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Public debt ratio and its determinants in France since 1890
Does econometrics support the historical evidence?

Gilles Dufrénot[1] and Karim Triki[2]

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[1] Corresponding author : Aix-Marseille School of Economics, Banque de France and CEPII, Aix-Marseille Université, Postal adress : DEFI, Château Lafarge, Route des Milles, 13290, Les Milles. Tel : +33 4 42 93 59 60, Fax : + 33 4 42 38 95 85. Email : gilles.dufrenot@univ-amu.fr

[2] Banque de France, Direction de la Conjoncture et de la Prévision Macroéconomique, Service d'Étude des Politiques de Finances Publiques, 39 rue Croix des Petits Champs, 75001, Paris, Tel : +33 1 42 92 42 92, Email: karim.triki@banque-France.fr.

Résumé:

Peut-on prévoir l'évolution du ratio de dette publique à partir de ses principaux déterminants ? Alors que les récents plans de relance ont entrainé une envolée des ratios de dette publique, les facteurs susceptibles d'enrayer sa dynamique haussière font l'objet d'incertitudes et de débats entre économistes. Les seules consolidations budgétaires seront-elles suffisantes ? Faut-il revenir à des politiques inflationnistes, ou bien une forte croissance économique est-elle le facteur indispensable pour faire baisser le ratio de dette publique ? Ce papier propose une étude rétrospective du cas de la France sur longue période. Ce papier propose un modèle d'indicateurs avancés de l'évolution du ratio de dette et dont les résultats sont interprétés à la lumière de l'histoire économique. Il est démontré que depuis la fin du 19ème siècle jusqu'au début des années 1950, la croissance, l'inflation et le solde primaire sont des facteurs susceptibles d'expliquer l'alternance de phases de hausse et de baisse du ratio de dette. Puis, au cours des « trente glorieuses », une forte inflation et une forte croissance économique ont masqué les déséquilibres budgétaires naissant, tandis que les politiques budgétaires de «stop and go » étaient privilégiées. Les années 1980 ont marqué une rupture car la croissance et l'amélioration des soldes publics primaires ne permettaient plus d'infléchir la dynamique haussière de la dette.

Mots-clés : Dette publique, ratio de dette, indicateurs avancés, histoire économique

Classification JEL: H54C4

Abstract

Can the evolution of public debt be predicted from its determinants? While the recovery programs undertaken during the 2008 crisis have led to a big takeoff in public debt ratios, the factors likely to curb its upward spiraling dynamic are subject to considerable uncertainty and fuel debate among economists. Are budgetary consolidations alone sufficient? Is there a need to return to inflationary policies, or is strong economic growth the essential factor to bring about a drop in the public debt ratio? The present paper proposes a long term retrospective study of the French case. A model of advanced indicators for the debt ratio is proposed whose results are interpreted in the light of the historical context. It is shown that from the end of the 19th century to the beginning of the 1950s, growth, inflation and primary balances were factors capable of explaining the alternation between upward and downward phases in the debt ratio. Then, during the three decades of the post-war boom, very high inflation and economic growth masked nascent budgetary imbalances while the so-called "stop and go" policies were privileged. The 1980s marked a break in the sense that growth and improvement in the primary balances no longer allowed the upward dynamics of the debt ratio to be reversed.

Key words: Public debt, debt ratio, advanced indicators, economic history, forewarning indicator

JEL Classification: H54C4

1.- Introduction and motivation

The question of instruments to be used to reduce French public debt has been at the heart of the debates on economic policy since the 2008/2009 crisis led to a strong surge in its ratio expressed as a percentage of GDP. Public debt according to the Maastricht[3] definition amounted to 84.4% of GDP in 2010, representing an increase of 16.3 points of GDP as compared with 2008. This situation is all the more worrying in that the strong progression in public debt is not simply a phenomenon relating to the current economic situation, but is also structural in nature: debt has been increasing for 30 years following progression of the average annual public deficit of 3 points of GDP and no budget has been voted in order to achieve a balance since 1974. Hence questions as to the strategies that would allow this upward trend to be countered.

Three options at least usually fuel the debate between economists. The first would rely on a solution whereby a rate of inflation above the 2% target usually retained by the European Central Bank would be tolerated. For example, Olivier Blanchard, chief economist of the IMF proposed to raise this target to the level of 4%. In addition to the fact that it would allow the nominal growth rate to be increased and lead mechanically to a drop in the debt ratio, inflation would above all provide a means to reduce real interest rates (and thus stimulate growth) as the crisis is left behind. Critics of this proposal argue its uncertain effects considering the potential increase in risk premiums on public debt leading in turn to a snowball effect on debt.

A second solution to stop the progression of debt would be to reduce primary deficits. This approach provides the basis for current restrictive budget policies and measures aiming to constrain their development by rules (whether constitutional or not) and by stiffening the conditions of the European Stability and Growth Pact. However, the effects on the debt ratio are no less uncertain since economic growth, in the short and long term, is reliant on budget deficits. In the short term, automatic stabilizers dampen the effects of recession, while in the long term, the potential growth rate depends on public expenditure intended to improve the economy's competitiveness (with investment, research and development, and education). The effects of budget consolidation on the debt ratio thus depend on budget multipliers. In

[3] Under the Maastricht definition, a country's public debt is defined as the gross debts in nominal value, current or consolidated, of central public, local and social security administrations.

addition, cuts in public expenditure and tax hikes have redistributive effects whose impact on growth and debt should not be underestimated.

A third possible approach would be to adopt strategies allowing the trend in the growth rate of the economy to be pushed up above the interest rate on the debt. This strategy could indeed bring down the debt ratio in the short term, but its sustained impact will depend on the extent to which strategies for growth can be sustained, with some being liable to lead to imbalances (high private sector debt, creation of bubbles and an increase in global macroeconomic imbalances).

Strategies aimed at stopping the upward dynamic of public debt are thus subject to uncertainty and open to debate. The recent spiral of public debt following the 2008 depression led to the suggestion that models be constructed to better predict it on the basis of advanced indicators. While the accounting approach based on Government's budget constraints only allows for *ex post* analysis of contributions made by the determinants of the debt to the debt ratio, econometric models remain useful in conducting analyses in terms of prediction (thus *ex ante*).

The aim of the present paper is to study to what extent developments in the primary balance, growth in GDP, the debt burden and the rate of inflation, in a given year, allow changes in the evolution of the debt ratio from an upward to a downward trend. A conventional approach in addressing this question is to consider an indicator of vulnerability or fragility of the debt ratio and test the degree of predictability of the variables considered as advanced indicators (or warnings) of greater or lesser vulnerability. For the present purpose, a simple measurement for fragility of the debt ratio is retained by differentiating upward and downward phases in this ratio. An upward movement makes the government more vulnerable due to potential problems of sustainability that can arise in the long term, and through negative externalities that can weigh more heavily on its budget constraints (rise in premium rates, Ricardian effects). Conversely, when the debt ratio decreases, this kind of difficulty is less likely to be observed. Advanced or warning indicators retained here are quite simply the four basic determinants of the debt ratio as enumerated previously.

The period studied spans the years from 1890 to 2009. Our motivation for adopting a long-run perspective lies in the fact that the public debt ratio has been increasing on average for twenty five years and long series therefore need to be considered to encompass alternating periods of significant reductions in this ratio and periods showing an upward trend.

Furthermore, providing a historical perspective facilitates the comparison between different periods characterized by dissimilar economic policies and varying economic contexts. A number of authors have proposed works on changes in the French public debt over medium or long periods[4]. Their objective is to emphasize the salient features of the dynamics of debt over a number of centuries, or decades. Most of these works reason *ex post* in the sense that variations in the debt ratio are interpreted once they have occurred. Given the substance of current debate (thinking of the appropriate instruments to reverse the ever upward trend of the debt ratio), it may be of interest to reason *ex ante*, contemplating whether the rises and the falls in the public debt ratio observed in the past could have been foreseen, based on the observation of the dynamics of inflation, economic growth and budget policy orientations. Addressing this question will provide indications as to the way these variables can be worked on to reduce the debt ratio. We propose a model based on time-varying probability Markov switching process and show that over a period including the end of the 19th century and the entire 20th century, these variables have, since the middle of the 1980s, only a weak explanatory power to predict reductions in the debt ratio, including during the years of improvement in primary surpluses or accelerated growth. One of the interesting results here is that episodes of reduction in the debt ratio were only likely when they were preceded by substantial improvements in primary balances or substantial increases in growth rate, which does not seem to have been the case since the beginning of the 1980s. However, up until 1950, debt ratio determinants provided good predictors as to its downward trend. The results of our model of advanced indicators are interpreted in the light of historical fact, examining the effective contributions of inflation, economic growth and primary balances on how the debt ratio evolves.

The paper is organized as follows. Section 2 presents the data. Section 3 contains the econometric model. Section 4 provides some historical elements likely to explain the econometric results. Finally Section 5 concludes and discusses alternative strategies for reduction of the French public debt over the forthcoming years in light of the historical observations.

[4] See for example, Andreau et al. (2006), Eichengreen and Wyplosz (1988), Hautcoeur and Grottard (1995), Flandreau and Le Cacheux (1997), Insee (2006), Prati (1991), Reinhart and Rogoff (2008, 2009), Ritschl (1996).

2.- Data

We use annual data beginning in 1890, because before 1890 data on French public finances are scarcefor France. The accounting of public finance have changed several times over the period we consider. To our knowledge, no homogenous series are available from 1890 to 2009. So, we had to combine different existing databases giving priority to national sources.

Public finance data

For public finance data (debt, fiscal balance, debt burden), we limited ourselves to primary national sources by focusing on data from national accounts for several reasons. First, the international available debt serie from Abbas et al. (2010), is not accompanied by series of other fiscal aggregates (budget balance, debt burden), which makes the analysis of public finance data interactions difficult. Second, the series provided by Mitchell lacked details on sources that have allowed their construction. All in all, the series directly issued from national accounts or rebuilt using national accounting framework have the advantage of being already well analyzed in the past and used regularly by French Economic History specialists[5].

For 1890-1939 public finance data, our main source is Villa (1993) as it provides us with several series issued from 1938 national accounts which were reconstructed using available information coming from reference work. For instance, primary surpluses and interest rate payments were fixed at the 1938 accounting framework level and extended using L.Fontvieille (1976) growth rate. The author also provides us with a public debt serie, composed of state short term and long term debt, making this concept more easily comparable with current national account state debt serie (INSEE). On top of that, these series were initially built for long period econometric studies, providing us with annual time series without period breaks (especially war period).

For 1939-1949, we used data provided by INSEE retrospective statistics[6] (1966).

For 1949-1959, we used data provided by INSEE retrospective statistics (1990)[7].

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[5] L.A. Vincent, Évolution de la production intérieure brute en France de 1896 à 1938, études et conjoncture, n°11,1962,p933
L.Fontvieille, Evolution et croissance de l'État français, 1815-1969; Économie et sociétés, cahiers de l'ISEA,série AF n°13,1976
C . André, R. Delorme, l'État et l'Économie, un essai d'explication de l'évolution des dépenses publiques en France (1870-1980), Seuil, 1983

[6] Annuaire statistique de la France 1966. *Résumé rétrospectif*, Insee, 1966. (1913-1949)

Construction of public finance database

For flows series (primary balance, debt burden) 1949-1959 and 1959-2009, we fixed the level at 1959 actual accounting framework level (INSEE, 2000) and backward extrapolated the levels using Annuaire Rétrospectif de l'INSEE (1990) growth rates. As these series' ratio to GDP were consistent with the 1890-1948 series' ratio to GDP, we linked the two series, allowing us to obtain a seamless dataset for econometric analysis. We adopted the same process for debt series' construction, except that we have started the backward extrapolation in 1979 to ensure the consistency between the 1949-1979 data and the 1979-2009 data (INSEE does not provide us with data before 1979 in its actual accounting framework).

