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Using structural balance data to test the fiscal theory of the price level: Some international evidence

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Abstract

The fiscal theory of the price level has recently received important attention as an alternative theory of price determination. Empirical tests of the FTPL have been rare, and have undergone forceful criticism by Cochrane [Cochrane, J., 1998. A frictionless view of US inflation. NBER Macroeconomics Annual. MIT Press, pp. 323–384] based on "observational equivalence" arguments.

This paper proposes two extensions to the empirics of the FTPL. First, we apply the methodology initiated by Canzoneri et al. [Canzoneri, M.B., Cumby, R.E., Diba, B.T., 2001. Is the price level determined by the needs of fiscal solvency? American Economic Review 91, 1221–1238] to European data. Second, we use structural balance data, in order to overcome Cochrane's critique. Our conclusion is that for neither country the data support a FTPL interpretation.

JEL classification: E17; E63; H63

Keywords: Fiscal theory of the price level; Fiscal policy; Monetary policy; VAR

1. Introduction

Recent emphasis on inflation targets and monetary policy rules has given considerable weight to central banks as regards inflation determination. Meanwhile, central bank independence seems to testify for the low impact of interactions between fiscal and monetary

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policies. These developments have been rationalized in the context of the new standard monetary policy paradigm, building, as Woodford (2001) argues, on a mix of the following arguments. First, fiscal policy should have no influence on the long-run inflation rate. Fiscal policy may at worst fuel inflation via the future expected monetization of debts (Sargent and Wallace, 1981). Second, Ricardian equivalence should wipe out the real effects of an active fiscal policy. Third, owing to seigniorage being negligible in most developed countries, central bank independence should not be costly to governments.

The emergence of the fiscal theory of the price level (hereafter, FTPL) has however challenged this view. The FTPL indeed provides a theoretical determination of the price level with strong emphasis on the links between monetary and fiscal policies (Leeper, 1991), in both purely flexible and sticky prices frameworks (Woodford, 1995, 1996) and without resorting to seigniorage or monetization arguments. The FTPL links price determination to the government present value budget constraint, i.e. the equality of the public debt with the present discounted value of future expected primary surpluses. The key intuition of the FTPL is that, if current and future fiscal policies are set without concern for sustainability, the general price level will "jump" in order to fulfill the present value budget constraint.

Though the theoretical issues raised by the FTPL are crucial, there have been few attempts to test this theory on empirical grounds so far. A notable exception is Canzoneri et al. (2001) [CCD hereafter], who use a VAR approach to assess the FTPL. They consider that, under a FTPL regime, positive shocks to primary surpluses should raise the public debt to GDP ratio. With US data, CCD show however that positive shocks to the primary surplus provoke a *fall* in the public debt to GDP ratio, which they hence interpret as a rejection of the FTPL. Their methodology was quite severely criticized by Cochrane (1998). He argued that their results may be fully consistent with the prevalence of a FTPL regime, usually called a "non-Ricardian" regime.[1] Basing upon the distinction between the cyclical and structural (or cyclically adjusted) components of the primary surplus, Cochrane provides a *theoretical* set-up in which impulse response functions of the form given in CCD do arise, even though the FTPL prevails. The mechanism operates through a negative correlation between the *innovations* of the components of the primary surplus. Although CCD acknowledged Cochrane's critique, they performed only a limited investigation on this point.

The present paper proposes two extensions to the empirics of the FTPL. First, we apply CCD (2001)'s methodology to the case of the major Euro-area countries (France, Germany, Italy) and the UK. Analyzing the plausibility of a Ricardian regime for individual countries of the Euro area is particularly relevant, since it conditions the ability of the European Central Bank to achieve price stability (see Leeper, 1991 for a theoretical analysis, and Woodford, 1996, for an application to the Euro area). The European Stability and Growth Pact (SGP), enacted in 1997, cannot indeed be assumed to ensure a Ricardian regime.[2] The case of the UK is also worth being investigated. First, the UK has

[1] Conversely, a non-FTPL regime is called a Ricardian regime. Governments are labelled "Ricardian" when they implement policies which are set in accordance with the fulfillment of their present value budget constraint. The terminology on "Ricardian vs. non-Ricardian" governments originates in Aiyagari and Gertler (1985).

[2] First, several Euro-area countries have failed to abide by the 3% of GDP ceiling on public deficit in recent years (Portugal, France, Germany, the Netherlands and Italy). Moreover, it is not clear that the SGP embodies a Ricardian fiscal regime: for instance, bounded public deficits are a pre-requisite for price stability in a "non-Ricardian" fiscal regime; in a "Ricardian" regime, the key element is the feedback behavior leading to the stabilization of public debt rather than that of the public deficit.

experienced various monetary arrangements over the last decades, which may have impinged on the choice of its fiscal regime. Second, the possible prevalence of a "non-Ricardian" regime in this country would have strong implications with respect to his possible entry in the EMU. We also report empirical benchmark results for the USA.

Our second extension consists in incorporating structural balance data into the analysis in order to gain some immunity with respect to Cochrane's critique. We investigate whether, assuming a FTPL regime, the joint structural and cyclical deficit processes are able to produce empirical impulse response functions (IRFs) that would lead to "apparent rejection" of the FTPL. In particular, we extend the scope for Cochrane's argument by allowing for lagged, rather than contemporary, cross-correlations between both components of the primary surplus.

The rest of the paper is organized as follows. Section 2 reviews the macroeconomic implications of the FTPL and the different empirical tests which have been used so far and have invalidated the theory. The controversy between CCD and Cochrane is discussed. The data and methodology used in the paper are presented in Section 3. Section 4 is devoted to empirical results. The main findings are twofold: first, using the methodology of CCD, the FTPL must be rejected in the case of all five countries under study; second, including structural fiscal data to account for Cochrane's insights does not provide support to a FTPL interpretation of the data for France, Germany, Italy and the US. The UK case presents specific results which cannot however fully support the FTPL.

2. Testing the FTPL

2.1. The FTPL: An overview

The FTPL states that the government can exogenously set its real spending and revenue plans, and that the price level will take on the value required to adjust the real value of its contractual nominal debt obligations to ensure government solvency. This theory hence emphasizes that the price level is able to "jump" in relation to the government present value budget constraint and that governments can be labelled "non-Ricardian". Unlike the process developed by Sargent and Wallace (1981), the mechanism underlying the FTPL, while directly linked to the present value budget constraint, does not either hinge on the variation of the monetary aggregates or on the monetization of public debt.[3]

Consider the government flow budget identity:

$$B_{t+1} = (1 + i_t)B_t - S_{t+1}, \tag{1}$$

where B_t is public debt at the end of period t, i_t is the return on public debt, S_t is the net (primary) surplus.

This constraint can be formulated in terms of GDP shares as

$$b_{t+1} = r_t b_t - s_{t+1}, \tag{2}$$

where $b_t = \frac{B_t}{p_t y_t}$, $s_t = \frac{S_t}{p_t y_t}$ and $r_t = (1 + i_t)\frac{p_t y_t}{p_{t+1} y_{t+1}}$, with p_t the price level and y_t real GDP. Thus, $(r_t - 1)$ is approximately equal to the real interest rate less the economic growth rate. For

[3] The question of the role of fiat money in the FTPL is discussed more in depth in Appendix A in order to justify our choice of "public liabilities" data.

convenience, we assume that the expected real rate is constant and equal to r (i.e., $E_t r_{t+j} = r$ for all $j > 0$).

The flow condition can be solved forward to yield the present value budget constraint:

$$b_t = \sum_{j=1}^{k} \frac{1}{r^j} E_t s_{t+j} + \frac{1}{r^k} E_t(b_{t+k}). \tag{3}$$

Eq. (3) is an accounting identity. Stated ex post, it should hold for whatever value of the interest rate, the primary surplus or nominal income. Now, government solvency is ensured if the last term on the RHS of Eq. (3) tends to zero when k tends to the infinity. This transversality condition ensures that the public debt to GDP ratio does not increase by more than the gap between the interest rate and the GDP growth rate. The familiar sustainability condition for public finances is

$$b_t = \sum_{j=1}^{\infty} \frac{1}{r^j} E_t s_{t+j}. \tag{4}$$

The main outcome of the FTPL is in stating that there are two different ex ante mechanisms which enable the equality between both sides of Eq. (4). In the first case, the fiscal authority adjusts its future spending and taxes so that they meet the constraint for whatever value of the interest rate and the nominal income. The fiscal authority is called "Ricardian".

