Using structural balance data to test the fiscal theory of the price level: an application to France and the USA*

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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 (1998) based on "observational equivalence" arguments.

This papers proposes two extensions to the empirics of the FTPL. First, we apply the methodology initiated by Canzoneri, Cumby and Diba (2001) to French data. Second, we use US and French structural balance data, in order to overcome Cochrane's critique. Our conclusion is that for neither country the data support a FTPL interpretation.

Keywords: Fiscal theory of the price level, fiscal policy, monetary policy, VAR

JEL classification: E17, E63, H63

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1 Introduction

The development of the Fiscal Theory of the Price Level (hereafter, FTPL) has renewed interest for the theoretical determination of the price level. The FTPL links price determination to the government present value budget constraint, i.e. the equality of the public debt expressed in real terms 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 might jump in order to fulfill the present value budget constraint.

There have been few attempts to test this theory on empirical grounds, in part because of its reliance on future events. A notable exception is Canzoneri et al. (2001), who use the VAR methodology to assess the FTPL. They show using US data that positive shocks to the primary surplus provoke a fall in the public debt to GDP ratio, which they interpret as rejection of the FTPL.

Their methodology was quite severely criticised by Cochrane (1998) who argued that their results may in fact be consistent with the prevalence of a FTPL regime. Basing upon the distinction between the cyclical and structural components of the primary surplus, Cochrane demonstrates theoretically that a negative correlation between the innovations of both components can produce with impulse reaction functions of the form given in Canzoneri et al. (2001), even though the FTPL prevails. Although Canzoneri et al. (2001) acknowledge Cochrane's critique, they perform only a limited investigation on this point.

This paper proposes two extensions to the empirics of the FTPL. First, we apply Canzoneri et al. (2001)'s methodology to the case of France. Empirical analysis for the USA is reported to serve as a benchmark. Second, we incorporate structural balance data into the analysis in order to gain some immunity from Cochrane's critique. We investigate whether, assuming a FTPL regime, the joint structural and cyclical deficit process is able to produce empirical impulse response functions that would lead to apparent rejection of the FTPL. Unlike Canzoneri et al (2001), we furthermore allow for lagged cross-correlations between both components of the primary surplus.

The rest of the paper is organised as follows. The second section reviews the macroeconomic implications of the FTPL and the different empirical tests which have been used so far in the literature to invalidate it. The controversy between Canzoneri et al. (2001) and Cochrane (1998) is discussed. The data and methodology used

in the paper are presented in the third section. The fourth section is devoted to our empirical results. The main findings are twofold: first, using the methodology of Canzoneri et al., the FTPL must be rejected in the case of France also; second including structural fiscal data to account for Cochrane's insights, does not provide support to a FTPL interpretation of the data.

2 Testing the FTPL

2.1 The FTPL: an overview

The FTPL emphasises that the price level is able to 'jump' in relation to the government present value budget constraint.This theory 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. Unlike in the process developed by Sargent and Wallace (1981), the mechanism underlying the FTPL, while directly linked to the present value budget constraint, does not hinge on the variation of the monetary aggregates and the monetisation of public debt.

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 surplus.

This condition can be formulated in terms of GDP shares as:

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

where $b_t = \frac{B_t}{p_t y_t}$ 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 the growth corrected real interest rate. For convenience, we assume the expected real rate to be constant, equal to r. The flow condition can be solved forward to yield the present value budget constraint:

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

Equation (3) is an accounting identity. *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 equation (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. This condition is also used as a sustainability condition for public finances, so that:

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

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 equation (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.

In the second case, the fiscal authority does not act in accordance with the satisfaction of its budget constraint, so that p_t must adjust to ensure the equilibrium. For instance, at time 0, if future primary surpluses are set exogenously, and both initial nominal debt obligations and real GDP are predetermined, the general price index is set to satisfy the present value budget constraint according to:[1]

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

According to Woodford (2001), the *ex post* satisfaction of the present value budget constraint is obtained through a private net wealth effect: following a change in the sequence of future primary surpluses, due to expected lower taxes, households feel wealthier and thus consume more, so that the price level increases until their real net wealth returns to its initial level.

Needless to say, the FTPL poses a considerable challenge for existing theories of price level determination. The FTPL produces a "jumping general price level", so that formally the FTPL resembles the Quantity theory of Money. In fact, the FTPL is meant to substitute the Quantity theory of money with a Quantity theory of the Public Debt (Woodford, 1995). One motivation for this is that financial innovations

[1] 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, hence raising future inflation (Cochrane, 2001).

have largely challenged the foundations of the Quantity theory of money. Indeed, the transaction demand for money is very difficult to delimit, and central banks may not perfectly control a monetary aggregate.

In the alternative framework where central banks set short run nominal interest rate according to a feedback rule, the FTPL places important restrictions on monetary policy behaviour. Indeed, the determination of the price level depends on the interactions between monetary and fiscal policies. First, if the government adjusts its future primary surpluses to meet equation (4), the fiscal policy is called 'passive' (see Leeper, 1991). Leeper (1991) showed that 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. This first regime is a regime with a dominant monetary player (using the terminology of Canzoneri et al., 2001) or a Ricardian regime (using the terminology of Aiyagari and Gertler, 1985). Second, if the government does not adjust its future surpluses to meet equation (4), fiscal policy is called '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 to curb public debt growth. This second regime is a regime with a fiscal dominant player or a non-Ricardian regime. The FTPL holds in this latter case and the price level is able to jump.