Primary surplus and interest rate payments

♦ For the period 1890-1939, we use the national accounts statistics (base 1938) constructed by Villa (1993) [8].

♦For the period 1939-1948, when data are not available from Villa (1993), we extrapolate his series using the retrospective statistics by INSEE, 1966[9]. The extrapolation is done by using the growth rate of primary surplus and interest payments provided by the INSEE statistics.

♦For the period 1949-2009, we use the statistics provided by the INSEE (national accounts base 2000)

Public debt

Information on public debt in national accounts before 1979 are not available before 1979, thus we used state public debt as a proxy, which is available since 1890.

♦For the period 1890-1938, we consider data from Villa (1993). Public debt consists of the short-term debt (treasury bills, current accounts and deposits, liabilities to the Central Bank), long-run debt (consolidated debt, long-term bonds), debt for the financing of the railway sector.

♦For the years 1939-1948, we again extrapolate the data provided by Villa (1993) using the growth rate of the INSEE retrospective statistics.

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[7] Annuaire rétrospectif de la France, séries longues, 1948-1988, Insee, 1990 (1948-1988)
[8] http://www.cepii.fr/francgraph/bdd/ villa/mode.htm.
[9] Annuaire statistique de la France 1966. *Résumé rétrospectif*, Insee, 1966. (1913-1949)

♦ For the years 1949-2009, we use the historical statistics provided by INSEE

GDP

♦For the period 1890-1948, we consider data from Villa (1993).

♦From 1949 onwards, the series come from the INSEE statistics

Inflation

The series used is that reconstructed from the methodology proposed by Piketty (2001). From 1890 to 1985 we used the annual inflation calculated by P. Villa. From 1985 to 2009, we focused on the long term index of consumer prices given by INSEE (conversion coefficient of Franc / Euro of a year in a Franc / Euro of another year).

3.- The econometric model

3.1.- A model of advanced indicators for the evolution of the debt ratio

We denote Δd_t the rate of growth of the debt ratio between years *t-1* and *t*. The dynamic of the debt is characterized by two regimes, with it either increasing or diminishing. We assume that neither of these two regimes is observable *ex ante*. Thus, a dichotomous variable is introduced taking values 1 or 2 according to the regime liable to emerge. 1 can represent either the regime of a rising or a falling debt ratio, with regime 2 then being defined as the complementary regime. Reduction in debt, following an increase, can occur in several ways: it can be extremely rapid, following drastic budgetary consolidation or a burst of inflation, or it can occur just a few years after a government initially succeeded in slowing down its increase; it can also be difficult to achieve due to a snowball effect. Similarly, the debt ratio can increase very rapidly, or more slowly, according to whether the government has managed (or not managed) to generate surpluses over the previous years. Consequently, the successive emergence of such regimes is prone to a phenomenon of inertia. The econometric model thus has to formulate hypotheses, not only as to the way in which these regimes occur in succession, but also on the speed of transition from one regime to another.

The observation of regime 1 or 2 for year t thus depends on the successive regimes that were achieved in years *t-1*, *t-2*,…, *t-k*. Since it is not known in advance which regime will emerge, a probability $P \in [0,1]$ has to be ascribed to its occurrence. To simplify matters, it can be admitted that the variable s_t follows a Markov process of order one, implying that the

development of the debt ratio in an upward or downward trend over a given year is influenced only by the regime observed the previous year:

$$P\{s_t/s_{t-1}, s_{t-2}, \cdots, s_{t-k}\} = P\{s_t / s_{t-1}\}. \quad (1)$$

As the dynamic of the debt ratio is theoretically influenced by the macroeconomic environment (growth, inflation and trend in interest rates) and budget policy (budget balance trends), it is reasonable to assume that the increase or reduction in debt from one year to another depends on these variables. Consequently,

$$P\{s_t / s_{t-1}\} = P\{s_t/s_{t-1}, z_t\}, \quad (2)$$

and

$$s_t = \begin{cases} 1, \ si\ \eta_t < a(s_{t-1}) + z_t\ b(s_{t-1}) \\ 2, \ si\ \eta_t \geq a(s_{t-1}) + z_t\ b(s_{t-1}) \end{cases}, \quad (3)$$

where z_t indicates the contemporary or past values of growth rate, inflation rate, interest rate payments, or the ratio of the primary balance. In equation (3), s_t is a linear function of z_t (known as the transition variable). The influence of budget policy and macroeconomic variables on the rate of variation in the debt ratio for a given year thus depends on the regime observed initially over the previous year. This explains why *a* and *b* depend on s_{t-1}. η_t is a random term whose cumulative distribution function is noted Φ. We thus write:

$$\begin{cases} P\{s_t = 1/s_{t-1} = 1, z_t\} = p_{11}(z_t) = \Phi(a_1 + z_t\ b_1) \\ P\{s_t = 2/s_{t-1} = 2, z_t\} = p_{22}(z_t) = \Phi(a_2 + z_t\ b_2) \end{cases}, \quad (4a)$$

j=1,2. To describe the changes a logistic form is retained for Φ. From equation (4a), the following can be deduced:

$$\begin{cases} P\{s_t = 2/s_{t-1} = 1, z_t\} = p_{21}(z_t) = 1 - \Phi(a_1 + z_t\ b_1) \\ P\{s_t = 2/s_{t-1} = 2, z_t\} = p_{12}(z_t) = 1 - \Phi(a_2 + z_t\ b_2) \end{cases}, \quad (4b)$$

We briefly indicate, through examples, how the coefficients must be interpreted. Let us assume that 1 and 2 indicate respectively debt ratio downward and upward trends, and that z_t is the growth rate for year t-1. Also assume that $b_1 > 0$ and $b_2 < 0$. In this case, if the debt ratio increased over year t-1, it is likely that it will decrease the following year subsequent to a boost in the growth rate ($b_2 < 0$) and, if it was already diminishing, it is

probable that it will continue to do so ($b_1 > 0$)[10]. Now assume that z_t is the primary balance expressed as a percentage of GDP for year t-1 and that $b_2 > 0$, $b_1 > 0$. In this case, if the debt ratio were to increase over year t-1, it could continue to increase despite budgetary consolidation (with all the more likelihood in so far as the value of b_2 is great). But if the debt ratio were to diminish in year t-1, budgetary consolidation could lead it to diminish further the following year. This type of situation expresses sensitivity to the regime initially observed and can be explained by the "weight" of budgetary practices, or the scale of budgetary multipliers.

In order to take into account the lesser or greater inertia of its dynamics in each regime, an autoregressive process in the growth rate of the debt ratio is introduced into each. The model is thus supplemented by the following equation:

$$\Delta d_t = \begin{cases} \mu_1(s_t) + \beta_1(s_t)\Delta d_{t-1} + \sigma \quad \varepsilon_t, \quad with\ probability\ p_1(z_t) \\ \mu_2(s_t) + \beta_2(s_t)\Delta d_{t-1} + \sigma \quad \varepsilon_t, \quad with\ probability\ p_2(z_t) \end{cases}, \tag{5}$$

where $\varepsilon_t \backsim N(0,1)$. $p_1(z_t)\ et\ p_2(z_t)$ are *a posteriori* (or unconditional) probabilities of regimes 1 and 2 and depend on the probabilities of transition. It is assumed that the properties of ergodicity and invertibility of Markovian processes apply here.

The TVPMS model framework is useful to characterize dynamics with regime-switching. The initial formulation was proposed by Filardo (1994), and Filardo and Gordon (1998). A general framework was introduced by Kim *et al*. (2008). This type of model can be distinguished from Markov switching models as proposed by Hamilton (1989) by the fact that the transition probabilities vary over time. The parameters for this model are estimated using the maximum likelihood method, as proposed by Kim et al (2008).

The vector of observations of the debt ratio and the variable for transition of the initial year t_0 until year t-1 is defined by

$$\Omega_t = \left(d_{t_0}, d_{t_0+1}, z_{t_0}, z_{t_1}, \cdots, z_{t-1} \right), \tag{6}$$

and $\xi_t = \left(\Delta d_{t_0+1}, \Delta d_{t_0+2}, \ldots, \Delta d_t\right)$, $\theta = (\mu_1, \mu_2, \beta_1, a_1, b_{11}, \beta_2, a_2, b_{22}, \sigma)$. (7)

The conditional likelihood function of observations ξ_t is defined by the following expression:

$$L(\theta) = \prod_{t=1}^{T} f(\Delta d_t / \Omega_t, \xi_{t-1}; \theta) \tag{8}$$

[10] Indeed, $b_1$and b_2 measure respectively the effect of a variation in z_t as to the likelihood of remaining in regime1, $p_{11}(z_t)$, and the probability of remaining in regime 2, $p_{22}(z_t)$ between two years.

where

$$f(\Delta d_t/\Omega_t, \xi_{t-1}; \theta) = \sum_i \sum_j f(\Delta d_t/s_t = i, s_{t-1} = j, \Omega_t, \xi_{t-1}; \theta) \times P(s_t = i, s_{t-1} = j/\Omega_t, \xi_{t-1}; \theta) \quad (9)$$

Using Bayes' theorem, the following obtains:

$$P(s_t = i, s_t = j/\Omega_t, \xi_{t-1}; \theta) = P(s_t = i/s_{t-1} = j, z_t) P(s_{t-1} = j/\Omega_t, \xi_{t-1}; \theta) = P_{ij}(z_t) P(s_{t-1} = j/\Omega_t, \xi_{t-1}; \theta) \quad (10)$$

and

$$P(s_t = i \quad /\Omega_{t+1}, \xi_t; \theta) = P(s_t = i \quad /\Omega_t, \xi_t; \theta) \frac{1}{f(\Delta d_t/\Omega_t, \xi_{t-1}; \theta)} \sum_j f(\Delta d_t/s_t = i, s_{t-1} = j, \Omega_t, \xi_{t-1}; \theta) \times P(s_t = i, s_{t-1} = j/\Omega_t, \xi_{t-1}; \theta) \quad (11)$$

The function f in equation (9) is the function of conditional density depending on the regimes expressed in the following developed form:

$$f\left(\Delta d_t/\mathrm{s_t} = 1, \mathrm{s_{t-1}} = \mathrm{j}, \Omega_\mathrm{t}, \xi_{\mathrm{t-1}}; \theta\right) = \frac{\phi\left(\frac{\Delta d_t - \beta_1 \Delta d_{t-1} - \gamma d_{t-1}}{\sigma}\right) \Phi\left(a_{1j} + z_t \; b_{1j}\right)}{\sigma \quad P_{1j}(z_t)} \quad (12a)$$

$$f\left(\Delta d_t/\mathrm{s_t} = 2, \mathrm{s_{t-1}} = \mathrm{j}, \Omega_\mathrm{t}, \xi_{\mathrm{t-1}}; \theta\right) = \frac{\phi\left(\frac{\Delta d_t - \beta_2 \Delta d_{t-1} - \gamma d_{t-1}}{\sigma}\right) \Phi\left(a_{2j} + z_t' b_{2j}\right)}{\sigma \quad P_{2j}(z_t)} \quad (12b)$$

The choice of the best model[11] is made retaining several criteria, namely information criteria of the AIC/BIC type, correlation tests on weighted normalized estimation residuals (Ljung-Box statistic) and by applying non-linearity tests on the estimated residuals (non-parametric test based on the Hinich and Patterson (1989) and Tsay (1996)).