In the second case, hereafter referred to as the "non-Ricardian" case, the fiscal authority does not act in accordance with the fulfillment of its budget constraint, so that p_t must adjust to ensure equilibrium. For instance, at time 0, if future primary surpluses are set exogenously, and both initial nominal debt and real GDP are pre-determined, the general price level is set so as to satisfy the present value budget constraint according to:[4]

$$p_0 = \frac{B_0}{y_0} \left[\sum_{j=1}^{\infty} \frac{1}{r^j} E_0 s_j \right]^{-1}. \tag{5}$$

Hence, other things equal, the higher future public primary deficits, the higher the initial price level.

Needless to say, the FTPL poses a considerable challenge to existing theories of price level determination. The FTPL is a theory of the "jumping general price level" which substitutes the quantity theory of money with a quantity theory of the Public Debt (Woodford, 1995). That financial innovations have largely challenged the foundations of the quantity theory of money provides some support to the above-mentioned "substitution". Indeed, the transaction demand for money is very difficult to delimit, and central banks may not perfectly control a definite monetary aggregate. Alternatively, if central banks set short-run nominal interest rate according to a feedback rule, the FTPL still places strong restrictions on monetary policy behavior. Indeed, the determination of the price level depends on the interactions between monetary and fiscal policies. Two stable regimes

[4] A third solution would consist for the government in selling additional long-term debt, with no change in future surpluses. This would devalue outstanding long-term debt and raise future inflation (Cochrane, 2001).

are possible (Leeper, 1991). First, if the government adjusts its future primary surpluses to meet Eq. (4), fiscal policy is 'passive', and the economy is on a stable path *if and only if* monetary policy is 'active', i.e. the short-run nominal interest rate over-reacts to deviations of the inflation rate from its target. Second, if the government does not adjust its future surpluses to fulfill Eq. (4), fiscal policy is 'active'. A locally stable path for the economy then requires the implementation of a 'passive' monetary policy, i.e. a reduction in the real interest rate after a positive deviation of the inflation rate from its target; this fall consequently curbs public debt growth. Only this latter regime can be consistent with the FTPL.

These two (locally-)stable regimes are at the heart of an empirical controversy between Cochrane (1998) and Canzoneri et al. (2001). Cochrane showed that the VAR analyses of the latter authors, which provide "apparent evidence" of a negative short-run correlation between debt and surpluses (a 'Ricardian' regime), may in fact hide a positive relationship if some assumptions are verified. The resulting "observational equivalence" notably applies under some conditions which are discussed below.

2.2. Fiscal policy and the FTPL: The empirical controversy

Most relevant empirical tests of the FTPL rely on analyses of the relationships between fiscal variables only. Alternative approaches indeed seem to be less suited. First, though a straightforward idea could have been to perform a "direct" test using the price level as a LHS variable and to assess whether an equation like (5) holds, this approach, to our knowledge, has never been implemented. It would surely face the objection that the above-mentioned equation relies on the joint hypothesis of the FTPL and fully flexible prices.[5] Second, as suggested by Woodford (1998), estimating monetary rules should reveal whether central banks' behavior is consistent with the FTPL. Indeed, Leeper's characterization of a 'passive' monetary rule, consistent with a FTPL regime, is that the inflation coefficient in the interest rate rule is inferior to unity, thus violating the "Taylor principle" which states the coefficient should be superior to unity. Evidence provided by Clarida et al. (1998) suggests that the "Taylor principle" has been empirically observed in most industrial countries, ruling out the FTPL. However, this type of evidence is not definitive for at least two reasons. First, it is not robust to the time span (Clarida et al., 2000) or to the estimation methodology (Woodford, 1998). Second, even if monetary policy were 'active', fiscal policy might still be 'active' and the economic regime would be (locally-)unstable. In such a situation, fiscal behavior would still clearly influence the price level, though in a destabilizing way.

The above-mentioned arguments suggest to specifically investigate fiscal behavior. Leeper (1991) and CCD showed that a "Ricardian" regime is obtained provided the primary surplus responds positively to debt. This condition is fulfilled if the fiscal authority follows a feedback rule like:

$$s_t = \alpha b_{t-1} + \varepsilon_t. \tag{6}$$

[5] Canzoneri and Diba (2003), Leith and Wren-Lewis (2000) and Woodford (1996) showed that the FTPL could be consistent with sticky prices. In this case, Eq. (4) would determine nominal GDP in the "non-Ricardian" regime; price rigidity hence affects how changes in nominal GDP materialize, either via (slow) price changes or via real GDP changes. As the above-mentioned equation cannot testify for the existence of sticky prices, a direct test may prove irrelevant.

Such a rule implies that the sustainability condition (4) will hold for whatever level of p_t, hence that the regime is "Ricardian". Consequently, empirical evidence on fiscal feedback rules, e.g. Bohn (1998), have been interpreted as a rejection of the "non-Ricardian" regime.

Cochrane (1998, pp. 340–341) forcefully criticized this interpretation, stating that the FTPL can be subject to an "observational equivalence" phenomenon. Cochrane's argument stems from the fact that an equation like (6) may hold as an equilibrium condition even in a "non-Ricardian" setting and that it thus cannot provide conclusive evidence on the existence of a "Ricardian" regime.

Consider an exogenous autoregressive process for the surplus, which embodies a typical "non-Ricardian" behavior:

$$s_t = \rho s_{t-1} + v_t \tag{7}$$

with $0 < \rho < 1$ and v_t is i.i.d. In a "non-Ricardian" regime, provided the ex ante real interest rate is constant, the price level at time $t-1$ will follow:

$$p_{t-1} = (B_{t-1}/y_{t-1}) * \left(\sum_{j=1}^{k} \left(\frac{1}{r} \right)^j E_{t-1} s_{t-1+j} \right)^{-1}.$$

Since $E_{t-1} s_{t-1+j} = \rho^{j-1} E_{t-1} s_t$, the following equality will hold:

$$s_t = b_{t-1} * (r - \rho) - v_t. \tag{8}$$

Quite obviously, the latter equilibrium condition cannot be distinguished from a "Ricardian" feedback rule (6).

The VAR approach introduced by CCD was an attempt to overcome this "observational equivalence" problem. The approach relies on the dynamic properties of the joint debt-surplus process rather than on a single equation like (6). CCD observed that in a FTPL regime, the real value of debt should increase following a rise in surplus, at least if the surplus series present some positive autocorrelation. They estimated a bivariate VAR model using the surplus and debt series, and then studied the properties of the impulse response functions (IRFs). They found that after a positive surplus shock, the real value of debt decreases. They finally concluded in favour of a "Ricardian" regime and rejected the FTPL.

However, Cochrane (1998, pp. 368–370) argued that an "observational equivalence" issue applied as well in the VAR approach developed in CCD. He proposed the following example. Suppose that the observed surplus is the sum of two components, a cyclical component (a_t) and a structural (or cyclically adjusted) component (z_t) that respectively follow AR processes:

$$a_t = \eta_a a_{t-1} + \varepsilon_{at}, \tag{9}$$

$$z_t = \eta_z z_{t-1} + \varepsilon_{zt}, \tag{10}$$

$$s_t = z_t + a_t. \tag{11}$$

Also assume that the structural balance component is more persistent than the cyclical component, and that the economy is in a FTPL regime so that real debt is given by $b_t = \sum_{j=1}^{\infty} \beta^j s_{t+j}$, where $\beta = \frac{1}{r}$. Solving this forward-looking discounted sum yields:

$$b_t = \frac{\beta\eta_a}{1-\beta\eta_a} a_t + \frac{\beta\eta_z}{1-\beta\eta_z} z_t. \tag{12}$$

Using vector notations $Y_t = (s_t, b_t)'$ and $X_t = (a_t, z_t)'$, Eqs. (9)–(12) can be put together into a state-space system:

$$X_t = AX_{t-1} + \varepsilon_t,$$
$$Y_t = MX_t,$$

where

$$A = \begin{bmatrix} \eta_a & 0 \\ 0 & \eta_z \end{bmatrix}, \qquad \varepsilon_t = \begin{pmatrix} \varepsilon_{at} \\ \varepsilon_{zt} \end{pmatrix} \quad \text{and} \quad M = \begin{bmatrix} 1 & 1 \\ \dfrac{\beta\eta_a}{1-\beta\eta_a} & \dfrac{\beta\eta_z}{1-\beta\eta_z} \end{bmatrix}.$$

An implied VAR representation for vector $Y_t = (s_t, b_t)'$ is then:

$$Y_t = MAM^{-1} Y_{t-1} + u_t \tag{13}$$

with $u_t = M\varepsilon_t$. As a consequence, the covariance matrix of u_t is $\Omega = M\Sigma M'$, where $\Sigma = E(\varepsilon_t \varepsilon_t') = \begin{bmatrix} \sigma_a^2 & \rho_{az}\sigma_a\sigma_z \\ \rho_{az}\sigma_a\sigma_z & \sigma_z^2 \end{bmatrix}$.