These two economic regimes, 'Ricardian vs. non-Ricardian', are at the heart of a recent empirical controversy between Cochrane (1998) and Canzoneri et al. (2001). Cochrane showed that the VAR analysis of the latter authors (see the following sections for details), which provides "evidence" of a negative correlation between debt and surpluses (a Ricardian regime), may in fact hide a positive relationship, if one can demonstrate that long term fiscal surpluses are negatively correlated with cyclical ones and that the latter is less persistent than the former. This "observational equivalence" is striking, but Canzoneri et al. show that the correlation between the two surpluses is very low in the US case and thus cannot hide a non-Ricardian regime. We discuss this specific point later on.

2.2 Alternative tests of the FTPL

Several alternative approaches can be considered for testing the FTPL. First, a straightforward idea would be to use the price level as a left-hand side variable

and assess using price data if the following equation holds:

$$p_t = B_t y_t (E_t \sum_{j=1}^{k} \frac{1}{r^j} s_{t+j})^{-1}.$$

However, this approach has been seldom implemented in the literature. One main reason is that such an equation relies on the joint hypothesis of the FTPL and fully flexible prices. Woodford (1996) nonetheless showed that the FTPL could be consistent with sticky prices (although not with sticky inflation, as argued by Creel and Sterdyniak, 2001). In the case with sticky prices, the above equation does not hold exactly. We thus did not pursue the idea of performing a direct test.

Most tests have focused on the behaviour of monetary and fiscal authorities. Following the analysis by Leeper (1991), the behaviour of policymakers determines whether the economy falls in a Ricardian or non-Ricardian regime. In particular, as suggested by Woodford (1998), estimating monetary policy reaction functions should reveal whether central banks behaviour is consistent with the FTPL. Leeper's characterisation of a 'passive' monetary policy rule, consistent with the FTPL, is that the so-called Taylor principle is violated, i.e. the inflation coefficient in the interest rate rule is inferior to unity. Evidence on monetary policies rules following Clarida et al. (1998) suggests that the Taylor principle has been empirically observed in most industrial countries, ruling out the FTPL. However, evidence is not definitive for at least two reasons. First, the finding that the Taylor coefficient is greater than one might not be robust to the period (Clarida et al., 2000) or to the estimation methodology (Woodford, 1998). Second, even if monetary policy is 'active', fiscal policy might still be 'active' (hence might follow a non-Ricardian behaviour) resulting in an unstable regime. In this situation, the fiscal behaviour clearly influences the price level, though in a destabilising manner.

We therefore consider tests relying on the fiscal behaviour. Leeper (1991) and Canzoneri et al. (2001) showed that a Ricardian regime is obtained as long as the primary surplus responds positively to debt. This condition is in particular met if the fiscal authority follows a fiscal reaction function of the following type:

$$s_t = \alpha b_{t-1} + \varepsilon_t \tag{5}$$

Such a feedback rule implies that equation (4) will hold for whatever level of p_t, hence that the regime is Ricardian. Hence, empirical evidence on fiscal feedback

rules, such as the one provided by Bohn (1998), have been interpreted as a rejection of the non-Ricardian regime, i.e. a rejection of the FTPL.

2.3 Fiscal policy and the FTPL: the controversy

Cochrane (1998, pp.340-1) has forcefully criticised this interpretation of feedback rules and stated that the FTPL is subject to an "observational equivalence" phenomenon. Cochrane's claim relies on the fact that an equation of the form (5) may hold as an equilibrium relationship even in a non-Ricardian setting, and thus does not provide conclusive evidence of a Ricardian regime.

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

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

with $0 < \rho < 1$ and v_t is i.i.d..

Then, in a non-Ricardian regime, the price level at time $t-1$ will follow if, as assumed, the real interest rate is constant:

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

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

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

This latter equilibrium condition cannot be distinguished from a Ricardian feedback rule (5).

The VAR approach introduced by Canzoneri et al. (2001) can be considered as 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 (5). Canzoneri et al. observe that in a FTPL regime, the real value of debt should increase following a rise in the surplus, at least if the surplus series present some positive auto-correlation. They estimate a bivariate VAR model using the surplus and debt series, and then study the properties of the impulse response functions. They find that after a positive surplus shock, the real value of debt decreases. They thus conclude in favour of a Ricardian regime and reject the FTPL.

However, Cochrane (1998, pp.368-70) argued that an "observational equivalence" issue also applies to the Canzoneri et al. (2001) VAR approach. He proposes the following example. Suppose that the observed surplus is the sum of two components:

a cyclical component (a_t) and a structural component (z_t) which respectively follow AR processes:

$$a_t = \eta_a a_{t-1} + \varepsilon_{at} \quad (6)$$

$$z_t = \eta_z z_{t-1} + \varepsilon_{zt} \quad (7)$$

$$s_t = z_t + a_t \quad (8)$$

The structural balance component is assumed to be more persistent than the cyclical component. Suppose also that the economy is in a FTPL regime so that $b_t = \sum_{j=1}^{\infty} \beta^j s_{t+j}$, where $\beta = \frac{1}{r}$. Real debt shall therefore be positively correlated with the sequence of future discounted primary surpluses.

Solving this forward-looking discounted sum yields:

$$b_t = \frac{\beta\eta_a}{1-\beta\eta_a} a_t + \frac{\beta\eta_z}{1-\beta\eta_z} z_t \quad (9)$$

Using $Y_t = (s_t, b_t)'$, $X_t = (a_t, z_t)'$, and putting together equations (6) to (9) into a state-space system yields:

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

$$Y_t = MX_t$$

where $A = \begin{bmatrix} \eta_a & 0 \\ 0 & \eta_z \end{bmatrix}$, $\varepsilon_t = \begin{pmatrix} \varepsilon_{at} \\ \varepsilon_{zt} \end{pmatrix}$ and $M = \begin{bmatrix} 1 & 1 \\ \frac{\beta\eta_a}{1-\beta\eta_a} & \frac{\beta\eta_z}{1-\beta\eta_z} \end{bmatrix}$

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

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

with $u_t = M\varepsilon_t$.

