, and subjects describe expectation for the subsequent year. This goes on for about 15 to 20 years, to obtain a series of expectations for each subject and country. In this way we recall many series of expectations for various countries and several participants. A more detailed account of the experimental setup and of the whole procedure is given in Section 3.

With these observed expectations we develop an empirical model of formation of expectations, which can then be used to study the effect of fiscal policy and the validity of the predictions and implications of the "expectation view". In Section 4, we give a first overview of the results, which are currently under more careful investigations.

Even from this starting scrutiny, however, three interesting features emerge from the experiment: first of all, our subjects appear to follow some form of "rational" rule in their process of formation of expectations — which is a key premise for the "expectation view" — since we find that subjects outperform a trend extrapolating forecaster efficiently using the information on the whole set of fiscal variables available to them; second, we find a a surprisingly good correlation between the effects of fiscal policy on private consumption in the field and in the laboratory, and particularly for those countries and those periods which have most often be considered as manifestations of Antikeynesian effects, giving in this way some independent support for the "expectation view"; more generally, the evidence seems quite supportive for the whole idea of combining real world data with data from laboratory experiments. We will briefly consider the methodological and philosophical implications of this idea in a concluding Section 5.

2 The "Expectation view"

2.1 Background

During the eighties the so called "German school" (Fels and Froelich [FF86], and Hellwig and Neumann [HN87]) advanced the idea that expectations about changes in future fiscal policy may abruptly affect the result of current fiscal policy conduct. Later, during the nineties[1], two of the most articulated expositions of the "Expectation view" on fiscal policy stem from Bertola and Drazen [BD93] and Sutherland [Sut97]. Bertola and Drazen build on an uninformal discussion of Drazen [Dra90] and Giavazzi and Pagano [GP90]. Sutherland elaborates on Blanchard [Bla90] also commenting Giavazzi and Pagano.

2.2 A common framework

Both approaches can be reviewed with the help of a general and simple structure: A non-monetary small economy where fiscal policy follows a known stochastic process and facing a perfect world capital market. The typical consumer choice's problem can generally be written as:

$$\max \int_t^{\infty} e^{-(r-\theta)(z-t)} E_t \left\{ u(C_z) \right\} dz \tag{1}$$

where C is consumption of a single homogenous good; $E_t\{\cdot\}$ denotes the expectations operator conditional on information available at time t; r is the consumer's rate of time preference and also the world interest rate on bonds; θ is a Poisson death rate of individuals. When θ is 0, the

[1] There is also an earlier theoretical literature, developing from the classic Sargent and Wallace [SW81] and including also contributions by Drazen and Helpman [DH90], which studies the possibility of counterintuive macroeconomic dynamics arising due to expectations of future taxes in face of current unsustainable fiscal policies. The interest for that earlier literature, however, is on the inflation rate rather than output and private consumption.

approach reduces to an infinitely living agent model; when instead $\theta > 0$, the approach turns into the overlapping generations structure proposed by Blanchard [Bla85].

The consumer's budget constraint is written as:

$$\int_t^\infty (C_z + \tau_z - Y)e^{-r(z-t)}dz \leq A_t \tag{2}$$

where $\{\tau_t\}$ is the process of taxes net of transfer payments to consumers (τ_t can be negative in the case of net positive transfer payments); Y is the income assumed to be constant; and A_t are total private assets, which may include claims on both foreigners and on the government.

Under stochastic fiscal policy, and assuming that utility is quadratic in C, the following general expression for optimal consumption is derived:

$$C_t = Y + (r+\theta)\left[A_t - \int_t^\infty E_t\{\tau_z\}e^{-(r+\theta)(z-t)}dz\right] \tag{3}$$

The dynamics of private consumption to fiscal policy, hence, depends on: the exact structure of the utility function considered, i.e. whether a finite or infinite horizon model is considered; the actual fiscal policy stochastic process; and, at least in principle, the process of expectations formation, though both Bertola and Drazen [BD93] as well as Sutherland [Sut97] assume rational expectations.

2.3 The Bertola and Drazen (1993) model

Bertola and Drazen [BD93] consider an infinite horizon model, i.e. $\theta = 0$; without transfer payments from the government to consumers, that is $\{\tau_t\}$ is the process of taxes alone; and with government consumption $\{G_t\}$ not entering the consumer's utility function and following a stochastic process specified below. Giving the intertemporal budget constraints,

$$\int_t^\infty \tau_z e^{-r(z-t)}dz = B_t + \int_t^\infty G_z e^{-r(z-t)}dz \tag{4}$$

equation (3) for the optimal consumption then turns into:

$$C_t = Y + r(A_t - B_t) - r\int_t^\infty E_t\{G_z\}e^{-r(z-t)}dz \tag{5}$$

or, expressing everything in terms of ratios to GDP:

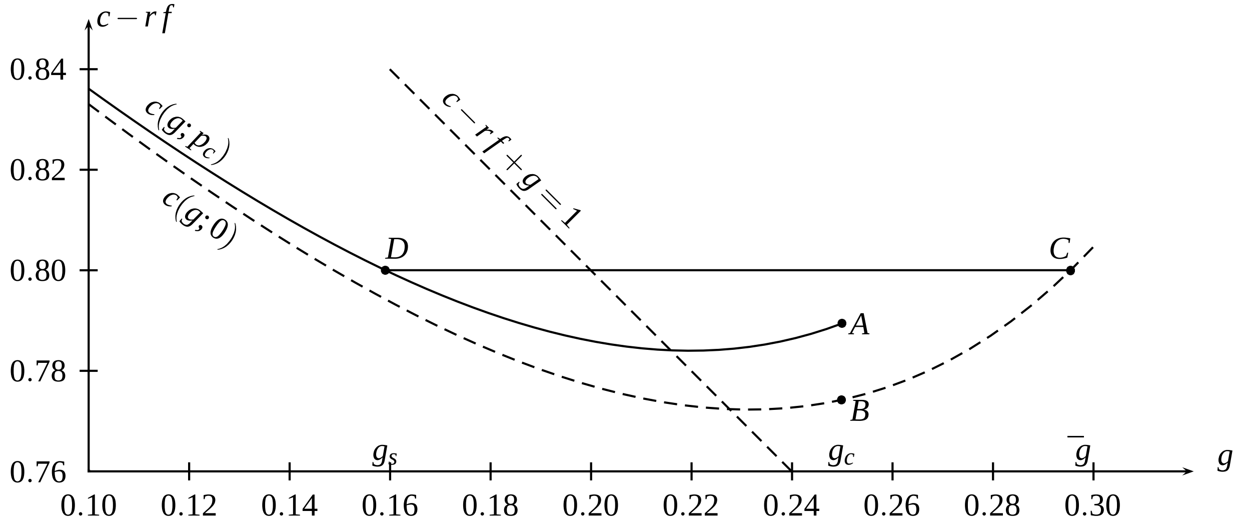
$$c_t = 1 + rf_t - r\int_t^\infty E_t\{g_z\}e^{-r(z-t)}dz \tag{6}$$

where f_t is the ratio of net foreign assets $(A_t - B_t)$ to GDP.

