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TAX SMOOTHING AND SEIGNIORAGE IN ITALY, 1861-1998

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Tax Smoothing and Seigniorage in Italy, 1861-1998.

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ABSTRACT

We shown some evidence that fiscal policy has been set in an optimal fashion in the period 1861-1998, and not in the 1950-1998 period. When we extend the analysis to revenue from money creation, even if we cannot obtain any result for long-run behaviour, we find that revenue from implicit and explicit taxation behave quite independently each other for both periods. Therefore, there is evidence in favour of the extended tax smoothing model.

Keywords: fiscal policy, monetary policy, optimality.

JEL Classification numbers: E62, E63, H21, H62, H63

1. Introduction

Starting from different premises, optimal taxation over time and the public finance case for inflation have gained a considerable interest in the literature. The former is a theory of government debt in a world in which Ricardian equivalence holds. In this framework, since government debt is neutral, there is no point in issuing government bonds. Barro (1979) provided a theory in which government debt is used to smooth the tax rate over time and, accordingly, reduce the welfare losses due to changes in the tax rate. Afterwards, the acknowledgement that the government is able to raise revenue from its right to print money, led to a theory in which both tax rate and seignoirage are used to smooth government revenue over time (Mankiw, 1987). This brings us to the public finance case for a positive inflation tax, firstly made by Phelps (1973). He argued that liquidity appears in the utility function along with leisure and real consumption expenditure and so there are no reasons to treat liquidity in a different manner with respect to the other arguments in the utility function, especially if the demand for money is highly interest inelastic. In addition, liquidity enters in the production function, and therefore contributes to the production of taxable income. Finally, there are collection costs associated with ordinary taxes that are absent in revenue from seignoirage.[1]

In the literature on the Italian public finance a very limited number of papers deal with these issues and they mainly cover short periods of time, as many in the international literature. We concentrate on long-run behaviour (1861-1998) because the financing needs of the two wars and of the great depression provide real test cases, and the availability of long time series reduces the small-sample bias. We are aware that long time-series may entail structural break problems, therefore we also focus on the post-World War II period. In addition, the Italian case is of interest because it shows both historical and contemporary high level of public debt and deficit.

The paper is organised as follows: Section 2 reviews the theory of optimal fiscal and monetary policy. In Section 3 previous empirical results are surveyed, while in Section 4 a short overview of the main Italian fiscal aggregates is presented. Section 5 and Section 6

[1] Criticism to this view are based to the foundations for liquidity in the utility function are not solid. Moreover, liquidity belongs to the production function, but the case for his taxation is based on the existence of "differential substitutability" (i.e., the net effect on untaxed leisure (hence unemployment) of the resulting change in relative prices) that cannot be taken for granted (Lucas, 1986).

respectively present the empirical methodology used here and the results. Conclusions are drawn in the final Section.

2. Models of optimal fiscal and monetary policy

If Ricardian equivalence holds, there is no rationale for the government to issue bonds. Starting from the idea that modify the marginal rate of taxation according to the changes in government expenditures would have high distortionary effects and would increase the dead-weight losses of taxation, Barro (1979) proposed the use of government bond as a way to keep tax rates constant. Then, issuing bonds when the current government expenditure is higher than its normal level, and retiring them when it is lower, would reduce the relevant losses. A similar result on tax rates is obtained by Mankiw (1987) in a model in which there are no government bonds but the government is allowed to print money to finance its expenditure (revenue-smoothing hypothesis or extended tax smoothing model).

2.1. Barro's tax smoothing model

The simple tax smoothing model considers a closed economy in which a representative agent consumes, works and saves. It is assumed that non zero tax rates impose a dead-weight loss on the representative consumer which represents the distortion of allocative decisions and administrative costs incurred by the tax raising institution. The goal of the government in period t is to find a tax collection sequence $\{T_t\}_{t=0}^{\infty}$, which minimises the present discounted value of the excess burden of taxation. Given the inherited value of debt and an exogenous time path for government expenditure, the government has to minimise its objective function:

$$E_t \sum_{j=0}^{\infty} \boldsymbol{b}^j L(T_{t+j}, Y_{t+j}) \,, \qquad (1)$$

where Y_t is the tax base which is assumed to be equal to the real national income, T_t is the total real tax revenue at time t, and L is the loss function with $L' > 0$ and $L'' > 0$.

The objective function (1) is minimised with respect to $\{T_t, B_{t+1}\}_{t=0}^{\infty}$ subject to a sequence of budget constraints:

$$B_{t+1} = (1+r)B_t + G_t - T_t \,, \qquad (2)$$

where r is the constant real interest rate, B_t and G_t denote respectively the real value of public debt and the real government expenditure net of interest that follows an exogenous stochastic process, and B_{t-1} is the stock of debt at the beginning of period t. Under the assumptions of perfect foresight and the no-Ponzi game condition, we can impose:

$$\lim_{t\to\infty} \frac{B_t}{(1+r)^t} = 0 \,. \qquad (3)$$

Solving the difference equation (2) using (3) as terminal condition, we obtain the intertemporal government budget constraint:

$$\sum_{j=0}^{\infty} \frac{1}{(1+r)^j} E_t T_{t+j} = B_t + \sum_{j=0}^{\infty} \frac{1}{(1+r)^j} E_t G_{t+j} \,. \qquad (4)$$

Equation (4) states that the expected present value of tax collection equals the sum of the current value of debt plus the expected present value of government expenditure. The Euler equation associated with the problem of minimising (1) subject to (4) is:

$$\frac{L'(T_t)}{E_t \beta L'(T_{t+1})} = 1 + r \,. \qquad (5)$$

In the case in which $\beta = 1/(1+r)$, eq. (5) reduces to:

$$E_t T_{t+1} = L'(T_t) \,, \qquad (6)$$

which states that the marginal social costs of taxation must be equated in every period.