If the innovations in the two components of the primary surplus are negatively correlated (with $E(\varepsilon_{at}\varepsilon_{zt}) = \rho_{az}\sigma_a\sigma_z < 0$), then the innovations of 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 is assumed to prevail A rationale for the negative correlation is that after a decrease in the cyclical component of the primary surplus, the government may tend to increase the structural component of

the surplus. The persistence of the latter variable is high, so that, *in fine*, real debt increases because the present value of total surplus has increases. 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 Canzoneri et al. consider sufficient to reject the non-Ricardian regime. One can therefore observe, at the same time, a negative correlation between a shock on the surplus and real debt (a "Ricardian" impulse response function) and an equality between real debt and the sequence of future discounted surpluses (a non-Ricardian regime). Cochrane's (1998) critique thus suggests that the methodology used by Canzoneri et al. (2001) should be supplemented with the inclusion of cyclical and structural components of the primary surplus. For high values (in absolute terms) of the negative correlation between the innovations in both components, the observed negative correlation in the innovations of the debt-surplus process might in fact hide a FTPL situation rather than its rejection.

The empirical approach followed in this paper, - it is described in the next sections -, will hence build upon Canzoneri et al.'s methodology and take meanwhile into account Cochrane's critique.

3 Data and methods

This section presents the data we use as well the two steps we follow in the empirical approach : first, we estimate, respectively on French and US data, a bivariate debt-surplus VAR model in the spirit of Canzoneri et al. (2001). Then we use structural balance data to cope with Cochrane's "observational equivalence" argument.

3.1 Data

We use annual over the sample 1963-1999 (note that for the US the data are available from 1957). All US series are taken from the Congressional Budget Office (CBO) dataset. For France, the sources are the OECD and the INSEE (Institut National de la Statistique et des Etudes Economiques). The output gap for France is available in the OECD data only posterior to 1974. We have backcasted it using the HP filter, which has proven a good approximation to the OECD indicator over the most recent period. To compute a structural balance over the 1963-1973 period, we have used an elasticity of 0.38 of the cyclical balance to the output gap, consistent with a linear

regression of total government balance on structural balance and the output gap on the available sample. The interest paid by the goverment over the whole sample period are taken from various INSEE publications. Data are pictured in **figures 1 and 2**, and table A 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 either raise the price level or provoke the expectation of high future surpluses. Looking at time series, it is therefore really difficult to assess the capacity of a given country to be in a non-Ricardian regime.

In the USA, for instance, although public deficits tended to increase in the sixties-seventies, the net public debt to GDP ratio decreased substantially until the mid-seventies. This is not surprising in a period of high inflation with negative real interest rates and mainly non-indexed debt. This might also be consistent with the FTPL. Moreover, the public deficit on GDP ratio seems to have always largely swung, with a positive trend until the eighties. Every 4 to 5 years, public surpluses nonetheless reemerged after the deficit had reached a peak : in 1959, 1968, 1976, and 1983. These peaks were generally due to external shocks: wars (Korea, Vietnam) or soaring oil prices. These swungs in the public deficits and the on-going rise in the public debt to GDP ratio since 1974 might well be consistent with a FTPL regime: increases in the deficits have given rise to higher debt and offsetting surpluses which satisfied the government present value budget constraint. The latest large peak for public deficit could be attributed to discretionary expansionary fiscal policy: under the Reagan administration, larger public expenditures in the defense sector, lower tax rates and the increase in net interests had a major impulse on public deficits. Since the mid-eighties, this trend has been reversed, except during a short period (1989-93) of economic turmoil. Under the Clinton administration, better economic conditions and discretionary measures to curb the growth in public expenditures benefit the public surplus[2]. In the eighties, the Reagan deficits and high real interest rates fueled net debt. It soared to about 50% of GDP in the early 90s. In 1999, net debt on GDP had come back to its level of 1964 and 1986. At first sight, this ratio seems rather stationary, implying the sustainability of US public finances, the latter element being a necessary but insufficient condition to be in a FTPL regime.

[2]On this topic, see the special issue in the FRB of New York Economic Policy Review, April 2000.

Data for France are less volatile than for the US. Peaks and troughs are more spaced in time. Still in comparison with the US, the trend towards higher deficits has been a very long process which has ended only in 1993, after a small improvement and a stop during the late eighties. Lower deficits seem to begin with during the European convergence process, i.e. after the Maastricht Treaty. The situation of French public finances is rather emblematic of the dramatic consequences of the real interest jump in the early eighties. Until 1980, net public debt on GDP in France was nil, even negative, although public finances were in deficit until 1975. After this year, this ratio never stopped increasing, with a very steep slope from 1980 to 1986 (real interest shock) as well as between 1992 and 1996 (economic slowdown). In 1999, the ratio equalled almost 45% of the GDP. At first sight, French public debt to GDP ratio appears non-stationary. Adopting a FTPL view, the steep rise in the public debt to GDP ratio until 1990 might hide the expectations of primary surpluses. The convergence process with the limitations on public deficit and the adoption of the Stability and Growth Pact for countries in the Euro area hence could have changed the expectations on future fiscal policies. Data for France clearly show that the primary balance has been in surplus until 1996, which could be analysed as a favourable trend for satisfying the government present value budget constraint.

3.2 Sustainability, the FTPL and the time series properties of fiscal data

The FTPL has strong links with the issue of government solvency : the FTPL does imply sustainability. Indeed sustainability is usually defined by the condition $E_t(\frac{1}{r^k}\frac{B_{t+k}}{p_{t+k}}) = 0$ when k tends to the infinity, which is assumed to hold under FTPL (equation (4)). Note that .the reverse is not true: the sustainability condition is consistent both with the FTPL hypothesis and with a Ricardian regime.