Using this basic model, Bertola and Drazen focus on government spending and assume that it follows a Brownian-motion with positive drift, which would be unsustainable without discrete adjustments. The ratio of government spending to output, g_t, follows the random walk

$$dg_t = \vartheta dt + \sigma dWt \tag{7}$$

where $\{W_t\}$ is a standard Wiener process and ϑ is a positive drift, which is thought to express, on the one side, the idea that governments tend to expand public expenditure whenever they can,



Parameters: $r = 0.05, \sigma = 0.006, \vartheta = 0.0045, p_c = 0.5, f = 0$

Figure 1: The relationship between private consumption and public expenditure in Bertola and Drazen's model, see [BD93, p. 19]

but, on the other side, also implying that fiscal policy becomes unsustainable without a discrete intervention. Given that political agreements to realize fiscal consolidations are often delayed due to the conflicts typically arising about the distribution of costs imposed by the adjustments, an idea formerly developed by Alesina and Drazen [AD91] and receiving increasingly credit[2], the latter are modelled by Bertola and Drazen under the assumption that the dynamics of public expenditure in equation 7 jumps downwards discontinuously only when it reaches excessively high levels. Whenever g_t hits a very high level $\bar{g}$ a stabilisation will be triggered with certainty, dropping g_t to an initial, lower level g_s. In addition, they assume that a stabilisation may also occur with some common-knowledge probability p at a lower level $g_c < \bar{g}$.

Assuming rational expectations in equation 6, Bertola and Drazen then show how the above model generates interesting dynamics for the relationships between private consumption and public expenditure. These can nicely be illustrated with the help of figure 1, which is based on Bertola and Drazen [BD93, p. 19][3]. In the figure, the dashed line $c + rf + g = 1$ is the benchmark case of perfect Ricardian equivalence, where a change in g is exactly matched by a one to one offsetting change in c. The solid curve $c(g; p_c)$ is the dynamics of optimal consumption as predicted by the present model. The main points to notice are the following. At low values of g, private consumption c falls less than dollar for dollar with increases in g; until public expenditure remains lower than the first possible consolidation level is reached at g_c (point A in the figure), the crowding out effect decreases as g increases. Very close to the possible stabilisation

[2] See in particular Alesina and Perotti [AP95] for a thorough review of the theoretical and empirical literature explaining why and when governments are more likely to departure from optimal tax smoothing policy.

[3] The diagram is drawn assuming $r = 0.05$, $\sigma = 0.006$, $\vartheta = 0.0045$, $p_c = 0.5$ and $f = 0$. Regarding the assumption of constant net foreign assets $(f = 0)$, Bertola and Drazen note that theoretically f_t is indeed a function of realized g_t. They, however, also notice that the dynamics of optimal consumption is not qualitatively affected by considering or not considering net foreigners claims.

point A, private consumption may even increase together with public expenditure. The intuition is that in this region increases in g increase the probability of a spending cut in the near future and thus decreases future expected taxes. As noted by Bertola and Drazen, it is interesting to note how this Keynesian implication (at least for the part in which there is incomplete crowding out) can arise in this model, despite its very neoclassical structure. At point A the stabilisation may occur or not. If it does, private consumption jumps up to point D, where of course the discrete increase in c is less than the cut in g, reflecting that the stabilisation was partially anticipated. If the stabilisation doesn't take place, first there is a discrete fall in c (point B in the figure), because g_c was clearly miss-perceived as stabilisation point. The economy is now on the lower dashed curve $c(g;0)$ which corresponds to the case where a discrete cut in g only takes place when the extreme value $\bar{g}$ is reached (point C in the figure). At the certain stabilisation point C, public expenditure drops to point D, without having any effect on c, since the cut was fully anticipated.

As noted, the focus of Bertola and Drazen for the relationships between private consumption and public expenditure was motivated by the desire to explain various observed and somehow unexpected characteristics of the effect of fiscal policy. First of all they notice that most European as well as non-European countries were characterised during the early and mid seventies, by an inverse relationship between c and g for low values of g, which progressively flattened out as g was increasingly rising during the late seventies and early eighties. That is a prediction of the model, consistent with the $c(g;p)$-path above point A. As anticipated in the introduction, one of the main point was also to show how it happened that in mid-eighties some countries, most notably Denmark (between 1983 and 1986) and Ireland (1987-89)[4], but also others including Belgium (1984-87), Portugal (1984-86), Sweden (1983-89), realized drastic fiscal consolidations, mainly (but not only) in the form of public expenditure cuts, which had quite expansionary effects, also on private consumption. This class of "Antikeynesian" effects is also consistent with the prediction of the theory, in particular for the part of the $c(g;p)$-path below point B. As a further observation, they also pointed out that before the big successful adjustment between 1987-89, in 1982 Ireland made a first stabilisation attempt, this first time, however, by increasing taxes rather than cutting expenditure. One of the main consequence was a big fall in private consumption, as indeed predicted by a standard Keynesian perspective. Bertola and Drazen suggest a different explanation based on their model: At the time a cut in public expenditure was expected but did not materialise. Therefore consumption dropped, which in the model corresponds to the fall in c from point A to B in figure 1.

2.4 The Sutherland (1997) model

Other types of Antikeynesian effects may arise due to the response of private consumption to the dynamics of public debt, rather than public expenditure; not for that matter, the expansionary fiscal consolidations alluded to above and described in the literature (see e.g. Giavazzi, Jappelli and Pagano [GJP00], and others quoted there) have been realized only via expenditure cuts and not also tax increases.

Within the general structure outlined above, Sutherland's [Sut97] model focuses specifically on the dynamics of debt, rather than on government spending, and abstracts away from any

[4] See Giavazzi and Pagano [GP90].

consideration of public expenditure G_t, while fiscal policy takes the form of transfer payments from or to the consumers. More specifically, fiscal policy in normal times can be represented by the dynamics of public debt, which is governed by the following expression:

$$dB_t = rB_t dt + \tau_t \tag{8}$$

where, given the absence of G_t, transfer payments τ_t also correspond to primary deficit. The stochastic elements is introduced into the model via τ_t, which follows the Wiener process

$$\tau_t = \sigma dW_t \tag{9}$$

where W is a standard Wiener process and σ is a scaling parameter.

Given equations 8 and 9 alone, fiscal policy would be unsustainable. Government solvency is, hence, ensured assuming discrete stabilisation programs. These are motivated as a consequence of a "game of attrition" between rival political groups (Alesina and Drazen [AD91]) and are, hence, implemented only when the debt level B reaches extreme values. U and L denote upper and lower crisis levels of B. At U, a lump sum tax of size T is imposed on consumers, bringing B to $U-T$; while at L, a transfer to consumer is imposed, which increases B to $L+T$.

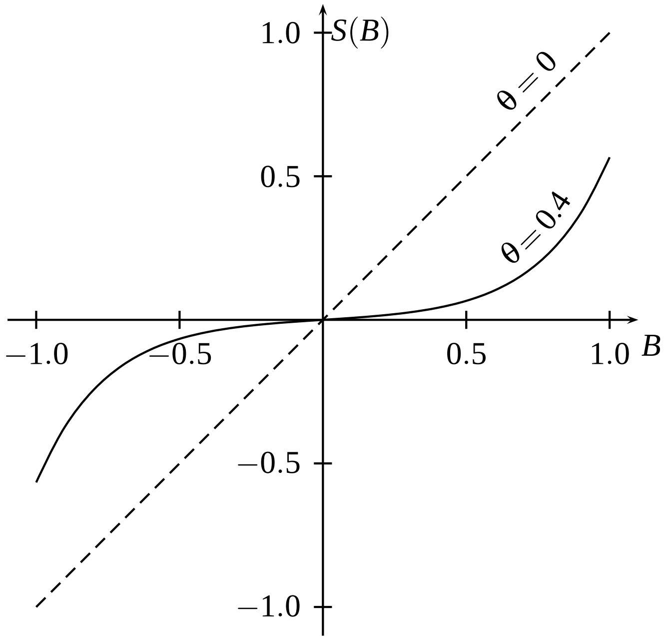
Giving this fiscal environment, optimal consumption in equation 3 turns into:

$$C_t = Y + (r+\theta)\left[A_t - \int_t^{\infty} E_t\left\{\delta_t T\right\} e^{-(r+\theta)(z-t)} dz\right] \tag{10}$$

where δ_t is a function taking the value $+1/dt$ when a crisis reduction in debt takes place, $-1/dt$ when a crisis increase in debt takes place and zero all other times. Thus, in this model the consumer eats all his flow endowment plus the interest income on assets net of the present value of expected future taxes; while the effects of fiscal policy on private consumption depend on the value of the latter variable:

$$S = \int_t^{\infty} E_t\left\{\delta_t T\right\} e^{-(r+\theta)(z-t)} dz \tag{11}$$