3.2.- Have primary inflation, growth and primary balances been advanced indicators of the French debt ratio since 1890?

Figure 1 shows the trend in the public debt ratio from 1890 to 2009 in both level and growth rate. The dynamics of growth rate shows the years during which the variability in the debt ratio is especially significant. These are generally the years corresponding to the two

[11] Indeed, one of the special features of TVPMS models is to generate multiple equilibria considering the non-linearity of the likelihood function to be optimized. The choice of equilibrium to be retained is decided on the basis of statistical criteria.

world wars and the five years following them. To neutralize the effect of this variability on the estimation results, a variable defined as the product of the growth rate in the debt ratio with an indicator variable valued at 1 for the years 1914-25, 1940-1946, 1948,1970 and 1983 (0 for the other years) is added to the right of the equation (5). The idea is to isolate the effect of these years whose observations would otherwise absorb a significant share of the explained variance.

INSERT FIGURE 1 ABOUT HERE

To evaluate the impact of the primary balance ratio on the dynamics of the growth rate for debt, it is decomposed into two parts distinguishing the trend and cyclical components. Similarly, the influence of the cyclical and trend components of the growth rate of real GDP is considered, as well as variation in the trend component for the rate of inflation (as approximation of core inflation). The trend components are calculated using an HP filter.

Primary balance and regime-switching of the debt ratio dynamics

The estimation results are shown in tables 1 to 4 and correspond respectively to cases where the transition variable is the structural fiscal balance (trend component of the primary balance) and the cyclical component of the primary balance. The TVPMS model shows the existence of two regimes, one in which the debt ratio increases (regime 2) and the second where it diminishes (regime 1). Indeed, in each regime, the average rate at which the debt ratio increases or decreases is indicated by the conditional mean of the endogenous variable calculated from estimates of the constant and autoregressive terms (on average the debt ratio diminishes by 3% and increases from 6% to 12%)[12].

In table 1, the coefficient b_2 is positive and significant at 10% suggesting that, if one starts out from an initial situation where the debt ratio is increasing (regime 2), despite an improvement in the structural primary balance, it is likely that two years later it will continue to increase[13]. If one starts from an initial situation where the debt ratio decreases (regime 1), it is impossible to say whether it will continue to diminish or not (b_1 is non-significant). Over the period, budgetary consolidations took on average two years before producing their effect on the debt ratio. Where one started out from an initial situation in which the debt ratio was

[12] The conditional mean of Δd_t in each regime is equal to the ratio of μ_j and (1-β_j), where j=1,2.

[13] Two years later, as the best model, considering the specification criteria (test on residues, information criteria), is that including two delays for the transition variable.

increasing, budgetary efforts were unable to reverse this trend. Starting out from an initial situation where the debt ratio was decreasing, the consequences were extremely variable over time: budgetary consolidations were followed by a rise or fall in the debt ratio, such that it would have been difficult to predict its evolution *ex ante*. The reductions in structural primary deficits thus had a weak impact in stopping rises in the public debt ratio. But this involved an "average" effect over the period studied. Figure 2c shows that this was the case, especially as from the middle of the 1950s (the probability of change from regime 2 to regime 1 is close to zero). Periods of reduction in the debt ratio consecutive to an improvement in primary structural balances seem nevertheless to have existed. As shown in figure 2c, this concerns, in particular, the years from 1909 to 1924 and to 1949, which covers part of the historical period named "Belle Epoque", the great depression of the 1930s and the two world wars, as well as the first four years of reconstruction. Figure 2d shows that the likelihood of switching to a regime of falling debt ratio could be explained by the higher budget surpluses when the country started out from a situation characterized by a strong initial degradation of the primary balance. Figure 2b shows that the passage from phases of increasing debt ratio to falling debt ratio was in particular observed for levels of structural primary deficits of less than 4%, with marked variability in the debt ratio at the time of regime-switching (the transition function having a steep slope). Figure 2a, retracing the posterior probability of being in the debt ratio downward regime, shows that the estimated likelihoods correspond well to variations in the debt ratio actually observed on figure 1.

INSERT TABLES 1 and 2 ABOUT HERE

INSERT FIGURES 2a, 2b, 2c, 2d ABOUT HERE

The variations in the cyclical primary balance seem to have exerted a short-term effect on the debt ratio. According to the estimations of table 2, an improvement in this balance increases the probability of the debt ratio dropping over the same year, whatever the initial upward or downward regime in which the debt evolves (b_1 is positive, meaning that if the debt ratio tends to diminish a given year, following with an improvement of the cyclical primary balance, it is likely to continue on a downward path the following year; b_2 being negative, a rise in the primary balance increases the likelihood of moving from an upward trend of the debt ratio to a downward trend). However, Figure 3a seems to suggest that such a scenario has not occurred since the middle of the 1950s (the probabilities of transition are close to 0), since less variability in the dynamics of the primary balance has been observed (Figure 3c). Comparing Figures 2b and 3a, it can be observed that the debt ratio is only likely

to diminish, following an improvement in the cyclical primary balance, if the latter is positive (whereas a negative structural primary balance was not incompatible with a change in trend of the dynamics of the debt). As for the structural fiscal balance, the estimated model with the cyclical balance as transition variable leads to probabilities *a posteriori* reflecting variations in the debt ratio observed in Figure 1. The cyclical balance gives a finer representation of the years during which changes in trend of the dynamics of the debt ratio were observed. Indeed, comparing Figures 2c and 3b, it can be seen that the probabilities of transition fluctuate much more in the latter case.

INSERT FIGURES 3a, 3b, 3c ABOUT HERE

As illustrated by tables 3 and 4, if the increase in cyclical fiscal balances could, before the 1950s, provide a means to bring about a reduction in the debt ratio, this mechanism worked in a highly transitory manner. Indeed, by increasing lags in the transition variable (t-1 in table 3 and t-2 in table 4), it can be seen that it is impossible to predict in which direction the debt ratio is supposed to vary one year after an improvement in the budget balance (b_1 and b_2 are not significant in table 3). Worse, over the two years following an improvement in the conjunctural budget balance, there were chances that the debt ratio continued to increase where such was already the case initially (b_2 being positive and significant to 10% in table 4). If it was diminishing, nothing could be said of its future trend (b_1 not being significant in table 2).

INSERT TABLES 3 et 4 ABOUT HERE

Improving primary balances and reducing deficits thus does not seem to have been a strategy capable of durably evolving from periods of rising to decreasing debt ratio since the middle of the 1950s. However, between 1890 and 1950, this *was* the case, though at specific periods corresponding to the years prior to the first World War (1909-1914) or the years following the two world wars (1920-1927 and 1946-1948). During those years, even if improvement in budget balance made the scenario of a change in the debt ratio trend from an upward to a downward cycle likely, this involved a highly transitory effect, the improvement in primary balances being followed a few years later with new increases in the debt. An interesting point is that an improvement in budget balances increased the probability that the debt ratio diminish provided it was extremely substantial, in fact after these balances had been strongly degraded a few years previously (see Figures 2d and 3d).

Effect of growth and debt burden

Has economic growth (measured by the rate of relative variation in real GDP) had an impact on the dynamics of the public debt ratio since 1890? To answer this question, the effects of medium-term growth (measured by the trend component of the real GDP growth rate is used as potential growth) have to be differentiated from those of the cycle on public debt.

The estimates of table 5 suggest that there was a mechanical effect of the business cycle on the debt ratio. Assuming the latter increased initially, the likelihood for it to diminish following a rise in the real GDP increased (the coefficient b_2 being significantly negative). The probability that it will continue to diminish, if such were already the case before the rise in GDP, was also higher (b_1 being significantly positive). But this concerned average behavior. Indeed, Figure 4a shows that this virtuous effect of growth manifestly only worked up to the early 1950s. It also reveals that this is a mechanical, instantaneous and not a sustained effect, account being taken of the "choppy" nature of the transition from one trend to another. Figure 4b confirms that, when a regime-switch occurred, it took place in brutal fashion (reflected in the near vertical slope of the transition function). After the 1950s, it thus seems that the business cycle has had a weak predictive capability in explaining the development of the State's debt ratio.

INSERT TABLES 5 and 6 ABOUT HERE

INSERT FIGURES 4a, 4b, 4c, 4d ABOUT HERE

The trending growth rate's impact is different. On average, comparing its evolution with that of the growth rate of the debt burden, there seems not to be systematic evidence of an inversion in the dynamics of the debt in the event of a rise of trend growth. The estimates show that it did not produce effects to maintain the debt ratio on a downward path over periods where the ratio had started to drop (the coefficient b_1 in Table 6 is not significantly different from zero). In addition, it seems that the debt ratio continued to increase after periods of higher trending growth (the coefficient b_2 being positive and significant). Figure 4c shows that the trending growth rate had a high predictive capacity in foreseeing phases where the debt ratio diminished between 1890 and the years prior to the depression of the 1930s, as well as from the middle of the 1940s up to the beginning of the 1980s. The posterior probability of the debt ratio evolving in a downward spiral was weak, either when the debt burden (measured as a percentage of GDP) increased more quickly than the real GDP, as was

the case during the decade of the 1930s (see Figure 4d), or when the differential between growth in real GDP and that of the debt burden was not significant. In this respect, Figure 4d shows that during the years of the Belle Epoque (years 1890 to 1914), it was sufficient for there to be a 1% gap on average between the trend growth rate of the real GDP and that of the debt burden to lead to a downward cycle in the debt ratio. Since the middle of the 1980s, the gap has had to be at least 2.5%. In other words, the effort required in terms of long-term growth to bring about a reduction in the debt ratio, considering the debt burden, appears to be greater at the end of the century than at the beginning.

Effect of inflation

Table 7 sets out the results of estimation when the rate of variation of the inflation rate is retained as an advanced indicator of the debt ratio. As in previous estimations, the TVPMS model distinguishes two regimes of rise and fall of the debt ratio. The coefficient b_2 is negative and significant. Consequently, episodes of rising inflation allowed the debt ratio to be reduced when the latter rose initially.

Figure 5a shows that the years during which the inflation rate was a good predictor of those phases when the debt ratio was falling include, firstly, those of the Belle Epoque, the First World War and the years prior to the great depression of the 1930s and, secondly, the three decades of the post-war boom from 1946 to the end of the 1970s. Figure 5b shows the inversion of upward spiral phases to downward spiral phases in the debt ratio consecutive to a rise in prices considered to have occurred gradually (a large number of points being located in "intermediate" regimes characterized by probabilities of transition varying between 0.45 and 0.7).

INSERT TABLE 7 ABOUT HERE

INSERT FIGURES 5a and 5b ABOUT HERE

As the greater variability in the debt ratio over the first half of the sample is likely to influence the estimates obtained over the entire period, our equations have been re-estimated restricting the sample to the years following 1949.

When the period of estimation is reduced to the years 1950 to 2009, the growth rate of the real GDP and inflation rate appear to be good predictors of the evolution in the debt ratio. Table 8 presents the estimated coefficients of the TVPMS model when the transition variable

is the difference between the trending growth rate of real GDP and the growth rate of interest charges expressed as a percentage of GDP. In Table 9, the advanced indicator retained is the variation in the trend component of the inflation rate. The two tables differ by the fact that, in the first, regime 1 is that of upward cycle phases in the debt ratio, whereas in the second these are described by regime 2.