Sustainability implies some restrictions on the time series properties of debt and deficit, which have been discussed at length by the literature since Hamilton and Flavin (1986). For instance, sustainability should imply that the overall (interest-inclusive) deficit is stationary. Furthermore, one restriction implied by the sustainability hypothesis is that, if the government surplus process is non-stationnary, it should be cointegrated with real debt (Trehan and Walsh, 1991). Bergman (2001) notes that, insofar as the rate of time preference is strictly above zero, the sustainabil-

ity of public finances is satisfied with government debt integrated of any finite order, provided government revenue and expenditures are cointegrated. Fève and Hénin (2000) define "effective sustainability" as real debt to GDP ratio being stationnary.

Empirical tests of government solvency have provided various results, with a tendency to reject sustainability (see e.g. Roberts, 1991, for the US, and Jondeau 1992 for France). An intuition of these findings is provided by the result of ADF unit-root tests reported in **table A (**lag number was selected using the AIC). The unit-root hypothesis cannot be rejected at the 5% level for any of the series. In particular, non stationarity of the interest-inclusive surplus points to non-sustainability. Note that for France primary surplus, cyclical surplus and structural surplus are found to be stationary at the 10% level. That cyclical surplus in the U.S. and in France (at the 5% level) are found to be non-stationnary is puzzling and may reflect the lack of power of unit-root tests in small-sample (the number of observations is 36).

Rejection of sustainability should of course imply rejection of the FTPL. Here, we adopt a favourable prior towards the FTPL, and follow the VAR in level approach proposed by Canzoneri et al (2001), which assumes sustainability. One motivation for this is the low power of unit root and cointegration tests in small samples. The main motivation is that, as Canzoneri et al., we want to test the FTPL hypothesis versus a Ricardian regime, both of which require sustainability. To discriminate between these two hypotheses, we therefore focus on the short-run properties of the system, as provided by the impulse-response functions, rather than on long-run properties. In the FTPL, 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 debt to nominal GDP ratio can jump, we expect the response of debt to a surplus shock to be positive in a FTPL regime.

3.3 Using cyclical and structural balance dynamics

In the second step of our empirical analysis, we use structural balance data 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. Canzoneri et al. (2001)

have verified that the innovations in US structural and cyclical components were uncorrelated and have concluded that the FTPL could be rejected.

However, this test is quite rough since it relies only upon the contemporaneous correlation between structural and cyclical balance. We propose to extend it to lagged cross-correlations between those two series. Indeed, we consider a more general non-diagonal A matrix in Cochrane's example. Assume, as in the example above, that:

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

but with now

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

X_t follows a VAR rather than two AR processes. If the FTPL still holds, $b_t = \sum_{j=1}^{k} \beta^j s_{t+j} = \sum_{j=1}^{k} \beta^j (a_{t+j} + z_{t+j})$, the instantaneous impact on real debt of a shock to cyclical balance can be written as:[3]

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

where $e = (1, 1)$, $e_1 = (1, 0)$ and P is the Cholesky decomposition of the covariance matrix of ε_{at} and ε_{zt}. Matrix P is thus lower triangular (i.e., we recursively order the shocks so that a shock on a may have an impact on z but the reverse is not true).

Depending on the coefficients in matrices A and P, b_∞ can be negative. In particular, even with uncorrelated contemporaneous innovations, the dynamic interactions between the cyclical and the structural components might produce a negative response of real debt following a positive surplus shock, even in a FTPL world.

This test with lagged cross-correlations can be implemented empirically estimating a 2-variable VAR with structural balance and cyclical balance.

4 Empirical results

4.1 A bivariate Debt-Surplus VAR

We first estimate a bivariate Surplus-Debt VAR model over the period 1964-1999 respectively for France and the USA[4]. Estimation results are given in **table B.**

[3] We use $\mathrm{E}_t(a_{t+k} + z_{t+k}) = eA^k X_t$

[4] While series are available for a longer span in the case of the US, this sample period has been chosen so as to be similar for both countries.

In the US case, we replicate the analysis of Canzoneri et al. (2001) with only 4 more years of data. The main difference with their study is that, due to the inclusion of the most recent years, a 2 lag VAR is needed rather than a 1 lag VAR. Impulse response functions for the surplus shock, with the surplus shock ordered first, are pictured in **figure 3.** For the US, they are very similar to those obtained by Canzoneri et al.. A positive shock on the surplus provokes a decrease in public debt. Note that this result is robust to the ordering of the VAR.

For France, we estimate a VAR with a single lag, as supported by LR tests (LR statistic for 1 lag against 2 lags is 2.73 with a p-value of 0.396 from the $\chi^2(4)$ distribution). This lag length is supported both by the Akaike and the BIC criteria. The main result from the impulse response functions is that, as in the US case, the debt decreases after a positive surplus shock has occurred. Confidence intervals indicate that this decrease is statistically significant at least for 10 years. This pattern is consistent with a Ricardian interpretation: favourable fiscal shocks helps reducing government debt. Note that the finding is robust to the ordering of the VAR and to the inclusion of additionnal lags in the VAR model[5].

4.2 Incorporating structural balance data

We now incorporate structural primary balance data into the analysis.