The relationships between the stock of debt B and expected future taxes $S(B)$ is qualitatively as shown in Figure 2, which is based on Sutherland [Sut97, p. 156]. The dashed 45° line is the case of Ricardian equivalence which corresponds to $\theta = 0$ in the model (i.e. the case of infinitely long living consumers), so that the discounted value of future expected taxes S is equal to the stock B of public debt. When $\theta > 0$ the value of S depends on the time and the expected sign of next stabilisation program. Sutherland [Sut97, p. 154] shows that: a) the closer the stock of debt B is to the trigger point, the shorter is the expected hitting time; b) likewise, the sign of the next stabilisation is stochastic, but the relative probability attached to hitting each trigger point depends on the relative distance between B and U and L. A fiscal transfer which takes place when B is close to half way between the two trigger points level U and L (that is when B is close to 0 in Figure 2), has less than a one to one effect on expected future taxes; when, one the other hand, B is very close to the trigger point, there is more than a one for one effect. Thus, a positive change in B, that is a fiscal deficit, when B is low (in absolute value) produces the traditional Keynesian result; while the same change when B is close to U or L generates a fall in consumption and, symmetrically, a reduction in fiscal deficit an increase in consumption. And this is the main Antikeynesian result of the model. Contrary to Bertola and Drazen, the structure



Parameters are $r = 0.02, \sigma = 0.2, L = -1, U = 1, T = 0.5$

Figure 2: The relationship between public debt and expected future taxes in Sutherland's model (see [Sut97, p. 159]).

underlying Sutherland's model is Keynesian, due to overlapping generations; the possibility of fiscal crisis and discrete stabilisations, however, produces departures from this standard situation, since they may alter the intertemporal distribution of taxation between generations: a moderate increase in taxation near the trigger points produces an Antikeynesian effect because it makes less likely that a big stabilisation will fall on the current generation.

The model presented has other interesting features, discussed by Sutherland [Sut97]. The first is that the strength and the region of Antikeynesian effects depends on the size of the stabilisation program, represented by the size of the lump sum T: the lower T, the weaker is the strength and the smaller the region of the Antikeynesian effects. That follows since with small T the tax distribution among generations becomes more equal and, thus, the non-linear effect in the model smaller. At the limit, when T approaches 0, stabilisation programs have only the effect of neutralising a current crisis debt. In such limiting case, fiscal policy has the standard Keynesian effect for all levels of B within the region $L - U$, and only becomes powerless at the trigger points themselves.

An other aspect worthwhile noticing is that in this model the realisation of a stabilisation program has no effect on private consumption since they are fully anticipated when actually realized. One can, however, have more complex dynamics, for example introducing the idea of possible intermediate stabilisation (as in Bertola and Drazen [BD93]), or when stabilisation taxes are unequally distributed across the population alive at the time a stabilisation program is implemented (as discussed in Blanchard [Bla95]).

Both Sutherland's [Sut97] and Bertola and Drazen's [BD93] fiscal environments can be made richer and other potential sources of Antikeynesian effect can be considered, for example those due to distortionary taxation as discussed by Blanchard [Bla90] and others since (including Bertola and Drazen [BD93]). Miller, Skildesky and Weller [MSW90] also discuss a model able to capture some aspects of the Antikeynesian perspective. More recently, Perotti [Per99] presents a model in which fiscal policy has standard effects at low debt-income ratio level and Antikeynesian features at high level (as in Sutherland [Sut97]), though in his model such non-linearities are not due to large discontinuities in fiscal policy and expectations at trigger points, but to distortionary taxation and credit constraints.

In the current paper we focus on the complementary treatment of public expenditure and debt in Bertola and Drazen's [BD93] and Sutherland's [Sut97] environments since these are less structured, hence more suitable for experimental investigation, still maintaining all and more of the essence of the "expectation view" on fiscal policy.

3 The Experimental Setup

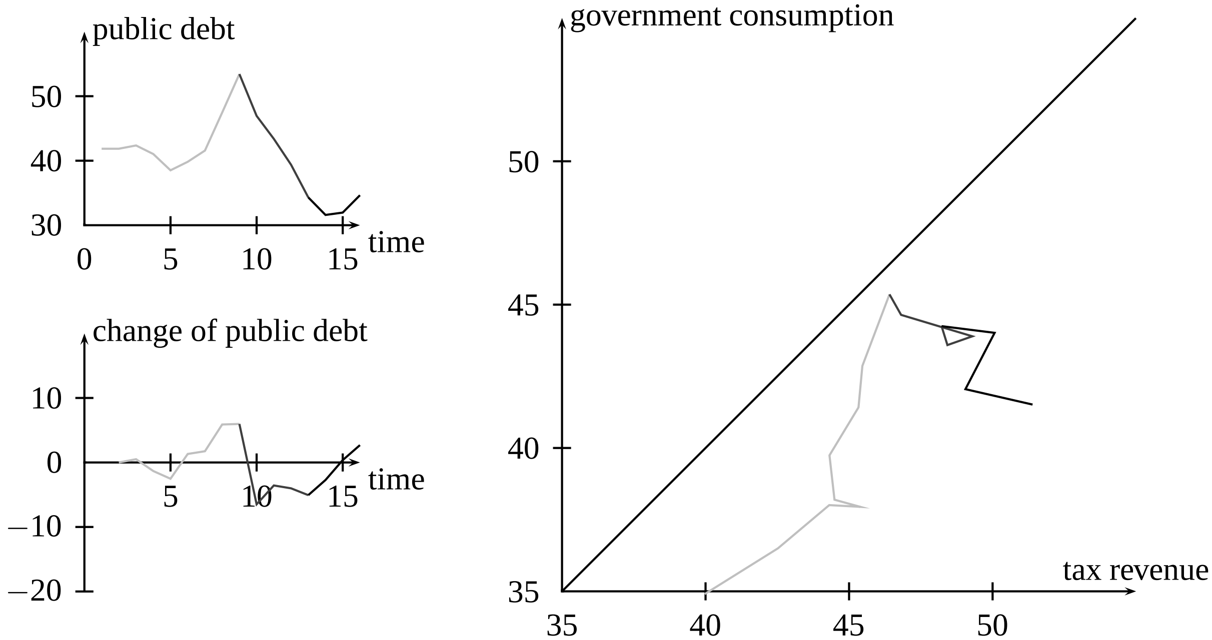
How could we identify a model and its parameters (rational) subjects use to form expectations? There are at least three obvious approaches that we could use:

- We could try to use only field data on G, T, B, and C and introduce some hypothesis that allows us to link subjects' expectations and C. However, such an attempt is likely to fail since the sample of field data is very small and the impact of other factors on C is considerable and correlated for all members of the economy.