It appears that any increase in the difference between the growth rate in real GDP and that of the debt burden made it possible two years later to predict a reduction in the debt ratio whatever the initial situation of either a rise or a fall in the debt ratio (b_1 is significant and negative and b_2 is significant and positive). However, Figure 6a shows that this was the case up to the beginning of the 1980s, then during years 2001 and 2002. As for the role of inflation, the results of the regression in Table 9 show significant influence, in so far as inflationary pressures will have increased the probability of switching from an upward cycle to a downward cycle in the debt ratio. Figure 6b shows the influence of inflation to have been strong between 1965 and 1985, then during years 2006 and 2007.

None of the regressions performed with the primary balance revealed a significant influence on the likelihood of change in debt regimes. Thus it seems that the primary balance was not a good advanced indicator capable of accounting for episodes of reduction in the debt ratio since 1950.

INSERT TABLES 8 and 9 ABOUT HERE
INSERT FIGURES 6a and 6b ABOUT HERE

4.- Confronting econometrics to history : can these results be explained in the light of the historical events?

Over the period 1890 to 2009, the previous estimates thus reveal “breaks” in the influence of its various determinants on the debt ratio. Table 10 summarizes our results. The years during which the different variables have a predictive capacity to explain the downward cycle phases in the debt ratio are shown.

INSERT TABLE 10 ABOUT HERE

Which elements differentiate the sub-periods? Why did inflation or growth have a significant impact on the debt ratio before 1980 that they have no longer had since those years? How can

it be explained that primary balances also no longer manage to so significantly reverse the upward dynamics of the debt ratio before and after 1950? To answer these questions, the historical contributions of the growth rate, inflation, the debt burden and the primary balance to the debt ratio are studied.

Denote D_t the stock of the debt for year t, R_t the apparent interest rate of the debt between years t-1 and t, and SP_t the primary balance in year t. The budget constraint is written:

$$D_t = (1 + R_t)D_{t-1} - SP_t \tag{13}$$

This relation can be rewritten considering the variables in terms of ratio of GDP. Noting d_t $et$and $sp_t$the ratios of the debt and the primary balance, g_t and π_t the growth rate and inflation for year t, the budget constraint can then be rewritten in the following form:

$$d_t = \frac{(1+R_t)}{(1+g_t)(1+\pi_t)} d_{t-1} - sp_t \tag{14}$$

The variation of the debt ratio between two years t and $t + \tau$ can be deduced :

$$\begin{aligned} d_t - d_{t-\tau} \quad = & \sum_{s=0}^{\tau-1} \frac{R_{t-s}}{Y_{t-s}} d_{t-s-1} - \sum_{s=0}^{\tau-1} \frac{\pi_{t-s}}{Y_{t-s}} d_{t-s-1} - \sum_{s=0}^{\tau-1} \frac{g_{t-s}}{Y_{t-s}} d_{t-s-1} \\ & - \sum_{s=0}^{\tau-1} \frac{\pi_{t-s} g_{t-s}}{Y_{t-s}} d_{t-s-1} - \sum_{s=0}^{\tau-1} sp_{t-s} \end{aligned} \tag{15}$$

The terms appearing in the right-hand side of the equation measure the contributions of the debt burden, the inflation rate, the real GDP growth rate, inflation and economic growth and of the primary balance to the variation in the debt ratio. Figures 7 to 10 represent the various contributions in the case where $\tau = 1$, i.e. when variations in the debt ratio from one year to another are examined.

The contributions confirms two major breaks/discontinuities (1950 and 1980)

Figure 1 shows that, since the beginning of the 1980s, the debt ratio has seen no further diminution, with at the most the upward trend being slowed down during some years. There exists a "break" as compared with previous years where the debt ratio alternated between upward and downward periods. From 1980 onwards, the primary balance has generally been contributing to augmenting the debt ratio, which illustrates another difference as compared with previous years when its contribution was on average negative in times of peace and outside the years of major crisis (see Figure 7). To explain what would appear to correspond to a discontinuity in the way the primary balance contributes to the debt's dynamics, a number

of facts need to be borne in mind. First of all, the beginning of the 1980s marked a change in the French "budget culture". Up to 1981, one of the objectives of economic policy was to maintain a strong French Franc. Having balanced public finances then appeared to provide a way of avoiding macroeconomic imbalances that would inevitably have weakened the currency. This philosophy of strong currency through the re-establishment of budget balances is to be encountered with ministers like Poincaré, Pinay and Barre. Secondly, the special attention devoted to budget balances before the 1980s was related to the scale of the debt burden, especially between 1890 and 1945, where governments did not yet have the possibility of benefiting from low interest rates thanks to the development of the financial markets. From this point of view, 1945 was the year of a break. It can be observed on Figure 8 that, after having made a particularly high contribution between 1890 and 1945, the debt burden weighed less in the dynamics of the debt between 1946 and 1980, before its weight again became significant. Before 1946, the debt burden was an obsession for successive governments who sought to bring it down at all costs (whence the priority given to the objective of budget balance).

Our econometric findings also support the historical observations over different sub-periods

•1890-1900. A high level of debt despite low primary deficits. The debt ratio diminishes thanks to growth.

A first interesting element of comparison lies in the fact that the contribution of the debt burden for that period is at a level comparable with that of the years following 1990 (Figure 8). The debt burden is high because the debt itself is high. Indeed, during the entire second half of the 19th century, interest rates were low (the Banque de France discount rate varied around 2%), but the governments ran into debt to finance their spending in public infrastructure. The Freyssinet Plan had been launched in 1879 in a context of economic crisis, seeing French growth declining as compared with that of Germany and the United States and the economic consequences of the 1870 war being felt with in particular the loss of Alsace and Lorraine, two economically thriving regions. Over the decade 1890 to 1900, France continued its policy of building major public infrastructure. However, instead of activating its public expenditure to finance the construction of infrastructures, the governments preferred to guarantee loans for companies (private at this time) to implement reconstruction in certain key sectors like the railways, roads, ports and inland waterways. This financing of

infrastructures through loan guarantees was not registered in the general budget, but appears as off-budget expenditure. The government spent all the less in so far as the tax system was under construction (many taxes were not very progressive and scarcely redistributive, with the main share being related to land ownership). All this explains why the contribution of the primary balance to variations in the debt ratio is negative (Figure 7), even if the loan guarantees provided by the governments led it in reality to accumulating burdensome financial expenses and a high level of debt. The expenditure by the companies benefiting from State guarantees generated growth (of 2.4% on average over the period) above the discount rate of the economy, which caused a drop in the debt ratio.

•1901-1913. A strong inflationary surge associated with vigorous growth contributes to reducing the debt ratio.

Compared to the previous decade, economic growth was even higher (with a difference in relation to the higher interest rate). Inflation kicked in again under the effect of the acceleration in industrial growth and the strong takeoff in financial liquidity (the rate of inflation thus went from 1.6% between 1860 and 1890 to 2.4% between 1890 and 1913). As a result, inflation contributed strongly to the debt ratio being diminished, especially over the three last years (Figure 9). The contribution of the primary balance remained negative as the policy of implementing major public infrastructure lost steam.

•1919-1925. The initial conditions related to a high debt burden weigh down heavily on the debt ratio.

The first striking fact here is the very strong negative contribution of the inflation rate (Figure 9). Indeed, this period corresponded to an inflationary crisis with prices being multiplied two- and three- fold. This big price hike was fed by depreciation of the Franc in relation to the Pound sterling and by monetary financing of the State's accumulating budget deficits (due in part to the weight of the debt burden). The second striking fact is the strong contribution of the debt burden (Figure 8). The debt accumulated as the country came out of the war created a substantial burden that in turn fostered new deficits and thus new debt. Its effect on the debt ratio dominated that of inflation. This explains the big rise in the debt ratio observed in Figure 1, especially between 1920 and 1921. It was the "initial conditions" (the fact that the country inherited major debt as peace returned) that weighed on the ratio (burdens due to the war, in particular war damage and pensions, had to be settled). The high level of debt burden is explained by a number of factors. Firstly, until adoption of the Dawes

plan in 1925, Germany experienced difficulties in honoring its war damage payments. Secondly, France itself proceeded with payments to the United Kingdom and the United States to refund the assistance these countries provided it with during the war. In April 1935, out of 578.3 billion Francs of public debt, nearly 228 billion were made up of foreign debts. In addition, the domestic public debt was primarily floating (for example, 53 billion Francs of National Defense bonds could be accounted).

•1926-1929. Primary balances lead to a reduction in the debt ratio

This was indeed the salient stylized fact for this period, as illustrated in Figure 7. Budget policy of the Poincaré period was characterized by a consolidation of public finances. This was based on taxes being increased (setting-up a capital tax and an increase in transfer taxes) and on a policy of debt management (creation of a sinking fund for the debt fed by tobacco revenues). At the same time, depreciation of the currency allowed growth to resume (a law of 1928 stabilized the Franc at $1/5^{th}$ of its value on the Gold Standard). Improvement in the public finances situation was also due to other factors, especially the implementation of the Dawes Plan set up in 1924 that allowed Germany to settle its war compensation to France through rescheduling of the debt.

•1930-1935. Deflation, slowdown in growth and primary deficits lead to a rise in public debt.

The primary balance contributed to the rise in the debt ratio (Figure 7) despite measures to reduce public expenditure taken by the Laval government (reduction by 10% in public expenditure and authoritarian reduction in interest on public debt). As from 1931, the slowdown in economic activity led to an increase in the budget deficit and debt, which explains the positive contribution of growth to variation in the debt ratio (Figure 10). On top of this, the end to war compensation payments by Germany and the level of tax evasion prevented any visibility when it came to budget estimates. At the same time, bumper crops in the farming sector (contributing a third of GDP) caused deflation (which explains the positive contribution of the debt ratio on Figure 10).

•1936-1938. Degradation of the primary balances leads to an increase in the debt ratio in a context of economic doldrums.

The budgetary context was symmetrical with that of years 1926 to 1929. Parts of the social measures voted in by the Popular Front were covered by the private sector (paid vacations and the 40-hour working week). But resumption of inflation due to measures to boost wages contributed to an increase in budget deficits, as some expenditure was indexed to inflation

(health, current expenditure, salaries and wages). From 1936, the State took on greater weight in the economy (public expenditure that accounted for 14% of gross national revenue in 1926 rose to 25.5% in 1938). At the same time, State budget revenue progressed slightly (its share in gross national revenue went from 12% in 1913 to just 17% in 1938 and tax revenues from 8% to 13%). These elements explain the positive contribution of the primary balance to variation in the debt ratio (Figure 7). Growth also contributed to the rise in the debt ratio (Figure 10) which can be explained by cyclical fluctuations at the low point of the cycle (W-shaped fluctuations).

•1947-1970. Period of strong inflation and exceptional growth. The debt ratio reaches its lowest level.

As shown in Figure 9, the contribution of inflation was negative, especially between 1950 and 1960. This development can be ascribed to three phenomena. First of all, between 1947 and 1953, in order to catch up economically on other countries, France adopted the Monnet Plan that was a major capital spending programme financed from the savings of private individuals transformed into long-term loans (through the Caisse des Dépôts et Consignations and nationalized banks). This Plan contributed towards the development of the iron and steel industry, energy, etc. It generated demand-pull inflation. At the same time, prices were gradually liberalized and the end of price control brought about inflation through the wage-price loop. The second inflationist surge occurred from 1953 on due to the Korean War (that pushed up world prices) and the Algerian War. The third rise in prices took place during the years of 1968 and 1969 following strike movements that ushered in wage rises. Figure 10 also shows a negative contribution of growth, corresponding to the period of the post-war boom.