4.2.1 The structural and cyclical balances as AR processes

First, we model the structural and cyclical balances as AR processes. Results are reported in **table C.**

In the case of France, we obtained an AR(1) model for the structural primary surplus. The autoregressive term is 0.60. The cyclical balance can be modelled either as an AR(2) model, with autoregressive parameters of 0.92 and -0.28 respectively for the first and second lags, or as an AR(1) model, with parameter 0.71. A first important finding of this univariate analysis is that, contrary to the intuition, the cyclical balance is more persistent than the structural balance. Furthermore, the innovations for the two AR processes appear to be uncorrelated (correlation coefficient is $\rho = -0.02$). Both elements point against the FTPL interpretation of the data.

[5] These latter results are available from the authors upon request.

For the US, one lag is enough to model the structural balance (whose autoregressive parameter is equal to 0.69) and the cyclical balance (whose autoregressive parameter is equal to 0.79). Contrary to the result reported in Canzoneri et al. (2001), and although we share the same source for the data, the cyclical component of the primary surplus is, like for France, more persistent than the structural surplus process. The difference between our results and Canzoneri et al's results regarding this specific topic may be due to the fact that the latter authors do not actually use *structural primary* surpluses but *interest-inclusive structural* surpluses. Indeed, they report using "standardized-employment" figures from the CBO which are not based, as far as we know, on the net-of-interest public deficit[6]. To obtain the structural primary surplus, we took the interest-inclusive structural figures (a positive sign represents a net asset) and added the net interests (a positive sign represents a net liability), where both series come from the CBO database. At last, we give evidence that the innovations in the cyclical and structural components of the primary surplus are uncorrelated ($\rho = -0.03$).

4.2.2 A 2-variable VAR including the cyclical and the structural primary balance

In light of the normative example given in section 3.1 above, we investigate for the relevance of Cochrane's observational equivalence argument as applied to the preceding evidence. We follow a two-step approach. First, we estimate a VAR with the cyclical and the structural balance. Second, we compute the change in the value of the debt when there is a shock on the cyclical surplus, assuming the FTPL hypothesis holds (the ordering for the VAR is such that the cyclical surplus comes first). We compute the afore-mentioned formula: $b_\infty = e\beta A(I - \beta A)^{-1} * P * e_1'$. Recall that if b_∞ is negative, a "Cochrane effect" is present and the FTPL cannot be rejected on grounds that the contemporaneous innovations in the cyclical and structural components of the primary surplus are uncorrelated. In the computation β was set equal to 0.99, consistent with the interpretation of this parameter as a growth-corrected interest rate.

[6] Using US structural interest-inclusive and cyclical surpluses, on the sample 1957-1995 (the beginning year is the first available for the structural balance in the CBO dataset - the end-of-sample year is taken from Canzoneri et al.), we checked that the structural component is very slightly more persistent (AR component equal to 0.687) that the cyclical one (0.685).

VAR results are reported in **table D.** We selected a 1-lag VAR for both countries, which is supported by the BIC. Note that for the US a 2 lag VAR, which is also consistent with the data and is selected by the AIC and LR test, provides similar results For both countries, the correlation between innovations ε_{at} and ε_{zt} is non-significant ($\rho_{US} = -0.02$ and $\rho_{France} = 0.07$), so that the ordering of shocks is of low importancel. 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 creating negative long run autocorrelation in the overall surplus. Assuming a Non-Ricardian regime, we find b_∞=2.88, so that the FTPL should be manifest in the response functions. Allowing for a 2 lag VAR provides an even higher value for b_∞ : b_∞=6.04.

For France, the lagged cyclical surplus appears with a negative sign b_∞=-0.18. At face value, this result indicate that we may observe a Ricardian impulse response function even if a Non-Ricardian regime prevails. However the parameter value is very weak. Moreover, this parameter is not stable across time. **Figure 4** reports recursive computation of b_∞ (binf) and the residual correlation, following recursive estimation of the VAR parameters.

On the whole, the actual structural-cyclical balance dynamics provide low support to a FTPL interpretation of the surplus-debt impulse response function.

4.2.3 A 3-variable VAR including the debt, the cyclical and the structural primary balance

Last, we estimate a VAR including the public debt, the cyclical and the structural balance. This is an unrestricted version of Canzoneri et al. (2001) test as well as an unrestricted version of the tests performed and presented above: here, a FTPL regime is not assumed and we rather investigate the dynamic properties on debt of a shock on the primary surplus, via impulse reaction functions.

With French data, we still compute a one-lag VAR whereas, in the US case, two lags are necessary according to the LR test. Results are threefold. First, for both countries, 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. This may somewhat dampen the resort to feedback policy rules to invalidate the FTPL. Second, whether the cyclical or the structural surplus are

raised, the public debt to GDP ratio always falls (see **figure 5** reporting impulse response functions for both surplus shocks). As in section 4.1 the IRFs have a more plausible interpretation in a Ricardian set-up than in a FTPL world. Last, these impulse response functions are robust to the sample period. Although a rise in the US structural primary surplus tends to increase public debt in the long run, when using a shorter sample, this debt rise is not statistically significant.

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 questioned the empirical plausibility of the FTPL in France and in the USA. We gave much attention to the "observational equivalence" argument developed by Cochrane (1998). This arguments points 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 function of a VAR model, either a two- or three-variable VAR, either with the primary surplus or with its two separate components (cyclical and structural), are always consistent with the benchmark results by Canzoneri et al. (2001). The FTPL hypothesis should thus be viewed as non-plausible for France and the USA. 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 suject to several limitations. First, the analysis has been conducted under the implicit assumption of constant expected discount rate. Allowing for a time-varying discount rate may provide some support to an FTPL interpretation of the data. Second, the approach supposes very flexible prices. A remaining question is thus what are the empirical implications of the FTPL in a sticky-price environment.