- Alternatively we could generate data for G, T, B and C in the laboratory. But how can we model the process that generates G, T and B in the laboratory? Explaining subjects that these data follow a Brownian motion might be too demanding. Alternatively G, T and B could be determined by some participants playing government. In this case we had to define a utility function for a government which did not seem to be an easy problem to solve.

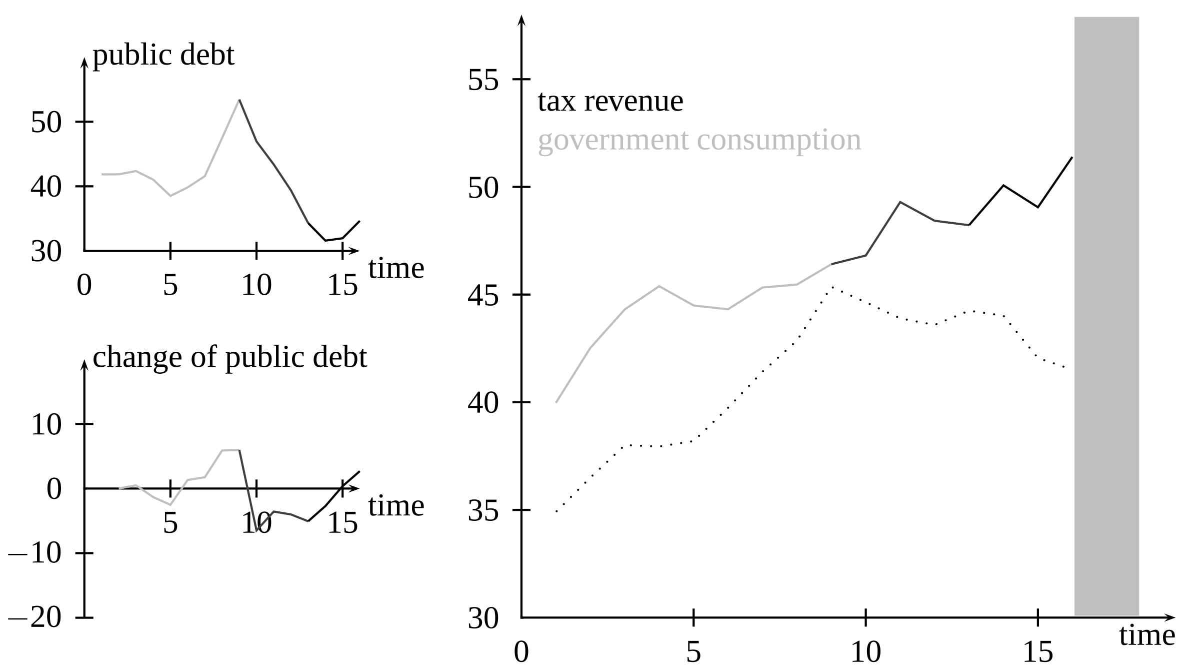
- We therefore decided to combine data from the field with data from the laboratory. We use field data on G, T and B as a stimulus to generate C in the laboratory. This avoids the problem of pure lab experiments, namely that G, T and B are artificially generated and incomprehensible for participants. This approach also avoids the problem of pure field studies, namely that expectations are unobservable and consumption is affected by noise which, in the field, is highly correlated for all members of the same economy.

Subjects are exposed to time series of $B, \Delta B, T$ and G. The representation to participants in the laboratory is shown in figure 3 or figure 4. The data is from various European countries (Values are % of GDP). In our experiment we vary two parameters of the experimental setups. One parameter is the type of forecasts. Some participants make forecasts for G and T simultaneously (see figure 3), others make forecasts for T only (as in figure 4). The second parameter is the type of data: net or gross. In the net condition participants are consistently confronted with values for public consumption G and taxes net of transfers T; in the gross condition the two variables consistently stand for total current public expenditure and total taxes. Subjects know



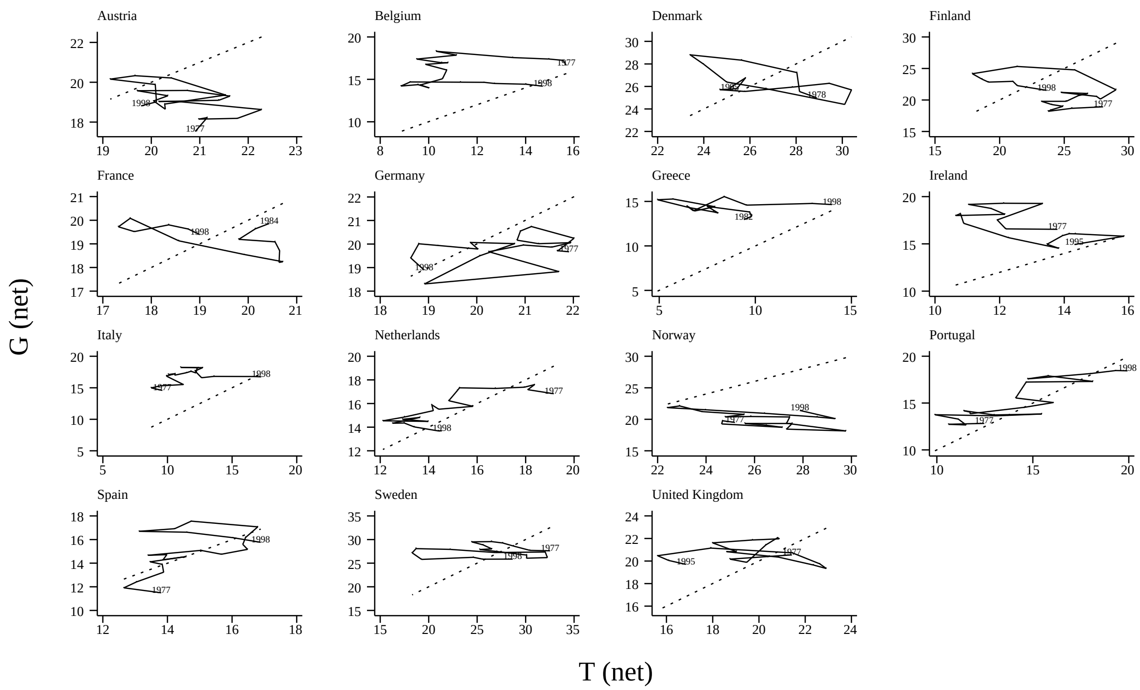
Values are given as percentage of GDP. Gray lines indicate past, black lines indicate recent years.

Figure 3: Treatment: forecasts for T and G



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

Figure 4: Treatment: forecasts for T only



Part of the 'stimulus data' (subjects did not know the country or the year, however, in addition to T and G they also knew B and ΔB).