Strong inflation combined with outstanding growth explains why the debt ratio was at its historical all-time low and that it was decreasing at a rate greater than that observed for example between 1890 and 1913 (Figure 1). In addition, a period of exceptionally low interest rates explains that the debt burden contributed slightly to an increase in the debt ratio (Figure 8). In this context, the governments achieved budget surpluses and the contribution of the primary balance was negative (Figure 7).

•1971-1979. Inflation and growth mask the budgetary imbalances to come.

This period corresponds to that of the so-called “stop and go” policies (economic surges followed by “cooling-off periods”) which illustrate the dilemma between inflation and unemployment following on from the two oil crises. In 1974, faced with the rise in inflation,

the French government initiated a restrictive economic policy (tightening of credit accompanied by new price controls), but as from the third quarter of 1975, this was loosened and the budget deficit increased. Once again, the recovery was interrupted in 1976, as it was considered too strong. Over this period, the primary balance thus contributed, sometimes positively, sometimes negatively, to variation in the debt ratio (Figure 7). The growth rate continued to curb the rise in the debt ratio, but less so than over the previous decade (Figure 10). Stop and go policies had the effect of ensuring the debt ratio failed to diminish any further (Figure 1).

•1980 to 2009. A major break in the contributions of debt determinants to the dynamics of debt ratio

During this period, growth and inflation rates were no longer adequate to counter the effect of the primary balance on the rise in the debt ratio. Figure 7 shows, more generally, a positive contribution of the primary balance while Figures 9 and 10 show that growth and inflation systematically made negative contributions (except for the years 2008 and 2009). These contributions were at least as significant as during the period 1960 to 1979. But the difference came from the primary balances that were in surplus and thus contributed to bringing about a reduction in the debt ratio. This has no longer been the case since 1980. The rise in primary deficits fed the increase in the debt and its burden (Figures 1 and 8). Consequently, in the context of primary deficits following a general upward trend, growth and/or inflation rates much higher than those actually observed would have been needed to bring down the debt ratio.

From 1980, the debt ratio has thus failed to pursue any further downward trend, but has fluctuated through alternating periods characterized by years of upward movement followed by stabilization. These fluctuations in the debt ratio illustrate a form of intertemporal inconsistency in budget policy, with the upward and stabilization phases of the debt ratio reflecting the political-electoral cycle.

From 1981 to 1986, budget deficits increased due to the industrial relations policies adopted by the Socialist governments of Mauroy and Fabius, and this despite the economic rigor associated with the policy of devaluation of the Franc from 1983. Between 1986 and 1991, under the two successive Chirac and Rocard governments, primary surpluses grew due to the fall in the ratio of public expenditure in the GDP, which contributed to stabilizing the debt ratio. The period 1991-1995 saw two successive political majorities in government (the

Socialists with Cresson and Bérégovoy and the right-wing RPR with Balladur). Faced with the recession, budget policies were counter-cyclical and deficits increased. Then between 1996 and 2002, the Socialists came into government with Jospin. The debt ratio was stabilized thanks to a conjunction of factors including strong economic growth, as observed in all the industrialized countries, which curbed the upward trend in the debt ratio, contributing negatively to its variation, as seen in Figure 10. This effect was to contribute to an "unexpected" increase in tax revenues (what came to be known as a "budget windfall"). In addition, as from 1996, interest rates started to follow a downward spiral (Figure 8) caused by the pursuit of policies to modernize the financial markets that made it possible to boost liquidity on the capital markets (deregulation, disintermediation and desegregation of the markets). Another factor, the Maastricht effect, was to contribute to keeping budget policy under strict control. The reduction in structural primary deficits, combined with the positive cyclical effect of growth in tax revenues, explain the negative contribution of the primary balance to variation in the debt ratio over that period (Figure 7). Between 2002 and 2007, under the successive Raffarin and De Villepin governments, the debt ratio again was characterized by an upward cycle consecutive to the adoption of counter-cyclical fiscal policies. Lastly, the strong progression of the debt ratio since 2008 can be explained by recovery plans and packages to rescue the banks affected by the financial crisis.

5. Conclusion: what does history tells us about the future dynamics of the French debt?

One major conclusion that emerges from the above analyses is the following. Stabilizing the debt ratio (by slowing its upward progression or ensuring that it does not increase from one year to the next) will not be enough to reverse its overall upward movement. On the contrary, the debt ratio is more likely to evolve in different "steps", but continuing the upward trend. This is what has been observed since 1980, whereas previously, through setting a budget balance objective, governments made it a rule to bring about a drop in the debt ratio where it had increased over the previous years. If the present article had been completed before 1980, we would readily have concluded that as the economy recovers, a rise in prices or budget surpluses would have provided sufficient conditions to lead to a reduction in debt. However, this no longer applies since the beginning of the 1980s and a number of interpretations of the above results can be proposed.

It could be considered that the problem stems primarily from primary balances (because they are not sufficiently on the surplus side, and growth and inflation cannot contribute to achieving a reduction in the debt ratio). It was seen in the econometric section that the primary balance has made a poor predictor of the debt ratio since 1980. It is thus possible to have primary surpluses without the debt ratio necessarily diminishing, especially when starting out from an initial situation where it had already strongly increased (which has been the case since the implementation of stop and go policies). At most one will see success in slowing down its upward movement (as during the years of the Jospin government). If one sought to curb the upward dynamics of the debt, the solution could thus involve ensuring that once the rise became stabilized, the ratio does not again start to increase. The idea of tying government hands by measures such as stiffening the European Pact or making budgetary rules constitutionally binding can be seen to be based on such considerations. However, given the weight pulled by the State in the French economy, this approach is likely to raise debate. In particular, such a strategy could involve the government returning to budget balance before considering any budgetary recovery plan, an approach that has already led in the past to criticism, with some recommending vigorous action to cut back on deficits until the return of budget balances while others reckon this strategy to have been a vain sacrifice considering the economic cost of the public debt that has accumulated over the last 30 years.

Another interpretation suggests that episodes of reduction in the debt ratio have very often followed periods of extremely high inflation (beginning of the twentieth century before the First World War and during the economic boom of the thirty years following World War Two). In answer to this, it could be argued that inflation today has effects on the debt burden. On the one hand, the nominal interest rate required by bond holders would compensate for the drop in real yield. In addition, one difference as compared with the beginning of the twentieth century is that the debt is no longer held on a perpetual basis by rentiers, but that the structure of maturities on French public debt is predominantly in the short term, which requires the government to frequently resort to debt on the capital markets to repay previous maturities. Borrowing during periods of high inflation would weigh heavily on the debt burden, and thus on the debt itself. Not to mention the fact that holding such debt would appear to be more risk-fraught, meaning the debt burden would be further compounded by increased allowances for risk. Inflation would wipe out part of the past debt, but would feed future debt. However, it can be noted that inflationary surges in the past have generally coincided with episodes of strong growth so the debt ratio diminishes. This goes in the direction of the proposal

formulated by Blanchard *et al.* (2010). In a context of resumption in economic growth, the central banks, including the ECB, could raise their inflation target so as to reduce real interest rates in the short term and support private consumption and the accumulation of capital by companies. Then, as soon as private demand again reaches a satisfactory level, the governments would no longer be obliged to keep a budget deficit to support activity. Thus, if the fall in the real interest rate were to lead the private sector to contract debt, the government could reduce to its own by as much[14]. This approach thus assumes that several targets are set simultaneously, namely reduction in the public debt ratio and acceptance of a rise in private debt (and possibly an imbalance of the current balance).

A third, more pessimistic, possible interpretation would have it that the current situation resembles that which prevailed between 1930 and 1938. First of all, the context of the years 1930 to 1935 is, in several respects, identical to that which occurred between 2008 and 2009. The recent rise of the debt ratio took place in a context of economic crisis characterized by a situation of deflation, economic slowdown, an increase in budget deficits and reductions in national expenditure with a view to restoring the budget balance. The years 1936 to 1938 also have some common features with 2009, with the development of economic activity in the low phases of the cycle (identical to the current scenario of sluggish growth), "transfers" to the private sector of a certain number of social measures intended to sustain private demand (paid vacations during the years of the Front Populaire and the current proposal to pay employees a dividend-based bonus), measures to boost wages for certain categories of spending related to inflation), and the government being a big borrower on the capital markets. Over this period, even devaluations of the Franc in 1937 did not manage to kick start growth and meanwhile prices went up.

[14] This point of view has been criticized by economists like Taylor and Bernanke who explain that the choice of a higher inflation target nowadays would lead the central banks to aim at even higher levels in the years to come. Another advantage of inflation, looking at things from a monetary policy standpoint, is that it would give greater room for maneuver to the central banks to break out of the current liquidity crisis situation.

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Figure 1. – Debt ratio :level (left panel) and growth rate (right panel) – France :1890-2009

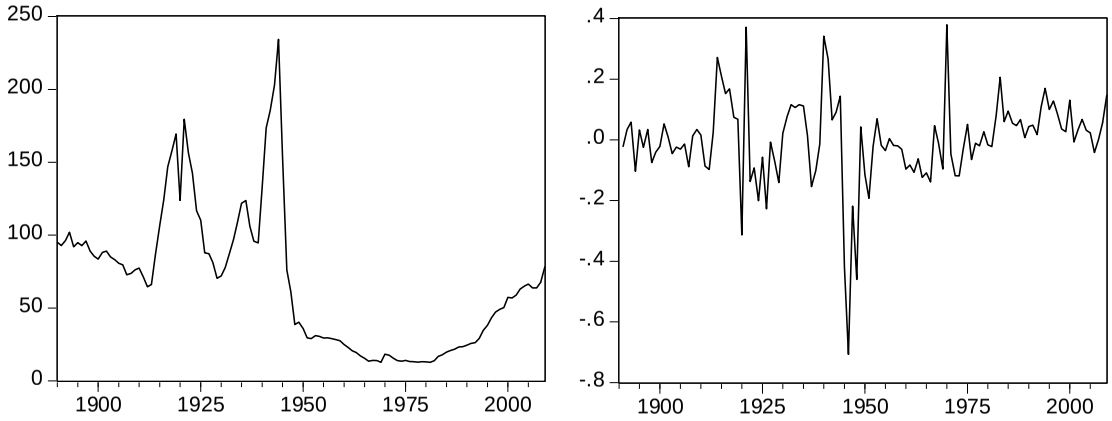


Figure 2a. Posterior probability of being in a regime of decreasing debt ratio (transition variable : structural component of primary surplus (t-2))