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Table A : Summary statistics

	Sample mean	St. Dev.	Min	Max	ADF t-stat.		Lags
France							
Primary Surplus	0,25	1,06	-2,38	2,13	-2,75	*	1
Debt	10,65	14,85	-3,35	43,20	1,04		1
Overall surplus	-1,84	1,84	-6,00	0,93	-1,82		1
Primary structural surplus	0,46	0,90	-1,42	2,07	-2,70	*	1
Cyclical surplus	-0,21	0,57	-1,05	1,06	-2,64	*	1
The US							
Primary Surplus	-0,18	1,63	-3,43	3,88	-1,56		1
Debt	35,57	8,37	23,86	49,49	-1,67		1
Overall surplus	-2,41	1,83	-6,04	1,36	-1,67		1
Primary structural surplus	0,49	1,11	-2,06	2,50	-2,47		1
Cyclical surplus	-0,67	1,21	-3,08	1,38	-2,00		1

Note : ratio over GDP, percentage point. Sample period 1964-1999
Lag lenght for ADF test selected according to AIC.
'*' indicate rejection of the unit root hypothesis at the 10% critical level.

TABLE B : VAR estimates Primary Surplus-Debt

Sample : 1964-1999

France			**The US**		
	SP	DD		SP	DD
SP(-1)	0,64	-0,93	SP(-1)	0,27	0,84
	0,15	*0,34*		*0,34*	*0,50*
SP(-2)			SP(-2)	0,03	-0,33
				0,18	*0,27*
DD(-1)	0,00	1,03	DD(-1)	-0,22	1,99
	0,01	*0,03*		*0,19*	*0,29*
DD(-2)			DD(-2)	0,31	-1,09
				0,21	*0,31*
Constant	0,08	1,11	Constant	-3,21	3,61
	0,19	*0,43*		*1,11*	*1,65*
Adj. R-squared	0,34	0,98		0,57	0,96
s.e. equation	0,86	1,96		1,07	1,60
AIC	2,62	4,27		3,11	3,91
SC	2,75	4,40		3,33	4,13
System					
Residual correlation		-0,62			-0,87
Log Likelihood		-109,22			-90,83
Akaike Information Criteria		6,40			5,60
Schwarz Criteria		6,66			6,04

Note : SP : Primary surplus, DD Debt, Standard errors in italics

Table C: AR processes for cyclical and primary structural surpluses

Sample: 1964 1999

France

Dependent Variable: SSP (z_t)		
Variable	Coefficient	Std. Error
C	0,196	0,138
SSP(-1)	0,604	0,140
s.e.	0,738	
DW	1,875	
Akaike info criterion	2,285	
Schwarz criterion	2,373	

Dependent Variable: SC (a_t)		
Variable	Coefficient	Std. Error
C	-0,081	0,072
SC(-1)	0,921	0,168
SC(-2)	-0,283	0,167
s.e.	0,393	
DW	1,956	
Akaike info criterion	1,053	
Schwarz criterion	1,186	
Corr. of innovation SC,SSP1	-0,017	

The US

Dependent Variable: SSP (z_t)		
Variable	Coefficient	Std. Error
C	0,185	0,153
SSP(-1)	0,688	0,136
s.e.	0,848	
DW	1,758	
Akaike info criterion	2,562	
Schwarz criterion	2,650	

Dependent Variable: SC (a_t)		
Variable	Coefficient	Std. Error
C	-0,097	0,156
SC(-1)	0,798	0,115
s.e.	0,791	
DW	1,731	
Akaike info criterion	2,424	
Schwarz criterion	2,512	
Corr. of innovation SC,SSP	-0,026	

Note : SC cyclical surplus, SSP primary structural surplus

TABLE D: VAR estimates Cyclical Surplus-Primary Structural Surplus

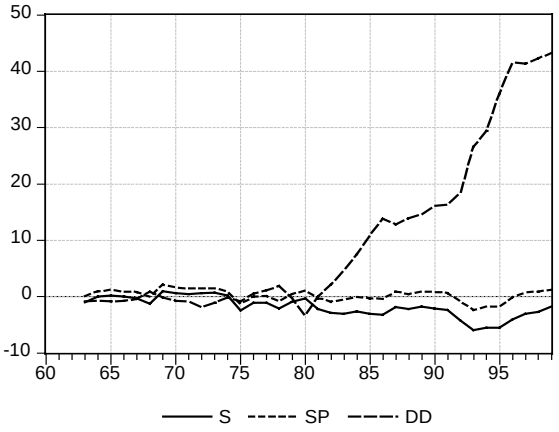
Sample : 1964-1999

France			**The US**	
Dependent var.:	SC	SSP	SC	SSP
SC(-1)	0,71	-0,35	0,78	0,19
	0,12	*0,21*	*0,11*	*0,12*
SSP(-1)	0,12	0,60	-0,18	0,71
	0,07	*0,14*	*0,13*	*0,13*
C	-0,11	0,12	-0,03	0,31
	0,08	*0,14*	*0,16*	*0,17*
Adj. R-squared	0,52	0,36	0,58	0,44
S.E. equation	0,39	0,72	0,78	0,83
AIC	1,05	2,26	2,42	2,54
SC	1,18	2,40	2,55	2,68
System				
Residual correlation		0,07		-0,02
b_{inf}		-0,18		2,88
Log Likelihood		-53,60		-83,36
AIC		3,31		4,96
SC		3,57		5,23

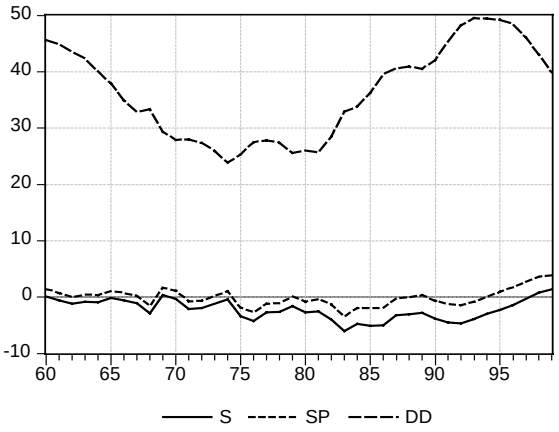
Note : SC cyclical surplus, SSP primary structural surplus, Standard errors in italics