Figure 5: Stimulus data (as G over T)

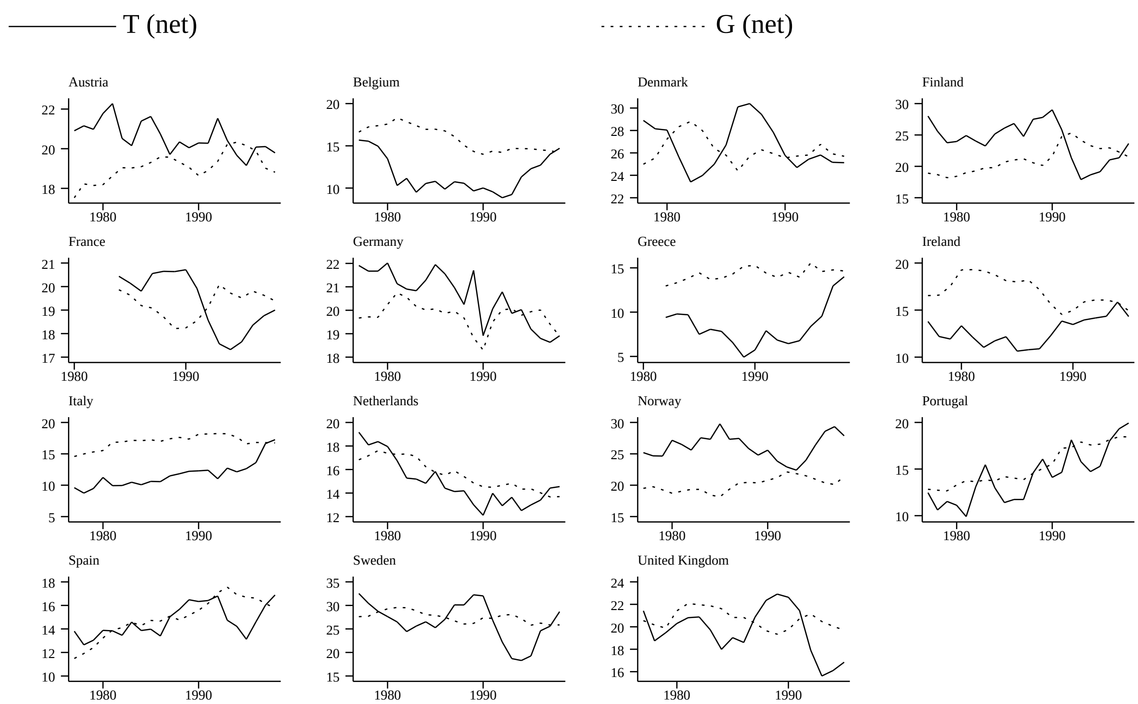
which of the two conditions they are in. We decided to use both conditions for two reasons: first, to introduce more variability in the data; second, to test whether or not subjects follow different expectations formation processes when facing gross or net data.

Table 1 summarises the number of participants in the respective conditions. To ease the

	gross	net
forecasts for T and G	27	28
forecasts for T only	28	27

Table 1: Number of participants

comparison of our results with the literature we will in the following only report results of the net-treatment. A summary of the stimulus data for the different countries is shown in figures 5 and 6



Part of the 'stimulus data' (subjects did not know the country or the year, however, in addition to T and G they also knew B and ΔB).

Figure 6: Stimulus data (as G and T over t)

3.1 Payoffs in the experiment

Subjects derive utility from consumption of two subsequent periods

$$u_t = \prod_{i=t}^{t+1} \gamma C_i + (1-\gamma) G_i \qquad \text{with } \gamma = \begin{cases} 1 & \text{net} \\ 0.75 & \text{gross} \end{cases} \tag{12}$$

subject to the budget constraint

$$\sum_{i=t}^{t+1} \underbrace{(1 - C_i - T_i)}_{\text{savings}} \cdot (1+r)^{i-t} = 0 \qquad \text{with } r = 0.1\,. \tag{13}$$

In each period t subjects make forecasts (by clicking with the mouse) for $\hat{T}_{t+1}$ and $\hat{G}_{t+1}$ or only for $\hat{T}_{t+1}$ depending on the treatment. Given this forecast the computer then determines an optimal consumption level C_t for the current period given equations 12 and 13 (When forecasts are made for T_{t+1} only, the computer assumes that $G_{t+1} = G_t$. This assumption is also maintained when payoffs are calculated in period $t+1$). In period $t+1$ then T_{t+1} and G_{t+1} realize and are communicated to the participant. The computer uses equation 13 to determine C_{t+1} and then uses equation 12 to calculate the participant's utility for period t. The participant's per minute wage is

$$w = 0.66 \cdot (u_t/u_t^*)^\eta \text{ where } \eta = \begin{cases} 15000 & T \text{ forecasts} \\ 12000 & T \text{ and } G \text{ forecasts} \end{cases} \tag{14}$$

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 forecasts only the first two minutes are payed. We have introduced this payment scheme to simultaneously encourage participants to think about their forecasts, but also to remain active.

The experiment was run in the experimental laboratory of the SFB 504 in Mannheim in December 2000. All 110 participants spent about 2 hours in the laboratory. On average they made 157 forecasts per participant. Each forecast took them on average 44 seconds to complete.

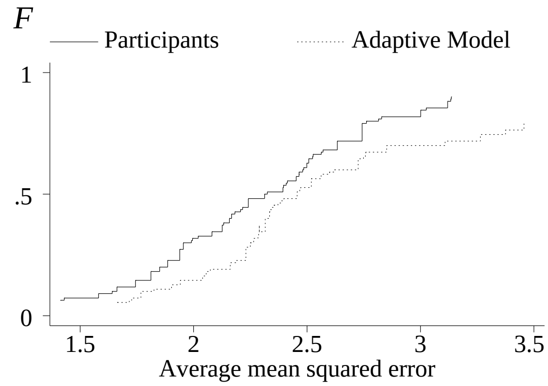
4 Results

4.1 Evidence o n expectations

For the presentation of the results we will proceed in three steps: First we will motivate that subjects are doing more than simply extrapolating trends. To do this, we construct as a reference case a simple 'adaptive model'.

$$\hat{T}_{t+1} = \hat{\beta}_0 + \hat{\beta}_1 T_t + \hat{\beta}_2 T_{t-1} \tag{15}$$

We imagine a hypothetical participant who feeds the data that is already visible on the screen into an OLS-regression and uses the estimated model to predict the value of T for the next



MSE of adaptive model (dotted line) is larger than MSE of participants forecast (solid line)

Figure 7: Cumulative distribution of mean squared errors.

period. This hypothetical participant extrapolates trends in an adaptive, but efficient way. For each participant we calculate the mean squared error between the prediction of the above model $\hat{T}_{t+1}$ and the true value T_{t+1}. Further we calculate for each participant the mean squared error between the actual prediction of the participant $\tilde{T}_{t+1}$ and the true value T_{t+1}. Figure 7 shows cumulative distributions of the adaptive model (dotted line) and of the actual forecasts (solid line).[5]. We find that on average the mean squared error of the adaptive model is significantly[6] larger than the mean squared error of the participants' actual forecasts. In the next section we will see that participants deviate in a very reasonable way from the adaptive model. To do that we explain the difference $\tilde{T}_{t+1} - \hat{T}_{t+1}$ between the participants forecasts $\tilde{T}_{t+1}$ and the adaptive model $\hat{T}_{t+1}$ as a linear function of the difference $T_{t+1} - \hat{T}_{t+1}$ between the true value T_{t+1} and the adaptive model $\hat{T}_{t+1}$.

$$(\tilde{T}_{t+1} - \hat{T}_{t+1}) = \beta \cdot (T_{t+1} - \hat{T}_{t+1}) + u \tag{16}$$

The value of β is estimated for each participant separately. The forecasts of a participant with $\beta = 0$ would be centered around the adaptive model. Forecasts of a participant with $\beta = 1$ would rather be centered around the true value of T_{t+1}.

Figure 8 shows that indeed most participants deviate from the adaptive model into the direction of the correct value of T_{t+1}. Our interpretation is that participants use more information than the adaptive model, e.g. information on B or G. To some degree they might indeed have rational expectations.

[5]The adaptive model is the same for each participant. However, participants play different sets of countries. Therefore also the mean squared error of the adaptive model differs among participants.

[6]A paired t-test finds $t = 4.6747$ and $P > |t| = 0.0000$.