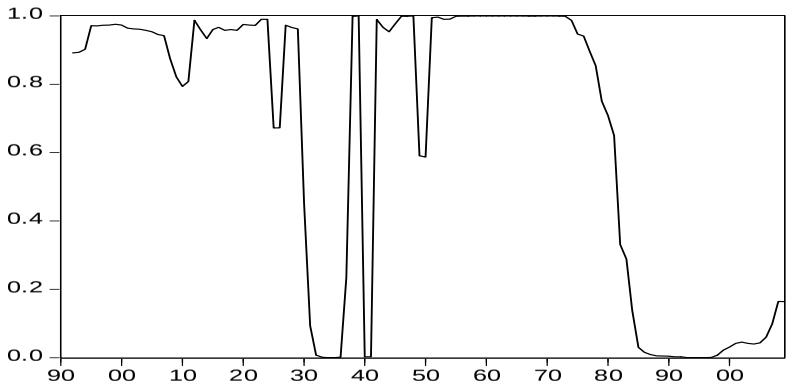
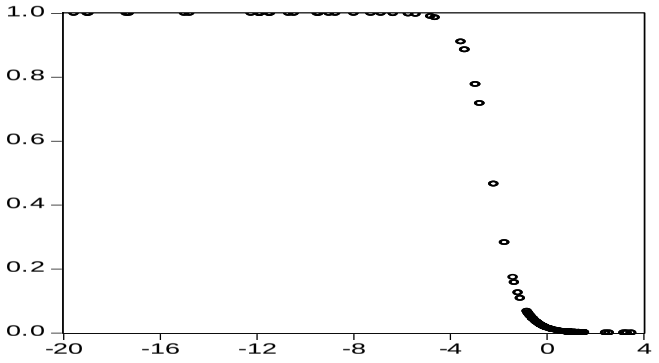


Figure 2b. Transition function from a regime of increasing debt ratio to a regime of decreasing debt ratio



x-axis : structural primary surplus (t-2), y-axis : transition function

Figure 2c. Transition probability of a regime of increasing debt ratio to a regime of decreasing debt ratio following an improvement of the structural primary surplus at time t-2

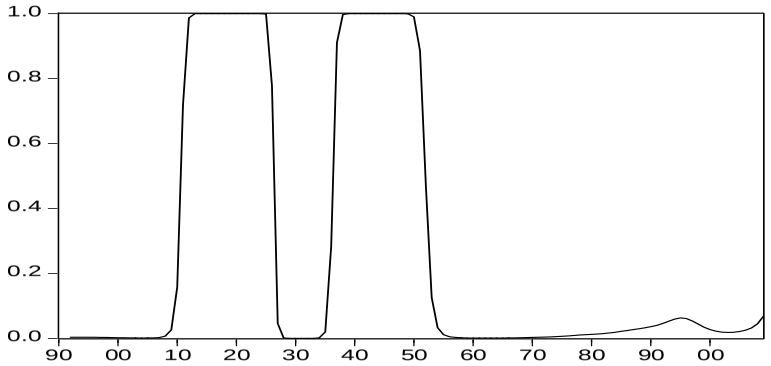


Figure 2d. Structural component of primary surplus (t-2)

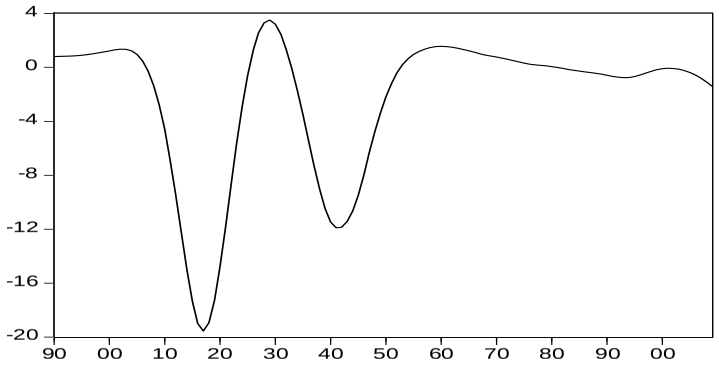
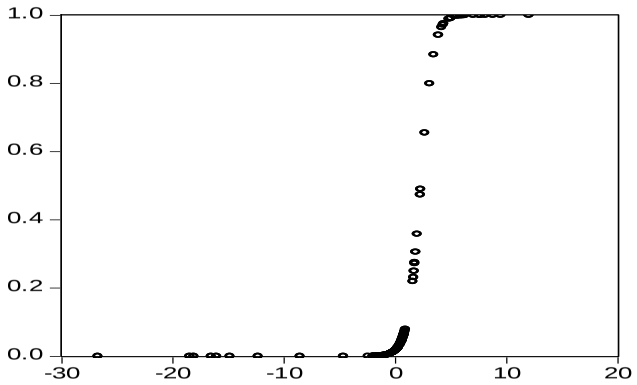


Figure 3a. Transition function from a regime of increasing debt ratio to a regime of decreasing debt ratio



x-axis : cyclical primary surplus, y-axis : transition function

Figure 3b. Transition probability of a regime of increasing debt ratio to a regime of decreasing debt ratio following an improvement of the structural primary surplus at time t

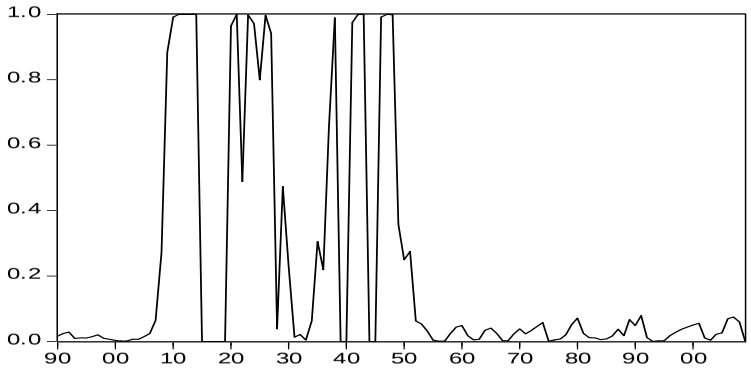


Figure 3c. Cyclical primary surplus (t)

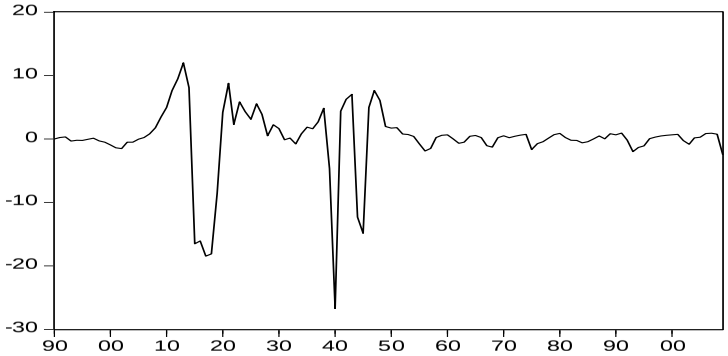
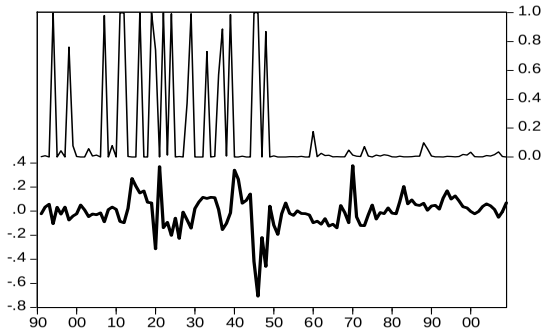
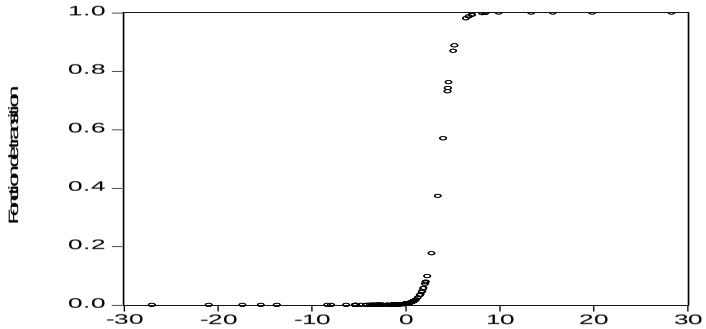


Figure 4a. Transition probability of a regime of increasing debt ratio to a regime of decreasing debt ratio following an increase in the GDP growth rate at time t-1



Bold : changes in debt ratio

Figure 4b. Transition function from a regime of increasing debt ratio to a regime of decreasing debt ratio



x-axis : Real GDP growth rate (cyclical component)
y-axis : transition function

Figure 4c. Posterior probability of being in a regime of decreasing debt ratio (transition variable : spread between the real GDP growth rate and interest rate payment (t-1)

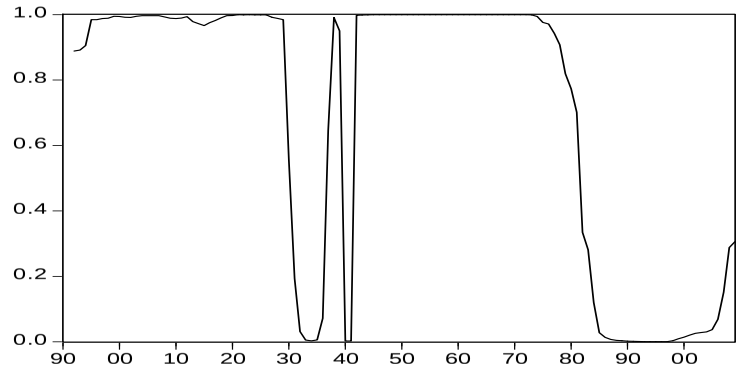
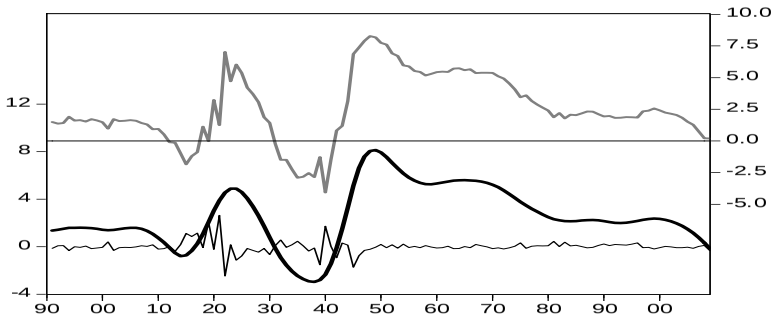


Figure 4d. Spread between the real GDP growth rate (structural componet) and changes in the ratio of interest rate payment as share of GDP



Bold : GDP growth rate, Grey : interest rate payment, black : spread

Figure 5a. Posterior probability of being in a regime of decreasing debt ratio (transition variable : changes in the structural component of the inflation rate(t-1)).