If the innovations in the two components of the primary surplus are negatively correlated (i.e., $E(\varepsilon_{at}\varepsilon_{zt}) = \rho_{az}\sigma_a\sigma_z < 0$), it is straightforward to show that the innovations in the debt-surplus process (s_t, b_t) can also be negatively correlated, thus producing the "appearance" of a "Ricardian" regime although a "non-Ricardian" regime was assumed to prevail.

The rationale for the negative correlation can be set out as follows: after a decrease in the cyclical component of the primary surplus, the government may tend to increase the structural component. As the persistence of the latter variable has been assumed to be high, *in fine*, real debt increases because the expected present value of total surplus has increased. In such a case, a positive shock on the surplus (a shock on u_{1t} originating in a shock on ε_{at}) causes the real debt to decrease, a situation which CCD considered sufficient to reject the "non-Ricardian" regime. Finally, one can observe simultaneously, on the one hand, a negative correlation between surplus and real debt following a fiscal shock (i.e., a "Ricardian" IRF) and, on the other hand, an equality between real debt and the sequence of future discounted surpluses (i.e., a "non-Ricardian" regime).

Cochrane's two-step critique thus suggests that the methodology used by CCD should be supplemented by including the cyclical and structural components of the primary surplus within the VAR.

3. Our empirical approach

Our empirical approach has two steps: first, a bivariate debt-surplus VAR model in the spirit of CCD is estimated for each country under study. Second, structural balance data are introduced in order to cope with Cochrane's "observational equivalence" argument. Data description is provided in Appendix A. Data are presented in Fig. 1 while Table 1 provides some summary statistics.

The FTPL implies that high public debt to GDP ratios should result from high future discounted primary surpluses. High public deficits (which raise nominal debt) should

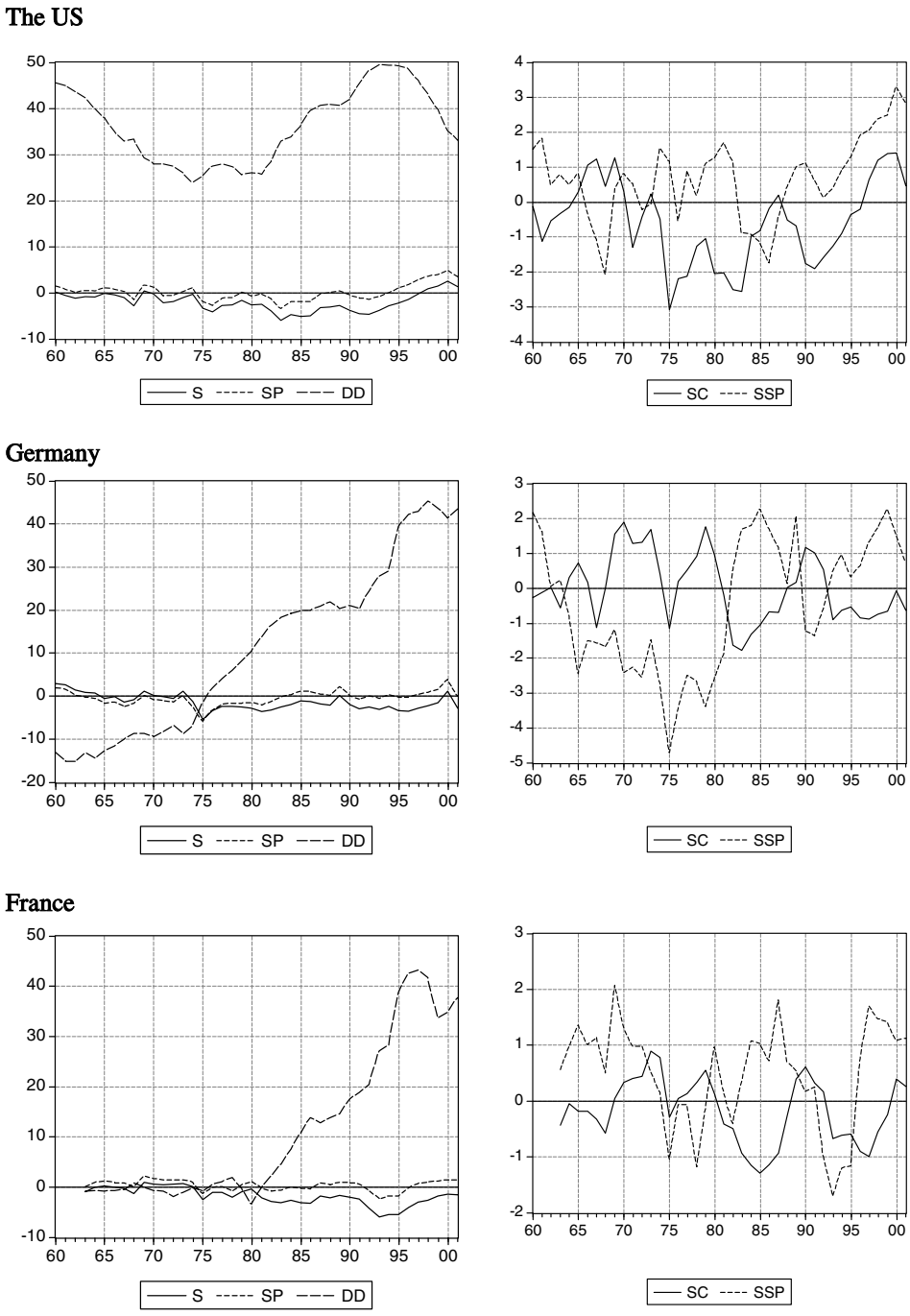

Fig. 1. The data. *Note:* The following series, expressed as a percentage of GDP, are plotted: overall surplus (S), primary surplus (SP), debt (DD), cyclical surplus (SC) and primary structural surplus (SSP).

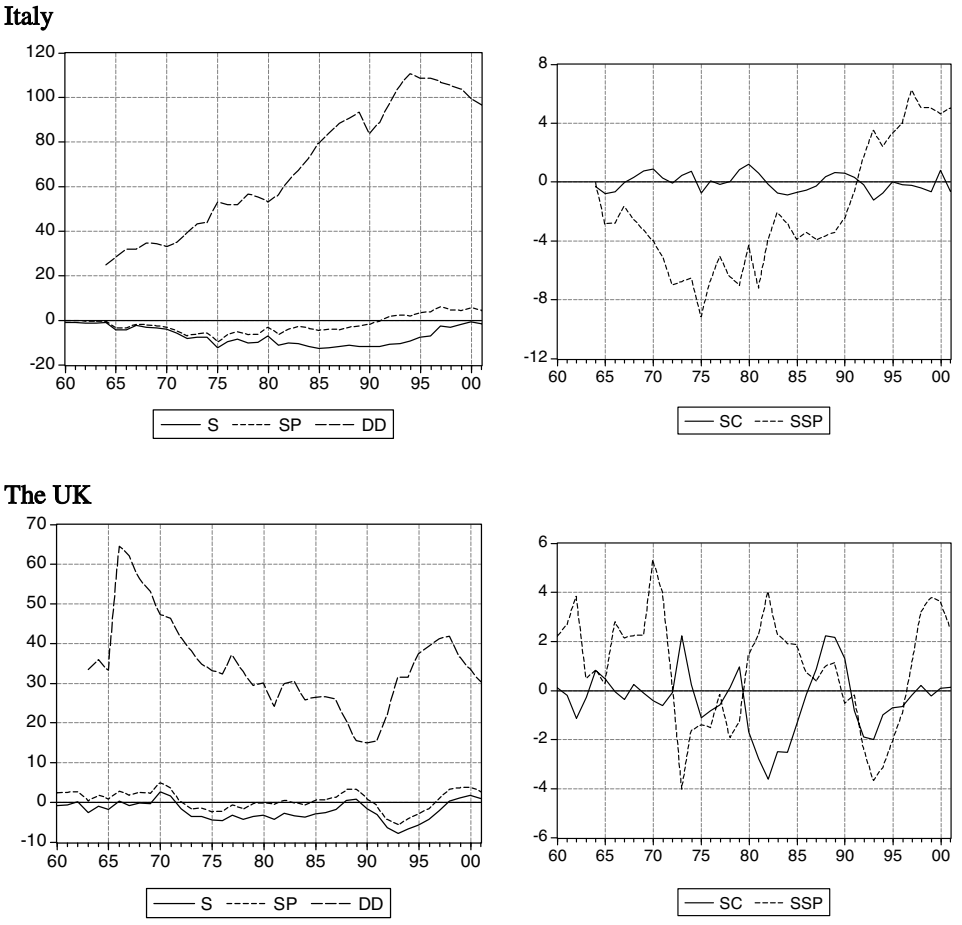

Fig. 1 (*continued*)

either raise the price level or provoke the expectation of high future surpluses. Merely looking at time series, it is difficult to distinguish between both options and to assess the plausibility of a non-Ricardian regime for a given country.