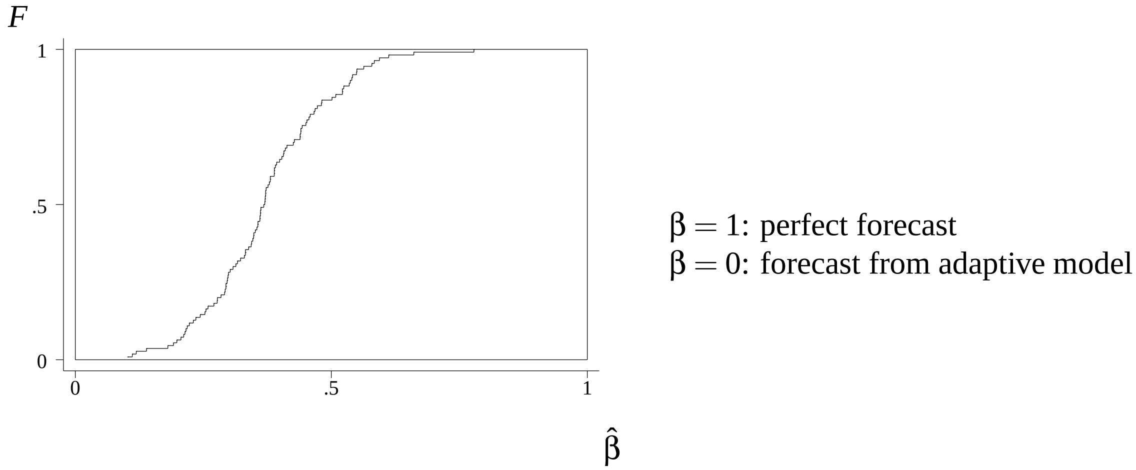


Figure 8: Participants deviate from adaptive model into the right direction.

4.2 Impact of B_t and G_t on ΔT_{t+1} and ΔG_{t+1}

Now that we have found in section 4.1 that participants seem to do more than simply extrapolating trends we will try do shed some light on determinants for their forecasts in this section. To do that we estimate the following four equations:

$$\Delta T_{t+1} = \beta_B^T B_t + \beta_G^T G_t + c \tag{17}$$
$$\Delta \tilde{T}_{t+1} = \beta_B^{\tilde{T}} B_t + \beta_G^{\tilde{T}} G_t + c \tag{18}$$
$$\Delta G_{t+1} = \beta_B^G B_t + \beta_G^G G_t + c \tag{19}$$
$$\Delta \tilde{G}_{t+1} = \beta_B^{\tilde{G}} B_t + \beta_G^{\tilde{G}} G_t + c \tag{20}$$

Figure 9 shows cumulative distributions for the estimated coefficients. The field values are $\Delta T_{t+1} = T_{t+1} - T_t$ and $\Delta G_{t+1} = G_{t+1} - G_t$, the laboratory values are $\Delta \tilde{T}_{t+1} = \tilde{T}_{t+1} - \tilde{T}_t$ and $\Delta \tilde{G}_{t+1} = \tilde{G}_{t+1} - \tilde{G}_t$. We notice in particular that while the relationship for the field values is sometime unclear, positive for some countries and negative for others, it is much clearer in the laboratory data.

Consistent with Sutherland's [Sut97] model we find that both in the field data as well as in the laboratory data an increase in public debt B yields on average to an increase in taxation T and to a decrease in government consumption G.

The impact of G_t on ΔT_{t+1} is ambiguous in the country data. In four countries from the sample T is more likely to increase when G is low, in ten other countries T is more likely to decrease in this situation. A possible interpretation in terms of Bertola and Drazen's [BD93] model could be the following: At the beginning of the cycle where the level of G is relatively low (with respect to trigger points) an increase in G means higher taxes. The point of consolidation is too far away to become relevant. Closer to the end of the cycle, where the level of G is high and close to the trigger point, an increase in G makes budget cuts and, thus, a decrease in taxes,