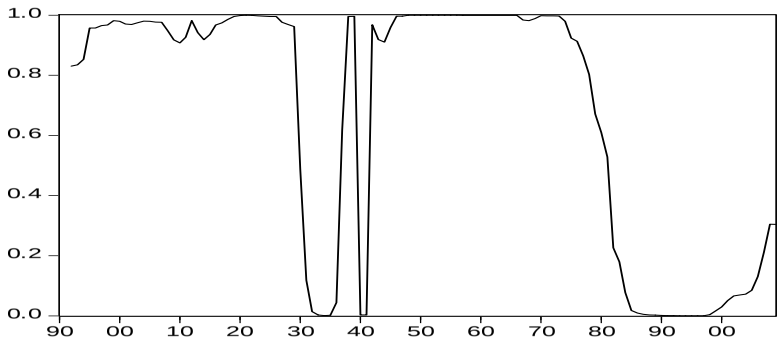
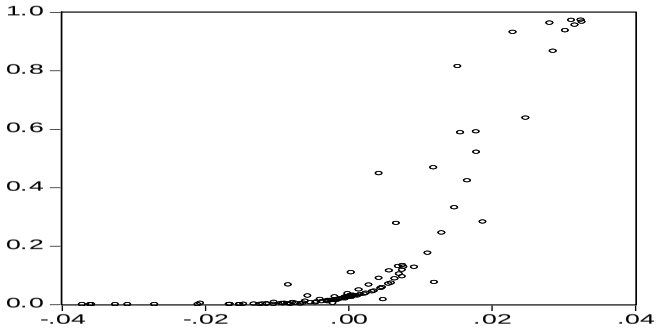


Figure 5b. Transition function from a regime of increasing debt ratio to a regime of decreasing debt ratio



x-axis : changes in the smoothed component of inflation, y-axis : transition function

Figure 6a. Posterior probability of bieing in a regime of decreasing debt ratio (transition variable : spread between the smoothed component of real GDP and the interest rate payment (t-2) – 1950-2009

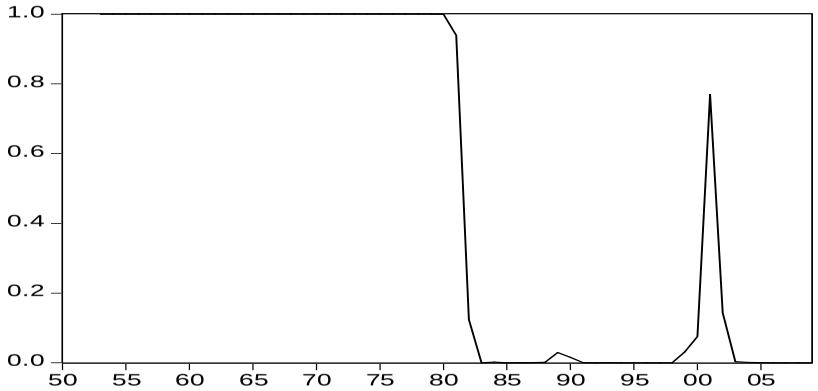


Figure 6b. Posteriro probability of being in a regime with decreasing debt ratio (transition variable : changes in smoothed inflation rate) 1950-2009

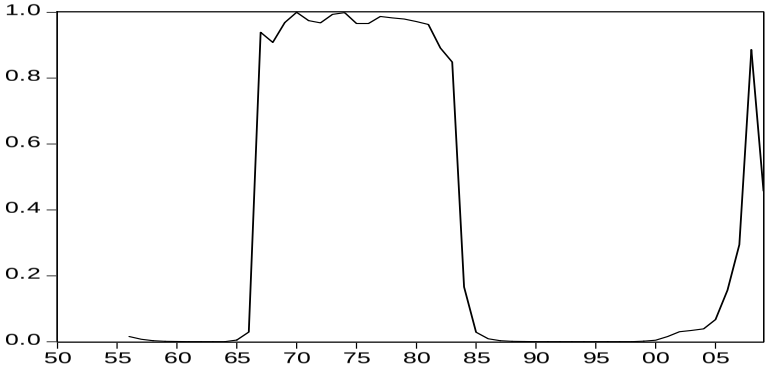


Figure 7. Contribution of primary surplus to changes in debt ratio
Left panel (1890-2009)- Right panel 1890-2009, except years of war)

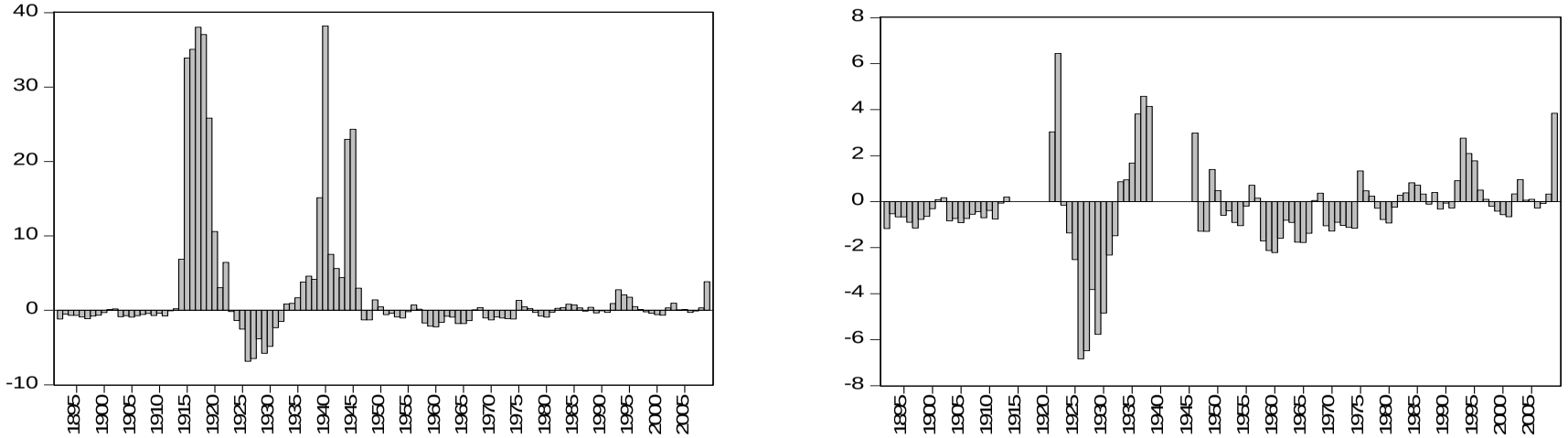


Figure 8. Contribution interest rate payments to changes in debt ratio :1890-2009

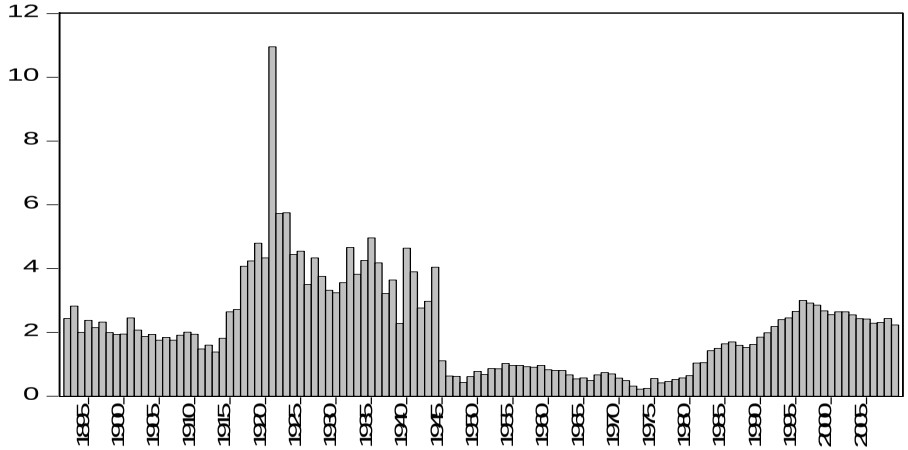


Figure 9. Contribution of the inflation rate to changes in debt ratio
Left panel : 1892-2009, Right panel : 1950-2009

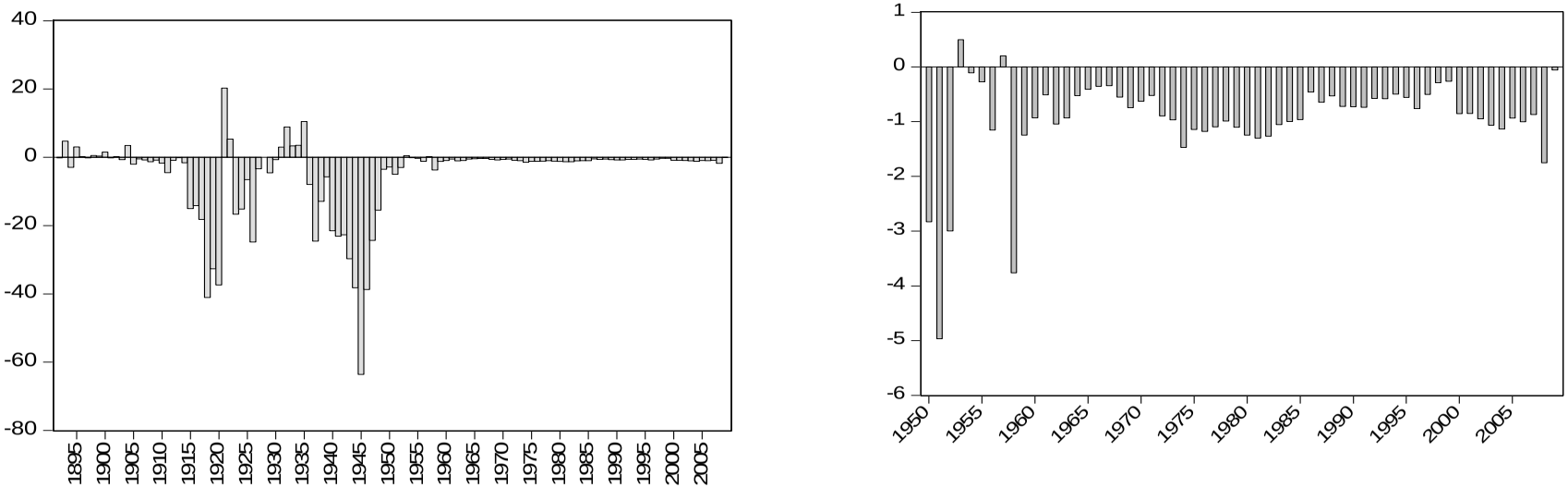


Figure 10. Contribution of the growth rate of real GDP and inflation to changes in debt ratio

Upper left panel : 1892-2009, Upper right panel : 1950-2009

Lower left panel : 1892-1949, Lower right panel : contribution of inflation (1892-2009)