In the USA, for instance, although public deficits tended to increase in the 1960–1970s, the net public debt to GDP ratio decreased substantially until the mid-1970s. A similar evolution can be found for the UK net public debt. Such an evolution might just reflect a period of high inflation, and negative real interest rates with mainly non-indexed debt, but it might also be consistent with a FTPL regime. Moreover, the US and UK public deficits on GDP ratios have largely swung, with a positive trend until the 1980s in the case of the USA. Every 4–5 years, US public surpluses nonetheless reemerged after the deficit had reached a peak: in 1959, 1968, 1976, and 1983. Most of these peaks were due to external shocks: wars (Korea, Vietnam) or soaring oil prices. These swungs in public deficits and the on-going rise in the public debt to GDP ratio since 1974 might also be consistent with a FTPL regime: increases in the deficits have possibly given rise to higher debt

Table 1
Summary statistics

	Sample mean	Standard deviation	Min	Max	ADF *t*-statistics	L	SP *t*-statistics	KPSS
The US								
Primary surplus	−0.18	1.63	−3.43	3.88	−1.56	1	−2.09	0.239
Debt	35.57	8.37	23.86	49.49	−1.67	1	−1.10	0.562(a)
Overall surplus	−2.41	1.83	−6.04	1.36	−1.67	1	−1.77	0.282
Primary structural surplus	0.49	1.11	−2.06	2.50	−2.47	1	−3.04[a]	0.284
Cyclical surplus	−0.67	1.21	−3.08	1.38	−2.00	1	−1.93	0.197
Germany								
Primary surplus	−0.57	1.53	−5.91	2.24	−1.66	2	−3.23[a]	0.502(a)
Debt	9.34	19.05	−15.27	45.36	0.32	4	−2.29	0.996(a)
Overall surplus	−1.41	1.82	−5.46	2.96	−2.48	2	−3.33[a]	0.513(a)
Primary structural surplus	−0.54	1.91	−4.70	2.28	−1.51	1	−2.40	0.557(a)
Cyclical surplus	0.02	0.98	−1.77	1.89	−3.43[a]	1	−2.80[a]	0.292
France								
Primary surplus	0.25	1.06	−2.38	2.13	−2.75[a]	1	−2.53	0.322
Debt	10.65	14.85	−3.35	43.20	1.04	1	−1.39	0.845(a)
Overall surplus	−1.84	1.84	−6.00	0.93	−1.82	1	−2.05	0.760(a)
Primary structural surplus	0.46	0.90	−1.42	2.07	−2.72[a]	1	−2.72	0.157
Cyclical surplus	−0.21	0.57	−1.05	1.06	−2.85[a]	1	−2.49	0.337
Italy								
Primary surplus	−2.46	3.79	−9.90	6.05	−0.47	3	−1.68	0.549(a)
Debt	67.13	28.39	24.95	110.75	−0.76	1	−2.02	0.977(a)
Overall surplus	−7.99	3.61	−12.66	−0.90	−1.83	4	−1.58	0.390(b)
Primary structural surplus	−2.42	3.99	−9.13	6.28	0.30	2	−1.56	0.555(a)
Cyclical surplus	−0.04	0.60	−1.21	1.21	−3.68[a]	1	−3.18[a]	0.191
The UK								
Primary surplus	0.15	2.41	−5.71	4.91	−3.15[a]	2	−2.15	0.159
Debt	34.57	11.73	14.96	64.47	−3.48[a]	3	−1.81	0.439(b)
Overall surplus	−2.48	2.40	−7.91	2.61	−3.04[a]	2	−2.04	0.201
Primary structural surplus	0.56	2.26	−4.02	5.33	−2.66[a]	1	−2.22	0.115
Cyclical surplus	−0.40	1.34	−3.61	2.24	−3.67[a]	1	−2.85[a]	0.094

Note: ratio over GDP, percentage point. Sample period 1963–2001.
SP: Schmidt–Phillips *t*-statistics.
KPSS: Kwiatkowski et al. (1992) statistic assuming no trend under the null.
L: Lag length for ADF test selected according to AIC.
For SP and KPSS test, lag truncation parameter was set to 3 following the rule $l4 = \text{int}[4(T/100)^{1/4}]$ mentioned in Kwiatkowski et al. (1992).
(a) and (b) indicate rejection at the 5% and 10% level of stationarity by the KPSS test.
[a] Indicate rejection of the unit-root hypothesis at the 10% critical level for ADF and SP tests.

because of offsetting surpluses which satisfied the government present value budget constraint.

Data for France, Germany and Italy, contrary to the US case and, to a lesser extent, the UK's, do not show a dramatic reversal in the evolution of the public debt to GDP ratio: the ratio has only stopped increasing at the end of the Nineties. Peaks and troughs as regards the public deficits have also generally been more spaced in time than in the US. Adopting a FTPL view, the steep rise in public debt to GDP ratios in France,

Germany and Italy until 1990 should have stemmed from expectations of large primary surpluses. It would mean that the convergence path, following the adoption of the Maastricht Treaty, and the limitations on public deficit incorporated in the SGP would have changed the expectations on future fiscal policies. Indeed, fiscal data for these three countries clearly show that the primary balance has been in surplus since 1996: this could be analyzed as a discretionary way to satisfy the government present value budget constraint.

3.1. Baseline approach: A bivariate VAR

Unlike the literature on the sustainability of public finances, which has been discussed at length since Hamilton and Flavin (1986), the FTPL does not consider the present-value budget constraint as a constraint but, rather, as an equilibrium condition.[6] Nevertheless, observing that (4) is satisfied does not permit to discriminate between "Ricardian" and "non-Ricardian" regimes for both regimes accept this equation as an equilibrium condition. For this reason, empirical tests of government sustainability are of no help as indirect tests for rejecting a "non-Ricardian" regime. Differently stated, the rejection of sustainability in a FTPL framework should be interpreted as a statistical problem, reflecting more on the test than on the theory itself.[7]

We thus follow the approach proposed by CCD, which focuses on the IRFs of a bivariate, unrestricted VAR-in-level, for surplus and debt expressed as percent of GDP. The VAR-in-level approach provides some robustness with respect to potential non-stationarity of the data and provides consistent estimates of IRFs. The motivation for focusing on response functions is in testing the FTPL hypothesis vs. a "Ricardian" regime hypothesis. Both hypotheses convey the same prediction in terms of long-run properties of debt and surplus.[8] To discriminate between both, we have to focus on the short-run properties of the system, as provided by the IRFs, rather than on long-run properties. Under the "non-Ricardian" regime, the government surplus is an exogenous forcing process (which may be either stationary or non-stationary). Given that surplus shocks are plausibly autocorrelated, and that in a "non-Ricardian" set-up the

[6] The theoretical controversy between Cochrane (2003) and Buiter (2002) as regards the ability of a government to violate its present value budget constraint is beyond the scope of this paper.

[7] Empirical tests of government solvency or sustainability (typically relying on tests of either the stationarity of the overall deficit, or the cointegration of debt and surplus) have provided various results, with a tendency to reject sustainability (see e.g. Roberds, 1991, for the US, and Jondeau, 1992, for France). The results of unit-root tests for the five countries under study are reported in Table 1. Using ADF procedures, the unit-root hypothesis can be rejected for the French primary surplus and for all UK fiscal data. These results are not robust to a change in the procedure, except for debt in the UK. Adopting a Schmidt–Phillips procedure, the unit-root hypothesis can only be rejected at the 10% level for German overall and primary surpluses. For all other countries, the non-stationarity of the interest-inclusive surplus cannot be rejected, which points to unsustainability. The application of KPSS tests (without trend) also provide contrasted results. Finally, Italian fiscal data prove non-stationary whatever the adopted procedure.

[8] Note that, as pointed by Roberds (1991), stochastic singularity may arise in these bivariate models which assume a present value budget balance to hold. However, stochastic singularity is avoided here, as in Roberds (1991), by assuming ex ante (not ex post) constant interest rate, and by allowing the surplus to Granger-cause debt.

debt to nominal GDP ratio can jump, the response of debt to a surplus shock is expected to be positive in this regime.