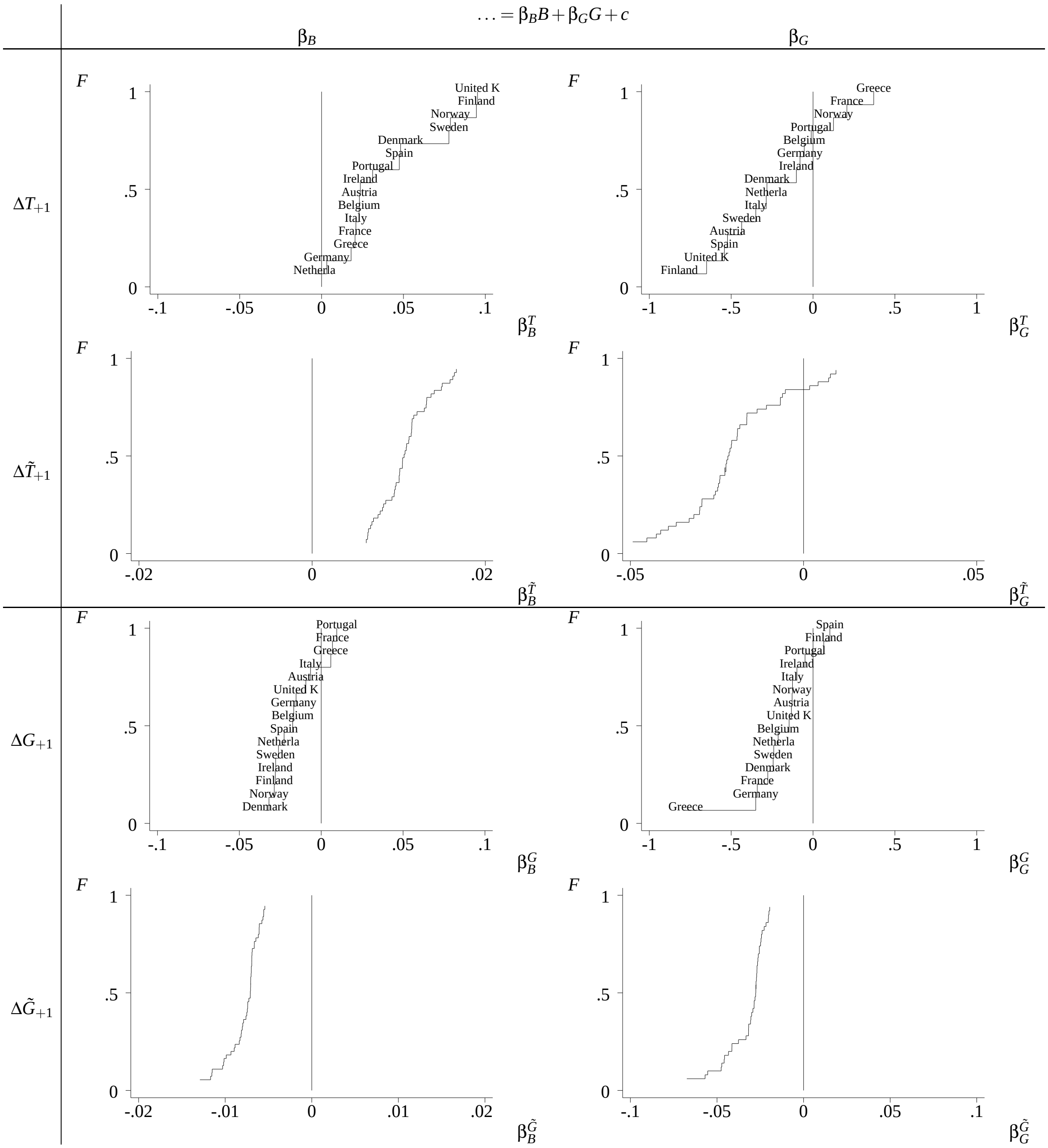


Figure 9: Impact of G and G on fiscal expectations

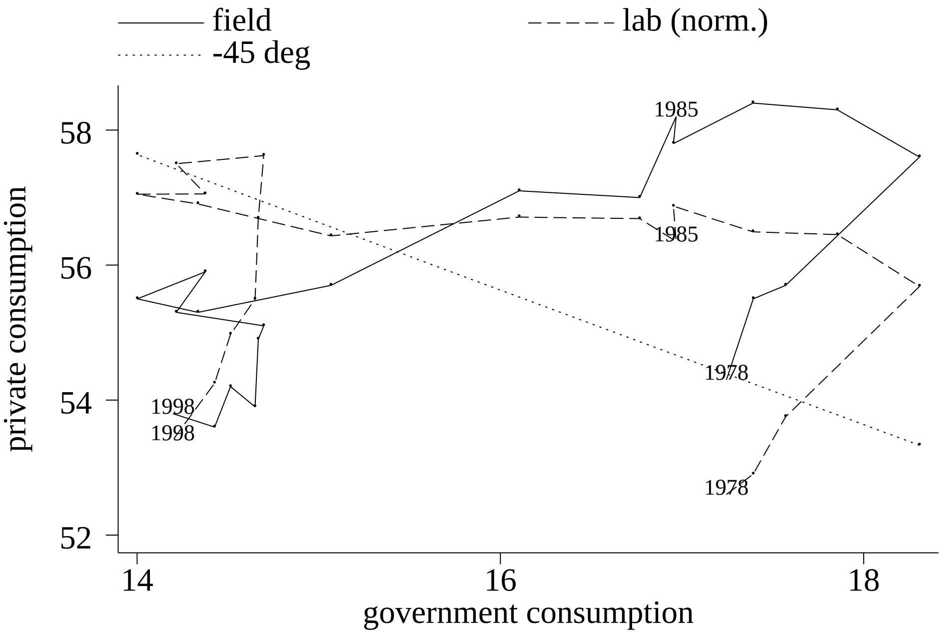


Figure 10: Consumption in the field and in the laboratory for Belgium

more likely. For the time period that we are considering most countries seem to be in the latter situation.

4.3 Compare consumption in the field with lab

In section 4.2 above we have studied the relation between current levels of B and G and expected changes in T and G. The levels of T and G are, however, not what we are primarily interested in. More crucial is the level of consumption C.

While it would be possible to derive from expectations over T and G an implied consumption pattern we can more easily take the consumption levels from the laboratory right away. As described above the consumption levels in the laboratory are determined through equations 12 and 13. One level for the period where the forecast is made (let us call this level C^0) and another level for the period when forecasted values realize and consumption for the next period is determined (let us call this level C^1). In the underlying overlapping generations model two types of consumers are present in each period. Young consumers were born at t, made a forecast at t, and now consume C_t^0. Old consumers were born at $t-1$, made a forecast in this period, and consume their remaining C_{t-1}^1. In the following we will use the mean of these two values as the value for laboratory consumption.

$$C_t^{\text{lab}} = \frac{1}{2} \cdot (C_t^0 + C_{t-1}^1) \qquad (21)$$

These consumption levels are consistently higher than those in the field. A main reason is that our subjects have a short planning horizon of only two periods which is substantially shorter that

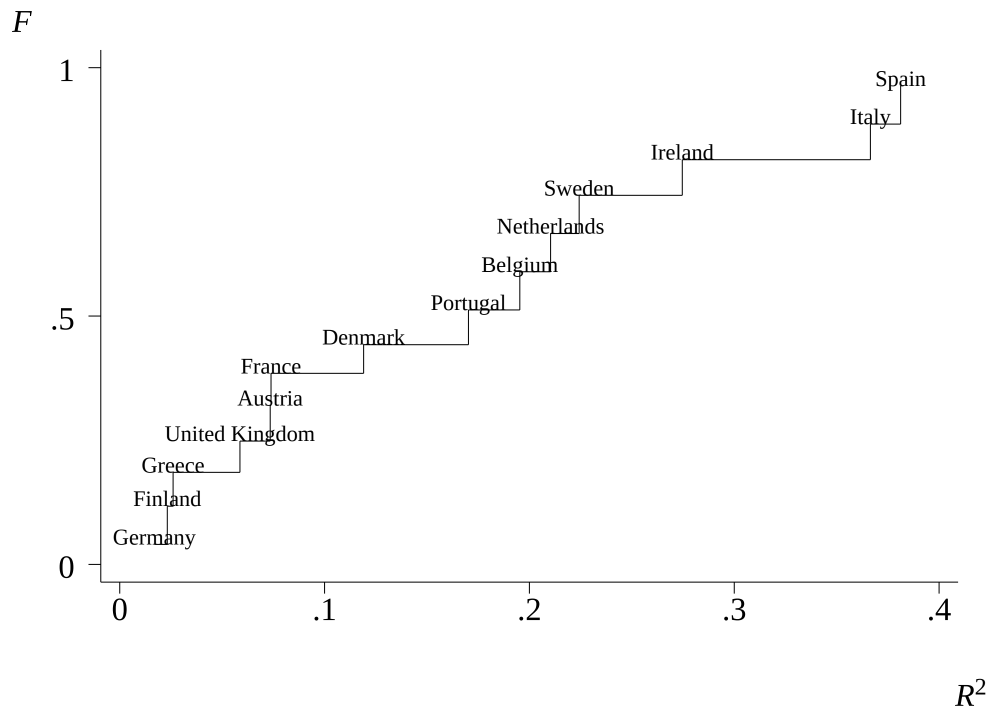


Figure 11: Cumulative distribution of correlation between consumption in the field and in the lab

the one of most real world agents. Also precautionary savings in face of the uncertainty about fiscal policy do not play a role in the experiment, since optimal consumption is automatically computed in the experiment from point expectations[7]. Further, our experimental economy does not consider the demand for investment (intended and unintended) and exports. Finally the experimental utility function that drives experimental consumption was never calibrated to fit real consumption behaviour. Given all these caveats it should be clear that we do not aim to compare the exact level of consumption in the laboratory with that in the field, but to study how the two move in response to the same changes in fiscal policy. In order to ease this comparison, C_t^{lab} is normalised using a linear transformation such that it has the same mean and standard deviation as consumption in the field C_t^{field}. This transformation is the same for all participants but is done separately for each country.

The consumption levels that we have derived in this way are surprisingly similar to consumption levels in the field. Figure 10 compares for Belgium the consumption level in the field (dark line) with the average consumption level given subjects expectations in the laboratory (dashed line). While there is no perfect coincidence, patterns of consumption seem to be very similar. This is even more surprising if we take into account that the laboratory consumption pattern is derived only using a very simple two-period utility function (equation 12). Correlation is good also for most other countries. Figure 11 shows the cumulative distribution of correlation

[7] Bernasconi and Kirchkamp [BK00] find that in experiments when subjects can make both expectations (in the case concerning monetary, rather than fiscal policy) and saving decisions they make precautionary savings too.

coefficients for all countries from our sample. For most countries laboratory consumption can explain a considerable amount of the variance in the field consumption.