Figure 1 : Debt, Surplus, Primary Surplus

France



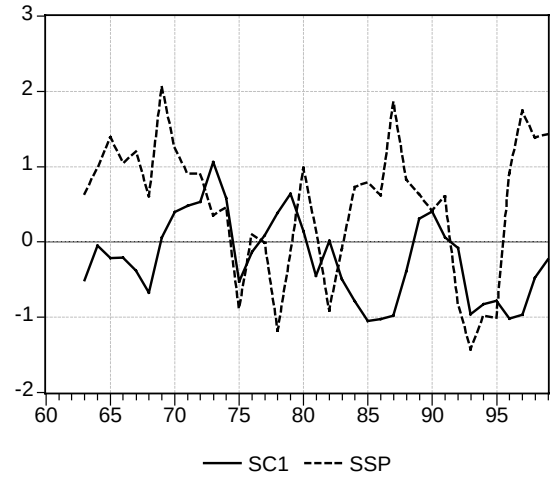
The US



Note : S : surplus, SP : Structural surplus , DD : public debt (ratios over GDP)

Figure 2 : Cyclical Surplus and Primary Structural

France



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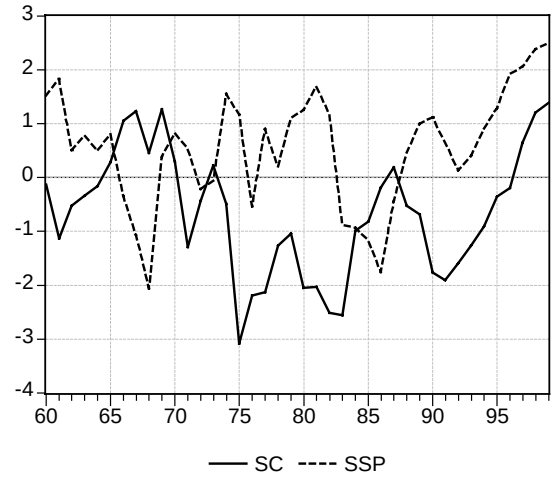
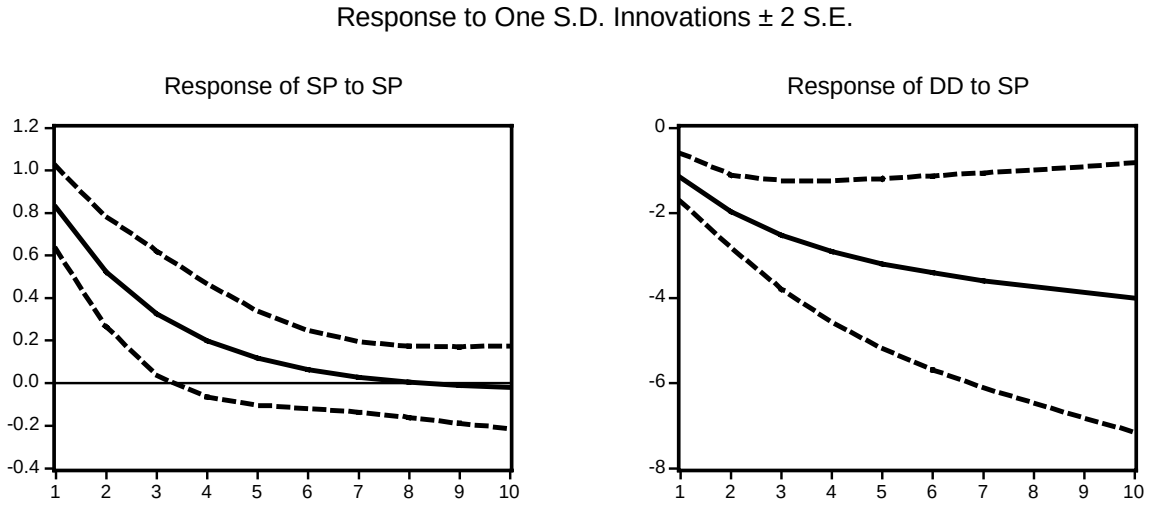


Note : SC, SC1 : Cyclical surplus SSP : Primary structural surplus (ratios over GDP)