3.2. Using cyclical and structural balance dynamics

In a second step, we introduce structural balance data in order to assess whether the first VAR results can be given an FTPL interpretation according to Cochrane's "observational equivalence" argument. A first test consists in estimating whether structural and cyclical balance *innovations* are negatively correlated. This has been showed to be required in Cochrane's above example. CCD verified that the innovations in US structural and cyclical components were uncorrelated and they concluded that a "non-Ricardian" regime could be rejected on grounds of Cochrane's critique. We will apply the same methodology to European data.

However, this test is quite rough since it relies only upon the contemporaneous correlation between structural and cyclical balance innovations. Extending it to lagged cross-correlations between these two series led us to consider a non-diagonal, hence more general than above, A matrix. Assume, as in Cochrane's example above, that:

$$X_t = AX_{t-1} + \varepsilon_t,$$

but now with:

$$A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix},$$

X_t follows a VAR rather than two AR processes. If a "non-Ricardian" (FTPL) regime still holds, $b_t = \sum_{j=1}^{k} \beta^j E_t s_{t+j} = \sum_{j=1}^{k} \beta^j E_t(a_{t+j} + z_{t+j})$. Using $E_t(a_{t+k} + z_{t+k}) = eA^k X_t$, the instantaneous impact on real debt of a shock to the cyclical balance can be written as

$$b_{\mathrm{FTPL}} = e\beta A(I - \beta A)^{-1} * P * e_1', \tag{14}$$

where $e = (1,1)$, $e_1 = (1,0)$ and P is the Cholesky decomposition of Σ, the covariance matrix of ε_{at} and ε_{zt}. Matrix P is thus lower triangular (i.e., shocks are recursively ordered so that a shock on a may have an impact on z but the reverse is not true, in accordance with Cochrane's logic). If A is diagonal, formula (14) provides the same short-run impulse response as (12).[9]

Depending on the coefficients in matrices A and P, b_{FTPL} may be negative. Most noteworthy, even with uncorrelated contemporaneous innovations, the dynamic interactions between the cyclical and the structural components might produce a negative response of real debt after a positive surplus shock, even in a FTPL framework. Thus, the FTPL cannot be rejected solely on grounds of a negative response of public debt to a positive surplus shock. In the following, we will thus provide a systematic investigation on the possible feature of an "observational equivalence" making full use of the value for b_{FTPL} which is implied by the bivariate VAR including structural and cyclical balances.

[9] When the VAR includes more than one lag, we implement a generalization of formula (14) using a companion matrix.

4. International evidence

4.1. A bivariate surplus-debt VAR

The bivariate surplus-debt VAR model has been estimated over the period 1963–2001 respectively for the five countries under study.[10] Estimation results and IRFs are reported respectively in Table 2 and Fig. 2. The surplus has been ordered first. This ordering allows for a contemporaneous effect of the shock on public debt/GDP, consistently with the existence of a "non-Ricardian" regime.

In the US case, our results only replicate CCD on a different time span (they used a 1951–1995 sample). Like them, we find that a 2-lag VAR is needed to fit the data.[11] IRFs are also very similar to those obtained by CCD. A positive shock on the surplus provokes an immediate decrease in public debt.

For Euro area countries, 1-lag VARs have been estimated. The features of the IRFs are very similar to those obtained in the US. Confidence intervals indicate that the falls in public debt/GDP are statistically significant, except after 4 years in the case of Italy.[12] These patterns are consistent with a "Ricardian" interpretation: favourable fiscal shocks help to reduce government debt.

The UK case deserves peculiar attention: within a 2-lag VAR, IRFs exhibit a positive – though non-significant – response of public debt/GDP. This suggests further investigation as regards the possible existence of a "non-Ricardian" regime in the UK. Furthermore, Fig. 2 indicates that after some time the response of surplus to a surplus shock eventually becomes negative for several countries (most visibly the US and Germany). This implies that following a positive surplus shock, the present value of future surpluses might decrease. In such a case, the negative response of debt found in the IRF could then be consistent with the FTPL, as in Cochrane's analysis. Further investigation is thus worthwhile, although the medium term negative response of the surplus are not significant.

4.2. Incorporating structural balance data

The second step of the analysis has consisted in incorporating the cyclical and cyclically adjusted primary balance data into the analysis.

4.2.1. The structural and cyclical balances as AR processes

First, the structural and cyclical balances have been modelled as AR processes. Results are reported in Table 3.

In the case of the US, Germany, France and Italy, an AR(1) model appears as a parsimonious representation for the structural primary surplus. The autoregressive term ranges from 0.66 for France to 0.97 for Italy. Two lags are necessary for the UK primary

[10] While series were available on a longer time span in the US case, the sample period has been chosen so as to be similar for all countries.

[11] Five tests have been performed: LR test, final prediction error test, Akaike, Schwarz and Hannah–Quinn information criterion tests. These five tests gave consistent results respectively for the five countries.

[12] Note that confidence intervals over a long horizon should be regarded with caution under the assumption of non-stationarity.

Table 2
VAR estimates "primary surplus-debt"

	The US		Germany		France		Italy		The UK	
	s_t	b_t	s_t	b_t	s_t	b_t	s_t	b_t	s_t	b_t
s_{t-1}	0.48	0.61	0.41	−0.47	0.67	−1.10	0.75	−0.21	1.07	−0.81
	0.29	*0.43*	*0.14*	*0.26*	*0.14*	*0.43*	*0.09*	*0.23*	*0.15*	*0.76*
s_{t-2}	0.06	−0.34							−0.45	0.27
	0.18	*0.26*							*0.16*	*0.77*
b_{t-1}	−0.13	1.87	0.03	1.02	0.01	1.00	0.04	0.99	−0.03	0.93
	0.18	*0.26*	*0.01*	*0.02*	*0.01*	*0.03*	*0.01*	*0.03*	*0.04*	*0.18*
b_{t-2}	0.20	−0.96							0.08	−0.05
	0.19	*0.28*							*0.04*	*0.18*
Constant	−2.69	3.07	*−0.73*	*0.98*	0.07	1.37	−3.13	2.16	−1.41	3.97
	1.01	*1.49*	*0.27*	*0.50*	*0.18*	*0.58*	*0.99*	*2.58*	*0.74*	*3.68*
Adj. *R*-squared	0.65	0.96	0.48	0.99	0.38	0.97	0.86	0.98	0.73	0.70
s.e. equation	1.08	1.60	1.18	2.19	0.84	2.68	1.53	3.98	1.30	6.43
AIC	3.11	3.90	3.25	4.48	2.56	4.89	3.76	5.68	3.49	6.69
SC	3.32	4.11	3.37	4.61	2.68	5.01	3.89	5.81	3.70	6.90
System										
Residual correlation		−0.88		−0.58		−0.46		−0.34		0.22
Log likelihood		−98.17		−132.57		−122.62		−152.72		−141.20
AIC		5.55		7.29		7.35		9.34		8.64
SC		5.97		7.55		7.62		9.61		9.08

Note: s_t primary surplus, b_t debt (both in percentage of GDP), standard errors are in italics, Sample period 1963–2001.

structural surplus. The cyclical balances are modelled either as an AR(1) model in the US and Italian cases, or as an AR(2) model in the cases of Germany, France and the UK.

Significant findings are threefold. First, in the cases of Germany and the UK, the cyclically adjusted primary surplus displays more persistence than the cyclical surplus, which is consistent with Cochrane's assumption. Moreover, the correlation coefficients between the innovations in both components of the primary surplus are respectively and significantly negative (correlation coefficients are $\rho = -0.3$ and -0.4). Both elements – persistence and negative correlation – pave the way for an FTPL interpretation of the surplus-debt to GDP preliminary model.

Second, despite higher persistence of the Italian structural balance in comparison with the cyclical one, the innovations for the two AR processes appear to be uncorrelated (correlation coefficient is $\rho = 0.03$).

Third, contrary to the intuition as well as to the results reported in CCD for the US case, the cyclical balance is more persistent than the structural balance in France and in the US. Furthermore, the innovations for the two AR processes appear to be uncorrelated. This latter outcome is consistent with the analysis performed by CCD on the US: they concluded that the correlation coefficient between both innovations was equal to 0.06; our result rather points to a mere 0.02. Higher persistence for the cyclical balance associated with the absence of correlation between innovations in the two components of the primary surplus points against an FTPL interpretation of the data.