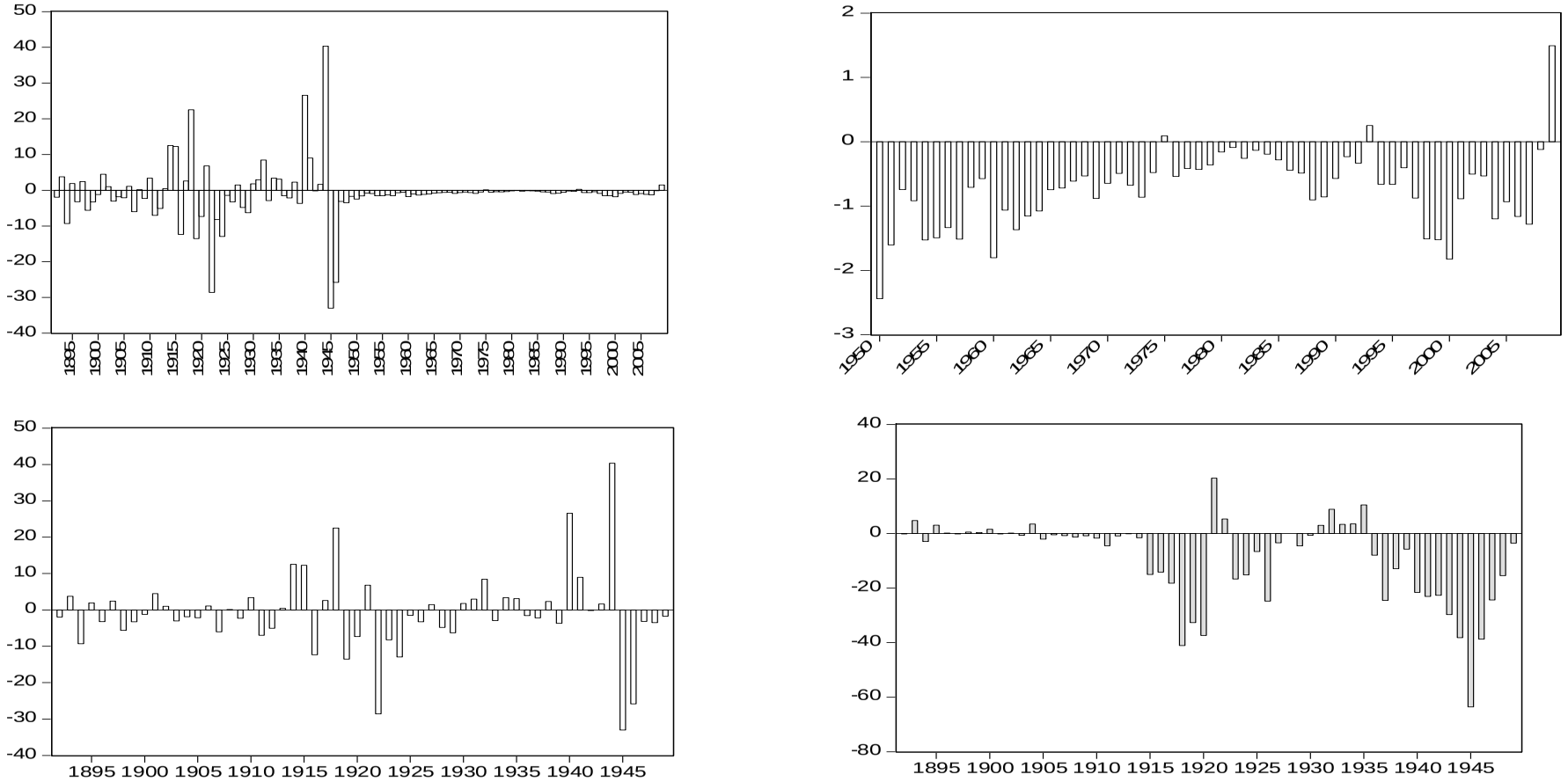


Table 1. – Estimation– Endogenous variable : Δd_t
Transition variable: Structural primary surplus(t-2)
1890-2009

Explanatory variable	Coefficient	t-ratio
Constant (regime 1)	-0.03*	-4.22
Constant (regime 2)	0.07**	1.82
Coefficient AR(1) (regime 1)	0.11*	2.28
Coefficient AR(1)(regime 2)	0.48	1.43
Residual standard error	0.06*	13.85
Dummy variable	0.95*	19.56
a1	3.11*	4.93
a2	4.08*	3.43
b1	0.02	0.18
b2	1.81**	1.87

Likelihood ratio test (null hypothesis : constant transition probabilities)
$\chi^2(2)$: 10.14 p-value : 0.006

Linearity tests on the standardized residuals
Bispectrum (statistic and p-value) : -4.55 0.99
Tsay test (statistic and p-value) : 3.60 0.0

Conditional mean of the endogenous variable
Regime 1 : -0.03 Regime 2 : 0.07

Table 2. – Estimation– Endogenous variable : Δd_t
Transition variable: Cyclical primary surplus(t)
1890-2009

Explanatory variable	Coefficient	t-ratio
Constant (regime 1)	-0.03*	-4.16
Constant (regime 2)	0.07**	2.68
Coefficient AR(1) (regime 1)	0.098*	2.23
Coefficient AR(1)(regime 2)	0.43**	1.77
Residual standard error	0.06*	19.86
Dummy variable	0.95*	19.36
a1	3.74*	4.45
a2	4.11*	3.35
b1	0.13*	2.02
b2	-1.76*	-2.17

Likelihood ratio test (null hypothesis : constant transition probabilities)
$\chi^2(2)$: 12.22 p-value : 0.0022

Linearity tests on the standardized residuals
Bispectrum (statistic and p-value): -1.23 0.89
Tsay test (statistic and p-value): 2.22 0.01

Conditional mean of the endogenous variable
Regime 1 : -0.03 Regime 2 : 0.12

Table 3. – Estimation– Endogenous variable : Δd_t
Transition variable: cyclical primary surplus(t-1)
1890-2009

Explanatory variable	Coefficient	t-ratio
Constant (regime 1)	-0.03*	-3.60
Constant (regime 2)	0.05*	2.66
Coefficient AR(1) (regime 1)	0.09*	2.05
Coefficient AR(1)(regime 2)	0.35*	2.60
Residual standard error	0.06*	14.57
Dummy variable	0.95*	18.61
a1	3.68*	4.245
a2	3.88*	3.06
b1	-0.02	-0.12
b2	0.33	0.90

Likelihood ratio test (null hypothesis : constant transition probabilities)
$\chi^2(2)$: 5.18 p-value : 0.07

Linearity tests on the standardized residuals
Bispectrum (statistic and p-value): -3.18 0.99
Tsay test (statistic and p-value): 2.18 0.01

Conditional mean of the endogenous variable
Regime 1 : -0.03 Regime 2 : 0.08

Table 4. – Estimation– Endogenous variable : Δd_t
Transition variable: Cyclical primary surplus(t-2)
1890-2009

Explanatory variable	Coefficient	t-ratio
Constant (regime 1)	-0.03*	-3.71
Constant (regime 2)	0.04*	2.69
Coefficient AR(1) (regime 1)	0.08	1.60
Coefficient AR(1)(regime 2)	0.32*	2.22
Residual standard error	0.06*	14.91
Dummy variable	0.96*	16.67
a1	3.61*	4.11
a2	3.98*	3.19
b1	0.001	0.0
b2	1.26**	1.73

Likelihood ratio test (null hypothesis : constant transition probabilities)
$\chi^2(2)$: 4.72 p-value : 0.09

Linearity tests on the standardized residuals
Bispectrum (statistic and p-value): -1.91 0.97
Tsay test (statistic and p-value): 2.05 0.02

Conditional mean of the endogenous variable
Regime 1 : -0.03 Regime 2 : 0.06

Table 5. – Estimation– Endogenous variable : Δd_t
Transition variable: Cyclical component of real GDP growth rate(t) 1890-2009

Explanatory variable	Coefficient	t-ratio
Constant (regime 1)	-0.06*	-5.89
Constant (regime 2)	0.03*	3.49
Coefficient AR(1) (regime 1)	0.07	4.45
Coefficient AR(1)(regime 2)	0.23*	2.73
Residual standard error	0.06*	15.24
Dummy variable	0.87*	17.04
a1	4.57*	2.05
a2	5.71*	2.55
b1	1.60*	2.34
b2	-1.48*	-2.41

Likelihood ratio test (null hypothesis : constant transition probabilities)
$\chi^2(2)$: 23.96 p-value :0.62×10^{-5}

Linearity tests on the standardized residuals
Bispectrum (statistic and p-value) : -
Tsay test (statistic and p-value): 1.62 0.11

Conditional mean of the endogenous variable
Regime 1 : -0.06 Regime 2 : 0.09

Table 6. – Estimation– Endogenous variable : Δd_t
Transition variable: Smoothed component of real GDP growth rate (t-1) 1890-2009

Explanatory variable	Coefficient	t-ratio
Constant (regime 1)	-0.03*	-4.36
Constant (regime 2)	0.07*	3.08
Coefficient AR(1) (regime 1)	0.09*	2.54
Coefficient AR(1)(regime 2)	0.40*	1.99
Residual standard error	0.06*	14.82
Dummy variable	0.95*	19.64
a1	2.74*	3.77
a2	2.93*	2.29
b1	0.34	1.20
b2	1.12*	1.98

Likelihood ratio test (null hypothesis : constant transition probabilities)
$\chi^2(2)$: 9.85 p-value : 0.007

Linearity tests on the standardized residuals
Bispectrum (statistic and p-value) : -1.45 0.93
Tsay test (statistic and p-value): 2.54 0.004

Conditional mean of the endogenous variable
Regime 1 : -0.03 Regime 2 : 0.11

Table 7. – Estimation– Endogenous variable : Δd_t
Transition variable: changes in the smoothed component of inflation (t-1) 1890-2009

Explanatory variable	Coefficient	t-ratio
Constant (regime 1)	-0.03*	-4.30
Constant (regime 2)	0.06*	3.22
Coefficient AR(1) (regime 1)	0.09*	2.08
Coefficient AR(1)(regime 2)	0.39*	2.23
Residual standard error	0.06*	17.90
Dummy variable	0.95*	19.11
a1	3.37*	5.01
a2	3.56*	2.95
b1	-33.76	-0.79
b2	-219.94*	-2.21

Likelihood ratio test (null hypothesis : constant transition probabilities)
$\chi^2(2)$: 9.91 p-value :0.007

Linearity tests on the standardized residuals
Bispectrum (statistic and p-value): -1.07 0.86
Tsay test (statistic and p-value): 2.38 0.006

Conditional mean of the endogenous variable
Regime 1 : -0.03 Regime 2 : 0.08

Table 8. – Estimation– Endogenous variable : Δd_t
Transition variable: spread between the smoothed components of the growth rate and interest rate payment (t-2)
1950-2009

Explanatory variable	Coefficient	t-ratio
Constant (regime 1)	0.05*	6.57
Constant (regime 2)	-0.03*	-3.26
Coefficient AR(1) (regime 1)	0.017	-0.51
Coefficient AR(1)(regime 2)	0.46*	3.78
Residual standard error	0.045*	12.00
Dummy variable	0.88*	7.90
a1	51.83*	9.00
a2	-7.29*	∞
b1	-20.68*	-9.15
b2	1.71*	16.32

Likelihood ratio test (null hypothesis : constant transition probabilities)
$\chi^2(2)$: 8.60 p-value :0.01

Linearity tests on the standardized residuals
Bispectrum (statistic and p-value): -1.75 0.96
Tsay test (statistic and p-value): 1.83 0.07

Conditional mean of the endogenous variable
Regime 1 : 0.05 Regime 2 : -0.05

Table 9. – Estimation– Endogenous variable : Δd_t
Transition variable: Changes in the smoothed component of inflation(t-1) 1950-2009

Explanatory variable	Coefficient	t-ratio
Constant (regime 1)	-0.02**	-1.60
Constant (regime 2)	0.03	1.11
Coefficient AR(1) (regime 1)	0.008	0.08
Coefficient AR(1)(regime 2)	0.79*	5.31
Residual standard error	0.05	9.88
Dummy variable	1.05	8.22
a1	3.34**	1.92
a2	3.79	2.63
b1	104.46	1.14
b2	-21.4×10^2**	-1.74

Likelihood ratio test (null hypothesis : constant transition probabilities)
$\chi^2(2)$: 9. p-value :0.01

Linearity tests on the standardized residuals

Bispectrum (statistic and p-value): -1.56 0.94
Tsay test (statistic and p-value): 1.45 0.18

Conditional mean of the endogenous variable

Regime 1 : -0.02 Regime 2 : 0.00

Table 10.- Years during which inflation, growth and primary surplus helped predict a decreasing debt ratio (according to the econometric model)

	Estimation 1890-2009	Estimation 1950-2009
Inflation rate	1890-1930 ; 1942-1980	1965-1985 ; 2006-2007
Growth rate – interest rate payment	1890-1930 ; 1942-1980	1950-1980 ; 2001-2002
Structural primary surplus	1909-1924 ; 1935-1949 d_t diminishes provided that the primary deficit ratio remains below 4%	none
Cyclical primary surplus	1905-1915 ; 1920-1927 ;1940-1945 ; 1946-1949 d_t diminishes provided that the primary surplus remains positive	none

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