We now estimate the impact of changes in government consumption ΔG on changes in private consumption ΔC. The two models that we discussed in sections 2.3 and 2.4 assume different kinds of impacts. Sutherland's model (see section 2.4) assumes that the interaction between ΔG and public debt B plays a crucial role. The model of Bertola and Drazen (see section 2.3) stipulates the same for the interaction between ΔG and government consumption G. We will tackle these two approaches one by one. In the left column of figure 12 we show

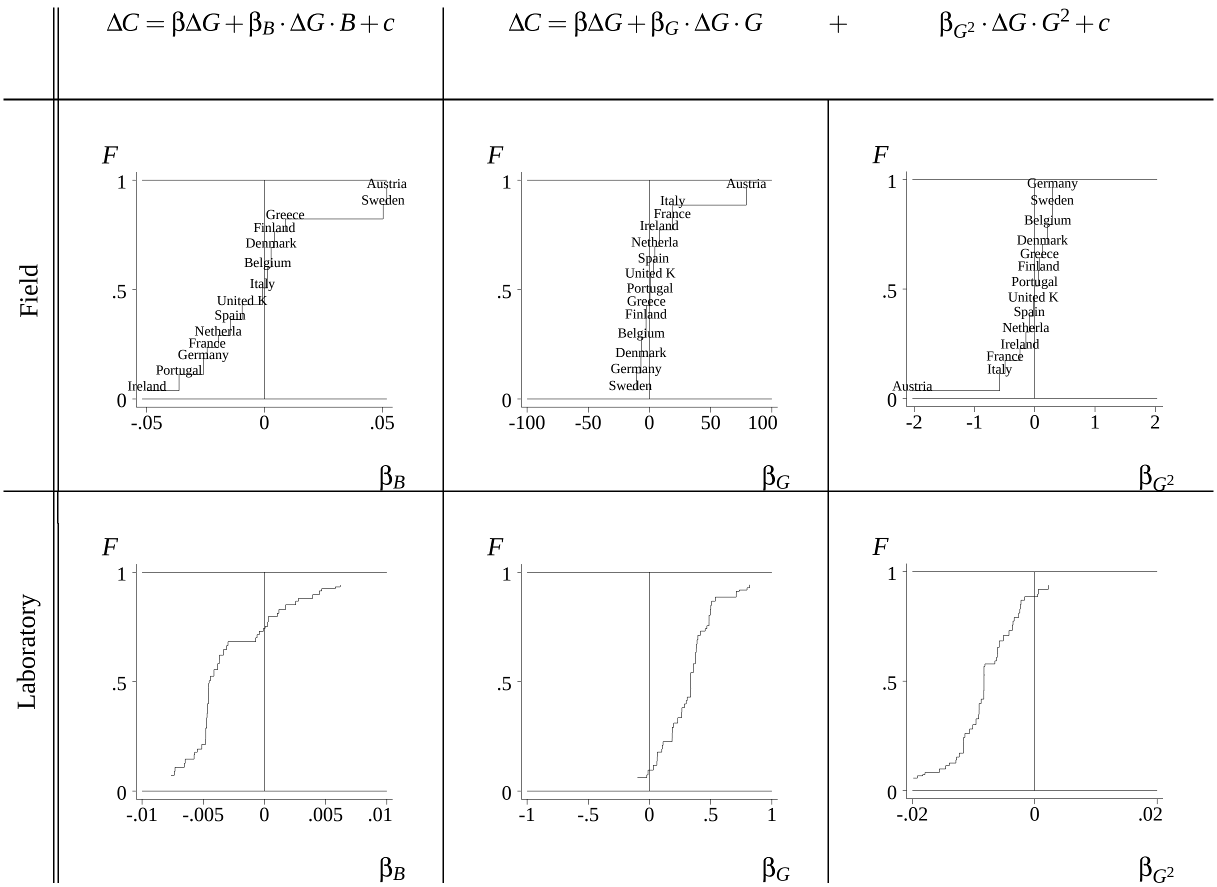


Figure 12: Consumption and public debt

results of estimating the equation

$$\Delta C_{t+1} = \beta \Delta G_t + \beta_B \cdot \Delta G_t B + c\,. \tag{22}$$

When discussing Sutherland's model we are interested in the interaction between ΔG_t and B. The prediction following the model would be that the estimate for β_B is negative. The higher public debt, the more private consumption will be reduced by a further increase in government consumption. From the field data we can not confirm this hypothesis. The top left graph shows the cumulative distribution of β_B for the field data. In about half the countries β_B is negative as predicted, in the other half it is positive. The field data, apparently, does not lend much support to Sutherland's model. The data that we gathered in the laboratory (lower left graph) seems to be more consistent with the theory. About 70% of all participants have indeed a β_B which is negative.

When discussing Bertola and Drazen's model the interaction between ΔG_t and G_t matters. The model predicts that for smaller levels of G_t an increase in G_t may even yield an increase in consumption, whereas for larger levels of G_t the effect should be the opposite. To capture this relation we therefore estimate a quadratic model.

$$\Delta C_{t+1} = \beta \Delta G_t + \beta_G \cdot \Delta G_t G + \beta_{G^2} \cdot \Delta G_t G^2 + c\,. \tag{23}$$

The middle and right columns from figure 12 show cumulative distributions for β_G and β_{G^2} respectively. As in the discussion of Sutherland's model the field data is inconclusive. The laboratory data, however, is much more consistent with the model. More than 90% percent of all participants have a positive β_G and also more than 90% have a negative β_{G^2}.

We find, hence, that Bertola and Drazen's model seems to fit with the expectations of a much larger share of participants of our experiments than Sutherland's model. We do not, however, want to be taken too literally. The methods that we have applied here are crude, and, further, many more models are conceivable. What we wanted to show here is that the laboratory data can be used to distinguish with more precision among models of fiscal expectation than field data can.

5 Concluding remarks on experiments with real world data

The results presented in the previous section are clearly preliminary, but we believe quite encouraging. In a first step we found that participants in our experiment deviate consistently from trend extrapolation into the right direction.

In a second step we have tried to derive properties of
a simple expectations formation model. As a general result properties of our laboratory data are more clear than properties of field data. In a third step we found it possible to compare experimental consumption with consumption in the field. It makes, thus, sense to measure the impact of government consumption or public debt on private consumption. Since in the laboratory we can rule out any other than these two factors, such a comparison is also much more easily done in the laboratory than in the field. We found some support for Sutherland's [Sut97] model but much better support for Bertola and Drazen's [BD93] model. We are currently conducting a more careful scrutiny of the expectations made by our subjects, with particular attention to the fiscal episodes more often referred to as examples of Antikeynesian effects, so to have some direct evidence on the importance that the "expectations view" on fiscal policy might have actually played in those instances. In addition, we are in a step of specifying a better developed empirical model of expectations formations for our subjects, which could perhaps then also be embedded in the theoretical frameworks of the Bertola and Drazen's [BD93] and Sutherland's [Sut97] models, so to analysed which model better fits real world data.

In addition to the focus and the evidence provided by this study on the specific process of expectations formations concerning fiscal variables, we believe that a more general novelty of our investigation is the idea of complementarily using field and laboratory data to test and shed light on an interesting and important macroeconomic question. 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 field of interests[8]. Very few experiments have instead been conducted in the field of macroeconomics. The reason, perhaps, is precisely that macroeconomists deal with real world questions to a much greater degree than other economists, in the believe that laboratory experiments cannot really answer to 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, make sure that everything else remains the same, and looks at the changes 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 [Bla97])

With this paper, however, we think we have shown (and we are confident we will be more convincing after more careful scrutiny of the results of this experiment) 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 is possible to get evidence on some quite interesting and practically important macroeconomic questions.

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[8] See Alvin Roth's web-page at http://www.economics.harvard.edu/~aroth/alroth.html, and the many references and links provided there, for a thorough and continuous monitoring of the development of the field of experimental economics.

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