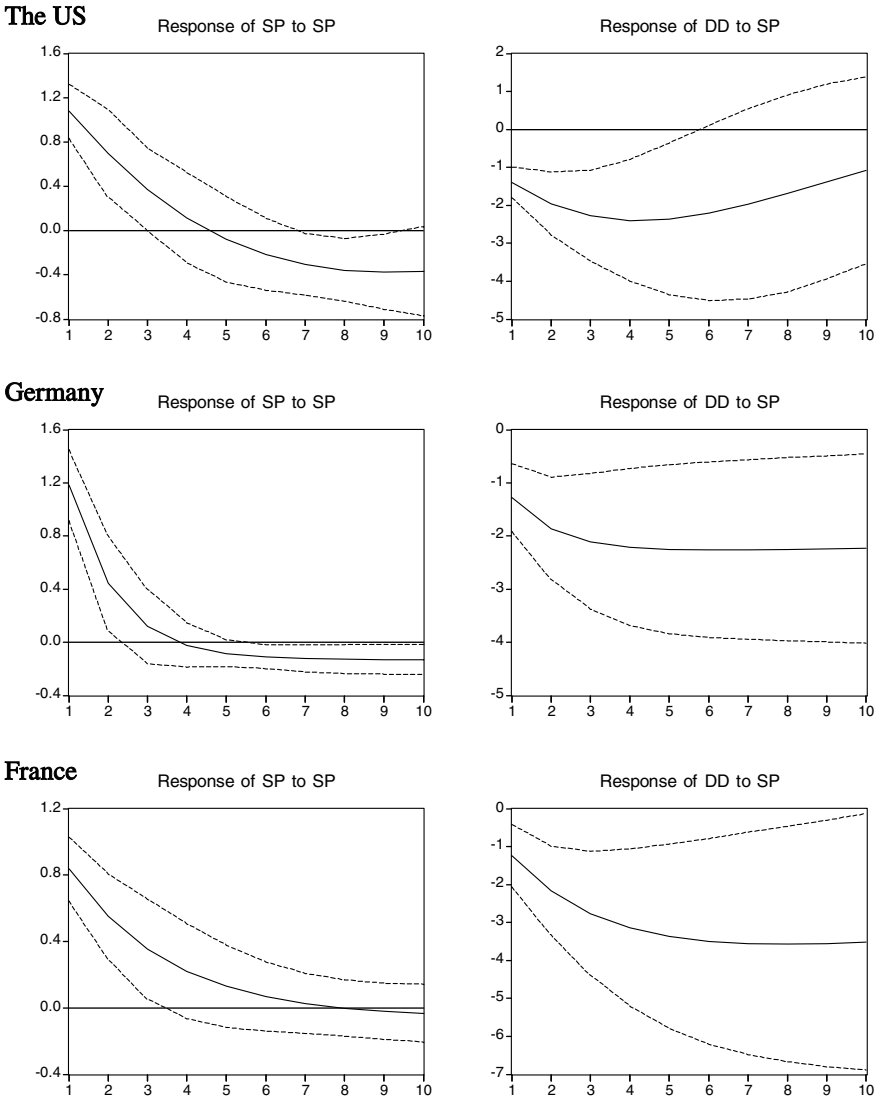

Fig. 2. Impulse response functions to a surplus shock.

At this stage, only German and UK fiscal data are able to be given an FTPL interpretation. France and Italy would be in a "Ricardian" regime. Similarly to the US case, this conclusion for the two latter European countries stems from a thorough analysis of fiscal dynamics, mixing CCD's and Cochrane's methodologies.

4.2.2. VAR dynamics for cyclical and structural primary balances

In light of the normative example given in Section 3.2 above, we have investigated the relevance of Cochrane's "observational equivalence" argument in two steps. First, we have estimated a VAR with the cyclical and the structural balances. Second, we have

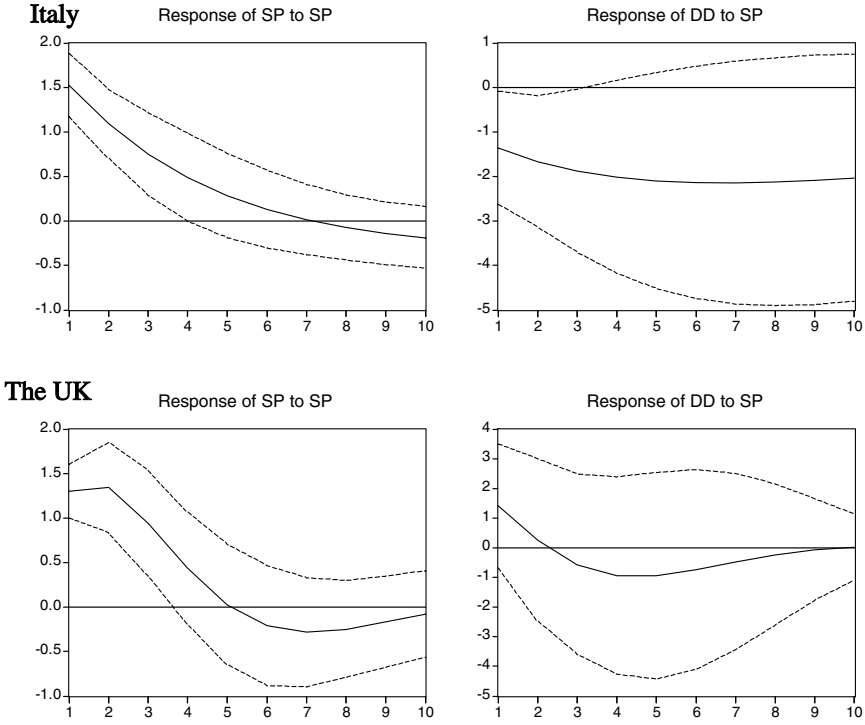

Fig. 2 (*continued*)

computed the change in the value of debt after a shock to the cyclical surplus, assuming that the FTPL hypothesis holds (the ordering for the VAR has been such that the cyclical surplus has come first). This computation relies on the aforementioned present-value formula (14). Recall that if b_{FTPL} is negative, a "Cochrane effect" is present and the FTPL cannot be rejected on the grounds that the contemporaneous innovations in the cyclical and structural components of the primary surplus are uncorrelated. In the computation, β has been set equal to 0.98, which is consistent with an interpretation of this parameter as one minus a growth-corrected interest rate.

VAR results are reported in Table 4. A 1-lag VAR has been performed for all countries, except for the UK for which two lags have proven necessary.[13] For the US and Italy, the correlation between innovations ε_{at} and ε_{zt} is not significant ($\rho_{\mathrm{US}} = 0.01$ and $\rho_{\mathrm{Italy}} = 0.03$), implying that the ordering of shocks is of low importance. In the US case, the lagged cyclical surplus appears with a positive sign in the structural surplus equation. As a result, introducing structural surplus into the analysis does not help to create long-run negative autocorrelation in the overall surplus. Assuming a "non-Ricardian" regime, we find b_{FTPL} to be equal to 3.42, so that the FTPL should be manifest in the IRFs; but this is not the case, indeed. In the Italian case, the value for b_{FTPL} is even higher (28.4). The parameter

[13] The VAR lag order selection has given rise to mixed results, except for France and Italy where the five tests reported in footnote 11 have led to the same result. For the other countries, we have favored the lag chosen by a majority of the five tests performed. In every case, the conclusion of the LR test procedure has been endorsed.

Table 3
AR processes for cyclical and primary structural surpluses

	The US	Germany	France	Italy	The UK
Dependent variable: z_t					
Constant	0.19	−0.08	0.18	0.09	0.23
	0.15	*0.18*	*0.13*	*0.29*	*0.26*
z_{t-1}	0.76	0.84	0.66	0.97	0.91
	0.12	*0.09*	*0.13*	*0.06*	*0.16*
z_{t-2}					−0.27
					0.16
s.e.	0.84	1.06	0.71	1.57	1.56
DW	1.83	1.93	1.87	2.23	1.91
AIC	2.55	3.01	2.22	3.79	3.80
SC	2.63	3.10	2.30	3.87	3.93
Dependent variable: a_t					
Constant	−0.10	0.00	−0.06	−0.03	−0.15
	0.14	*0.11*	*0.06*	*0.09*	*0.15*
a_{t-1}	0.79	0.94	1.07	0.46	0.99
	0.10	*0.16*	*0.16*	*0.15*	*0.15*
a_{t-2}		−0.37	−0.37		−0.43
		0.16	*0.16*		*0.15*
s.e.	0.77	0.69	0.35	0.55	0.87
DW	1.72	1.86	2.06	1.69	2.01
AIC	2.36	2.18	0.84	1.68	2.64
SC	2.44	2.31	0.97	1.77	2.77
Corr. of innovations a_t, z_t	0.02	−0.28	0.07	0.03	−0.42

Note: a_t cyclical surplus, z_t primary structural surplus (both in percentage of GDP). Standard errors are in italics. Sample period 1963–2001.

value for b_{FTPL} is also largely positive for the UK: this outcome should lead us to consider that the UK has not been in a ''non-Ricardian'' regime.