Figure 3 : Impulse response function to surplus shock

France



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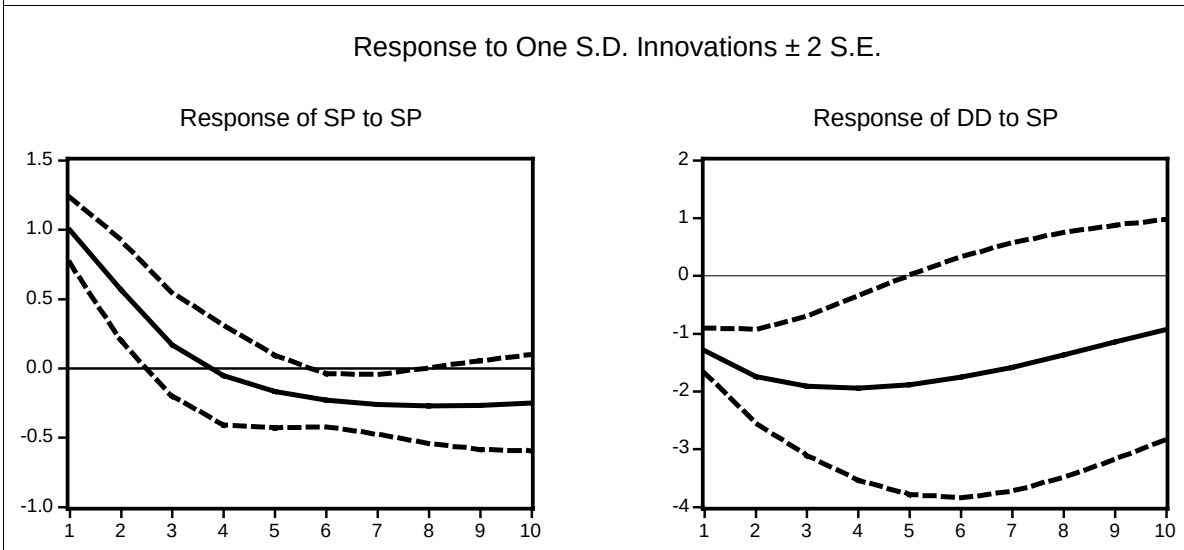
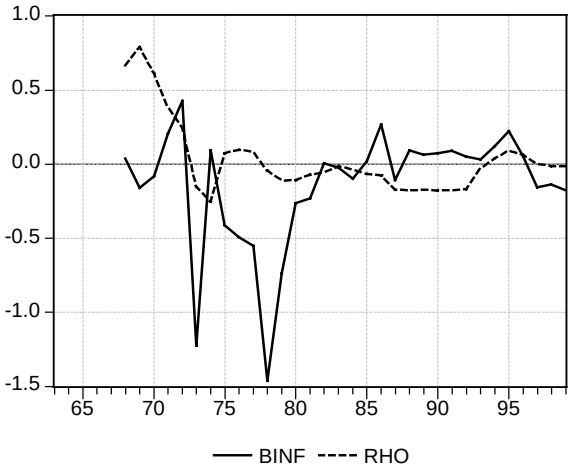


Figure 4 : Recursive estimate of b_K and innovation correlation

France



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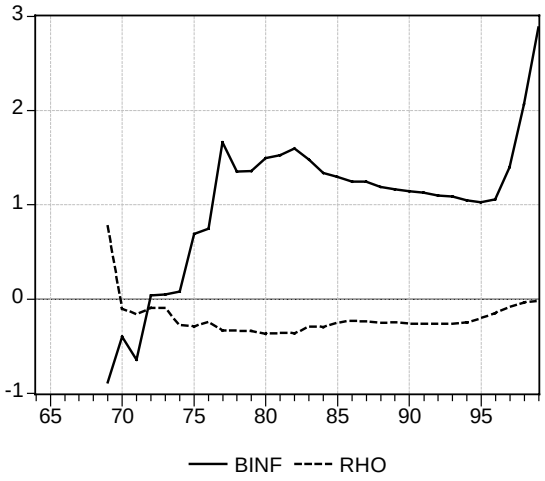
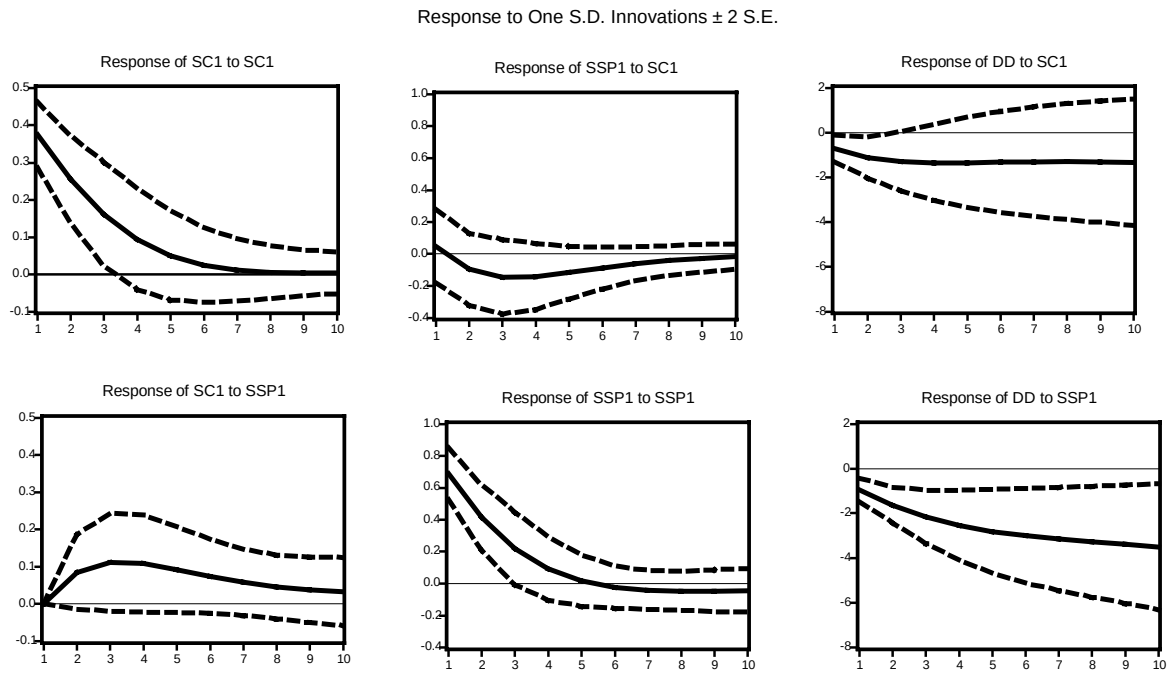


Figure 5 : Impulse response function to surplus shock, 3-variables VAR

France



The US