For France and Germany, the lagged cyclical surplus appears with a negative sign in the cyclically adjusted primary surplus equation, and b_{FTPL} is negative. At face value, this result indicates that we may observe a ''Ricardian'' IRF even if a ''non-Ricardian'' regime prevails. At least in the case of France, this is quite surprising in light of the results of previous tests which did not conclude in favor of an FTPL interpretation of fiscal data. Moreover, the value obtained for b_{FTPL} for these two countries are very low in absolute terms, suggesting that an FTPL interpretation of the data is fragile.

On the whole, the actual structural–cyclical balance dynamics provides low support to a FTPL interpretation of the surplus-debt IRFs for the major industrial countries considered here. One must yet acknowledge that the use of structural balance data is not able to refute Cochrane's claim that one cannot formally test for the prevailing fiscal regime. In the vein of Cochrane's equivalence argument, one could probably construct other theoretical examples in which b_{FTPL} is positive while the FTPL prevails. Moreover, the structural data compiled in the present paper as well as the CBO data used by CCD (2001) do not necessarily coincide with Cochrane's notion of cyclical and structural deficits.[14]

[14] Following Cochrane (1998)'s theoretical example, the deficit has a component set by fiscal policy (the structural component) and a component not set at all by fiscal policy. The structural component would thus be the ''pure discretionary fiscal stance'' whose empirical assessment remains unfortunately controversial.

Table 4
VAR estimates "cyclical surplus–primary structural surplus"

	The US		Germany		France		Italy		The UK	
	a_t	z_t	a_t	z_t	a_t	z_t	a_t	z_t	a_t	z_t
Dependent variable										
a_{t-1}	0.81	0.22	0.65	−0.47	0.80	−0.46	0.39	−0.05	0.96	0.49
	0.10	*0.11*	*0.15*	*0.21*	*0.10*	*0.19*	*0.15*	*0.45*	*0.16*	*0.29*
a_{t-2}									−0.37	−0.42
									0.16	*0.29*
z_{t-1}	−0.15	0.74	−0.04	0.69	0.13	0.63	−0.04	0.97	−0.01	1.03
	0.11	*0.11*	*0.08*	*0.11*	*0.06*	*0.12*	*0.02*	*0.07*	*0.10*	*0.17*
z_{t-2}									0.11	−0.39
									0.10	*0.17*
Constant	−0.01	0.34	−0.03	−0.16	−0.08	0.10	−0.11	0.09	−0.21	0.25
	0.15	*0.16*	*0.13*	*0.17*	*0.07*	*0.13*	*0.10*	*0.30*	*0.15*	*0.27*
Adj. *R*-squared	0.62	0.55	0.46	0.72	0.62	0.48	0.23	0.86	0.56	0.54
s.e.	0.76	0.81	0.74	1.01	0.36	0.67	0.53	1.59	0.87	1.54
AIC	2.36	2.49	2.32	2.93	0.87	2.11	1.66	3.84	2.67	3.82
SC	2.49	2.61	2.45	3.06	1.00	2.24	1.79	3.97	2.88	4.03
System										
Residual correlation		0.01		−0.32		0.16		0.03		−0.44
b_{FTPL}		3.42		−0.32		−0.39		28.40		3.45
Log likelihood		−88.47		−92.39		−47.91		−90.24		−109.00
AIC		4.84		5.18		3.08		5.50		6.26
SC		5.10		5.44		3.35		5.77		6.69

Note: a_t cyclical surplus, z_t primary structural surplus (both in percentage of GDP). Standard errors are in italics. Sample period 1963–2001.

Results in the present paper just point that a non-Ricardian interpretation of US and European fiscal data seems rather implausible.

4.2.3. Robustness analysis: A three-variable VAR

Last, we have estimated a VAR including the public debt, the cyclical and the structural balance, in percentage of GDP. This VAR is an unrestricted version of CCD's test as well as an unrestricted version of the tests performed and presented above: here, a FTPL ("non-Ricardian") regime is *not* assumed and what we have rather investigated has been the dynamic properties on debt of a shock on the primary surplus. IRFs are reported for shocks to the two components of the overall primary surplus in Fig. 3.

A 1-lag VAR has been estimated in the cases of Germany, France and Italy; whereas, in the US and UK cases, two lags have been necessary. Results are threefold. First, for the US, the UK and France, estimation results for the VAR process are such that public debt is never a significant determinant for either the cyclical or the structural component of the primary surplus. In these countries, this may somewhat dampen the resort to feedback policy rules to invalidate the FTPL. Second, after a positive shock to either the cyclical or the structural surplus, the public debt to GDP ratio falls in all countries, except the UK. As in Section 4.1, the IRFs turn out to have a more plausible interpretation in a "Ricardian" set-up than in a FTPL world. Last, the UK can be singularized here again:

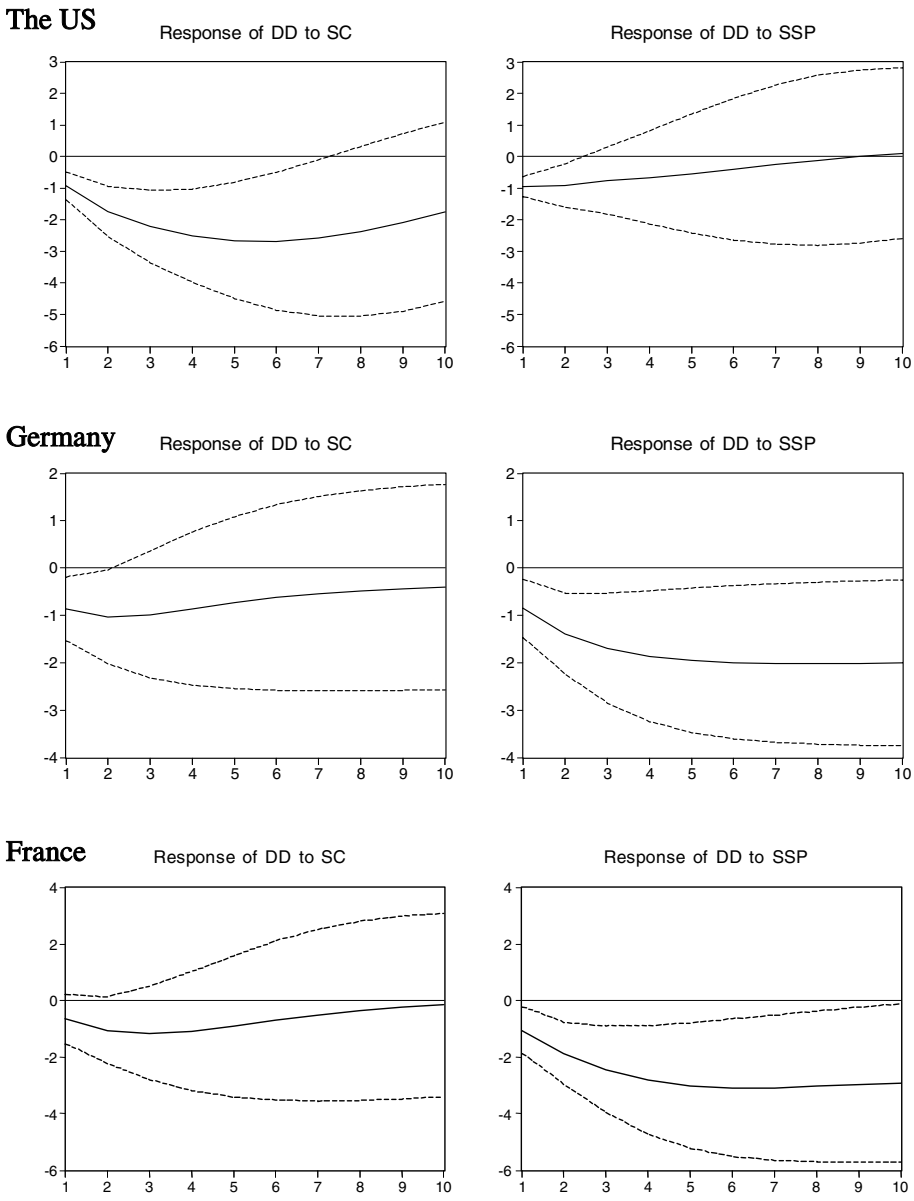

Fig. 3. Impulse responses of debt to structural and cyclical surplus shocks (three-variable VAR).

a positive shock on the cyclically adjusted primary surplus immediately and significantly raises the public debt to GDP ratio. This response proves insignificant right afterwards. All in all, though results are mixed as regards the UK economy, the lack of robustness of the IRFs, coupled with a high and significant parameter value for b_{FTPL} gives arguments for rejecting an FTPL interpretation of fiscal data in this country as well.

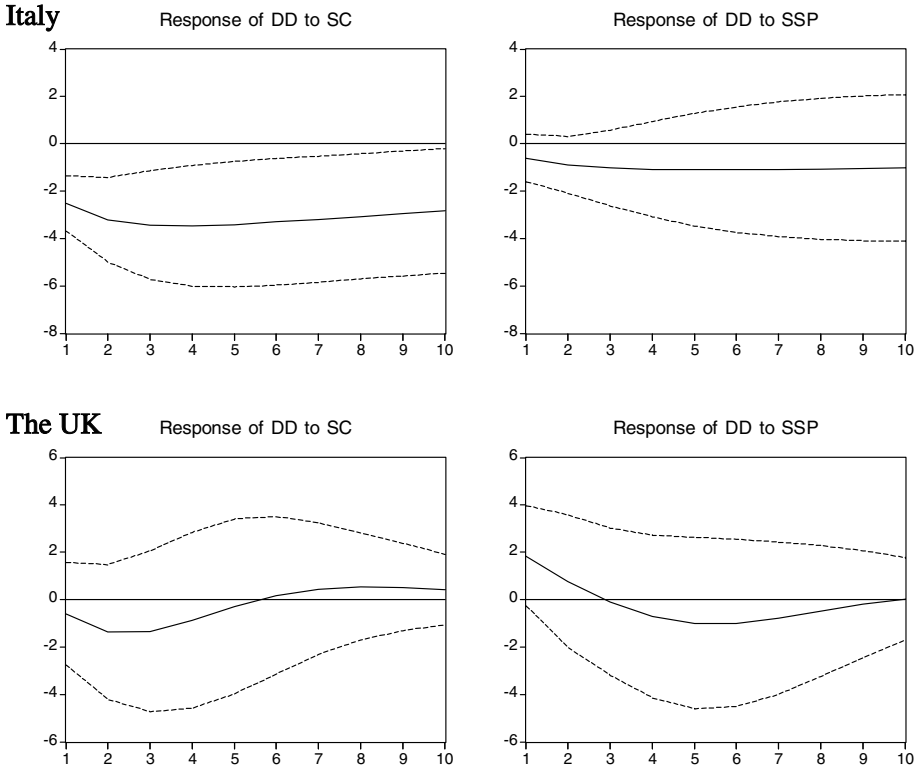

Fig. 3 (*continued*)

5. Conclusion

In this paper, we have investigated the relationship between public debts and deficits with a concern for the fiscal theory of the price level. More specifically, we have questioned the empirical plausibility of the FTPL in the major European countries and in the USA. Much attention has been given to the "observational equivalence" argument developed by Cochrane (1998). The argument states that a negative response of public debt to GDP ratio after a positive shock on the primary surplus can be observed even in a so-called "non-Ricardian" regime (or FTPL regime).

Our results show that the impulse response functions of a VAR model, either a two- or a three-variable VAR, either with the primary surplus or with its two separate components (cyclical and structural), are generally consistent with the benchmark "Ricardian" results obtained by Canzoneri et al. (2001). The FTPL hypothesis should thus be viewed as non-plausible for the five countries under study. Furthermore, taking into account Cochrane's critique through the introduction of cyclical and structural primary surplus dynamics does not allow to provide a FTPL interpretation to previous results.

This study has focused only on fiscal data and is subject to several limitations. Among them, we acknowledge that the analysis has been conducted under the assumption of a constant expected discount rate. Allowing for a time-varying discount rate would improve

the analysis and might possibly restore the prospect for an FTPL interpretation of the data.

Acknowledgement

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Appendix A. Data

The annual data set covers the sample 1963–2001. The data set has been limited to this time span for comparison purposes due to the unavailability of some data, most notably in the cases of France and the UK.

All US series have been taken from the Congressional Budget Office (CBO), The Budget and Economic Outlook: fiscal years 2001–2010, Report to the Senate and House Committees on the budget, January 2000. The following data: deficit/surplus, cyclically adjusted deficit/surplus, debt held by the public, actual and potential GDP have all been taken from table E1 p. 135. Data for the output gap are our own calculations based upon the series of actual and potential GDP. Net interest have been taken from table E8 p. 142. Primary deficit/surplus (primary cyclically adjusted deficit/surplus) data are our own calculations, i.e. the sum of deficit/surplus (respectively cyclically adjusted deficit/surplus) and net interest. This method has also held for the European countries under study. Debt held by the public is federal debt held by non-federal investors, including the federal reserve system.

For France, the main data source has been the OECD. However, long series for net interest was not available so that, over the period 1970–1999, we have used various issues of Annuaire Statistique de la France published by the INSEE (national institute for statistics). Prior to this period, data have been taken from table (pp. 237–239) of Le Mouvement Economique en France 1949–1979, INSEE, séries longues statistiques, published in May 1981.

Data source for Germany and Italy has been the OECD.

The data sources for the UK have been twofold: ONS (Office of National Statistics) and OECD. To facilitate comparison with other European countries, OECD data have been used as benchmark data. Availability has been the following: data begin in 1970, 1978, 1987, respectively for, first, net public debt, second, deficit/surplus and primary deficit/surplus, and third, cyclically adjusted deficit/surplus and cyclically adjusted primary deficit/surplus. ONS data have been used to backcast fiscal data.The deficit/surplus has been backcasted using general government net lending/net borrowing at current prices (series BBNNBK, Blue Book (BB02), table number: 1.7.7). The net public debt has been backcasted using levels of general government net financial assets/liabilities (series BBNYOG, Blue Book (BB02), table number: 1.7.9). Net interest are equal to interest paid by the general government (series NRKB, UK national statistics online) minus total property income received by the general government (series NMYL, UK national statistics online).

We last discuss more in details two specific data issues: debt and the output gap.

The definition of debt, for the European countries under study as well as for the US is net debt held by the public excluding base money. Excluding base money from net total liabilities is consistent with Hamilton and Flavin (1986) treatment of public debt. They notably exclude base money from "officially reported debt" (p. 812) and use the resulting "corrected debt" to test for the sustainability of fiscal policy, via the present value budget constraint (PVBC). By contrast, the FTPL asks how the PVBC is satisfied in equilibrium. Whatever the type of tests on the PVBC, be it related to the sustainability literature or to the FTPL, and whatever the interpretation of the results, using net public debt is crucial and in addition, excluding base money is in our view appropriate. It is not uncontroversial however, since Canzoneri et al. (2001) add base money to net federal debt (p. 1127).

The motivation for our choice has been twofold. First, the latest versions of the FTPL point to the uselessness of fiat money as a means of transaction, from the "cashless limit" case of Woodford (1997) – the money balances held to facilitate transactions become negligible, to the "cashless world" of Christiano and Fitzgerald (2000) which replicated the model "without money" by Sims (1994). We acknowledge that the original version of the FTPL states that the distinction between interest paying government bonds and non-interest bearing transactions money is irrelevant for price level determination, so that the measure of public liabilities in the PVBC should have had to be inclusive, rather than exclusive, of base money (see Woodford, 1995, or the early contributions by Sims). However, in including base money in the measure of public liabilities, analyses like that of CCD tend to mix up the FTPL with the Quantity theory,[15] though the former stems from the analytical rejection of the latter.

Second, and maybe more importantly, in including base money in public liabilities, one implicitly assumes that the central bank is not independent from the fiscal authority and that base money participates in the financing of public deficits. However, it has been a long time now since money creation and seigniorage have intervened substantially in the financing of public deficits within the countries under study, except maybe in Italy (see Buiter, 1990).

Finally, we have checked that the IRFs of our surplus-debt VAR for the US were similar to those obtained by CCD (2001) over the same time span (1951–1995). This indicates that, at least in the US case, results are fully robust to including or not including base money in public liabilities.

As regards the output gap, we generally have had difficulties finding long series for the European countries' output gap. The output gap is available in the OECD data only posterior to 1964, 1967, 1974 and 1987, respectively for Italy, Germany, France and the UK. We have thus backcasted the available output gap data using the HP filter applied to GDP at constant prices. This method has provided a good approximation to the OECD indicator over the most recent period. To compute a structural balance between 1963 and the last year for which data were unavailable, we have used elasticities of 0.31, 0.44, 0.32 and 0.49 of the cyclical balance with respect to the output gap, respectively for Italy, Germany, France and the UK. These elasticities were obtained from a linear regression of total government balance on structural balance and the output gap over the available sample.

[15] Including base money in the net liabilities of the government, there is still scope for price and inflation determination to be exclusively a monetary phenomenon, i.e. what the Quantity theory conveys as a major conclusion.

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