Alternatively, eq. (6) implies that the marginal cost of taxation is a martingale. If the loss function is quadratic in taxation levels,[2] the intertemporal first-order condition (6) becomes:

$$E_t T_{t+1} = T_t \,. \tag{7}$$

which is the Barro's result that tax collections are a martingale. If the social cost function is homogeneous, the above result is extended to the average tax rate. If future government expenditure were known with certainty, the optimal tax rate would be constant. Because future government spending is uncertain, the optimal tax rate sets the present value of revenue equal to the present value of expected spending. As information about spending becomes available, the optimal tax rate changes.

The government will run a smaller budget surplus in the current period if government expenditure is expected to decline over the planning horizon. This enables the tax reduction to be smoothed over time. Conversely, when the government expects to increase its expenditure during the planning period, it will seek to increase the tax rate and therefore the budget deficit will fall.[3] Therefore, government debt and expenditure have an anticyclical profile, as in the Keynesian theory.

2.2 Mankiw's revenue-smoothing model

In the Barro's model, government is assumed to abstain from inflationary finance. Abstracting from the possibility of government borrowing, Mankiw (1987) shows that if both fiscal and monetary policy are used to optimally finance government expenditures, inflation and nominal interest rates will also be smoothed and tax rates (the explicit taxes), nominal interest rates, and inflation (the implicit tax) will move together over time.

Let Y be the exogenous level of real output and t the tax rate on output. The revenue

[2] The adoption of a quadratic loss function is not motivated by any explicit microeconomic foundation.

[3] In this formulation the government does not engage in tax tilting, i.e., it has no incentives to systematically favour either budget deficits or budget surpluses. For example, a government that is unsure of its re-election prospects may favour higher current debt levels than are implied by the tax-smoothing hypothesis, in order to exert an influence on the future spending activities of rival political parties should they come in power. The reason to do this is twofold. Firstly, previous empirical results found very limited evidence for tax tilting. Second, the substantial stability in government by incumbents may have avoided this policy, since the entrants were usually not likely to win the elections. See Ghosh (1995) for a theoretical and empirical analysis.

raised by this tax rate is tY. It is assumed that the government finances expenditure in excess of taxes from seigniorage. Assuming that the demand for money is described by the quantity equation, $M/P = kY$, the real revenue from seigniorage is:

$$\frac{\dot{M}}{P} = \frac{\dot{M}}{M}\frac{M}{P} = (p + g)kY \,, \tag{8}$$

where p is the inflation rate and g is the growth rate of real output. Total tax revenue, T, is therefore the sum of the receipts from direct taxation tY, and seigniorage, $(p + g)kY$, that is $T = tY + (p + g)kY$.

The social cost of taxation and inflation are assumed homogeneous in output and denoted by $f(p)Y$ and $h(p)Y$, respectively, where $f' > 0$, $h' > 0$, and $f'' > 0$, $h'' > 0$. The government's goal is to minimise, with respect to t and p, the expected present value of social losses:

$$E_t \sum_{j=0}^{\infty} b^j \left[f(t_{t+j}) + h(p_{t+j}) \right] Y \,, \tag{9}$$

subject to the present value budget constraint,

$$\sum_{j=0}^{\infty} bG_{t+j} + B_t = \sum_{j=0}^{\infty} bT_{t+j} \,, \tag{10}$$

where G is real exogenous expenditure, B_t is real government debt at time t, and b is the real discount factor, assumed constant over time.

The first-order conditions necessary for optimal intertemporal monetary and fiscal policy are:

$$E_t\{f'(t_{t+j})\} = f'(t_t) \,, \tag{11}$$

$$E_t\{h'(p_{t+j})\} = h'(p_t) \,, \tag{12}$$

$$h'(p_t) = kf'(t_t) \,. \tag{13}$$

Conditions (11) and (12) are similar to those in previous analysis. However, since the government has an alternative financing method (i.e., creation of money), not only the marginal social costs of taxation have to be equated in every period, but so do the marginal social costs of inflation. Also, these conditions imply that the marginal social costs of taxation and inflation are martingales. As before, if $f(.)$ and $h(.)$ are quadratic, both the tax and the inflation rates follow a random walk, which implies that the nominal interest rate is also a martingale, assuming a constant real interest rate. In this sense taxes and inflation are smoothed. The static first-order condition (13) relates the tax rate to the rate of inflation and equates the marginal social cost of raising revenue through taxation and the marginal social cost of raising revenue through seigniorage. Therefore, increases in government revenue requirements increase the use of both implicit and explicit taxation. Hence if fiscal and monetary policy are used to optimally finance government expenditure, tax rates and inflation will vary together over time.

3. Empirical literature

It appears that the results are rather different when tests are made for the tax smoothing and the extended tax smoothing (which also includes seigniorage) model. While Barro (1979, 1986, 1987) shows that both the US and the UK government behave according the tax-smoothing hypothesis, recent empirical studies obtain conflicting results. On the one hand, Huang and Lin (1993), Ghosh (1995) and Serletis and Schorn (1999) examine U.S. and Canadian evidence in a VAR framework and find that increases in the budget surplus signal future increases in government expenditure. On the other hand, Sahasakul (1986) for the US, and Olekalns (1997) for Australia do not support the optimal fiscal policy model.

Mankiw (1987) provides evidence for the tax smoothing and seigniorage model, even if his results have been criticised for assuming a constant velocity of money over time and to not consider the stochastic structure of the data. This is done by Trehan and Walsh (1990), which found that there is no evidence of revenue smoothing for the US when nonstationary disturbances are taken into account.

Evans and Amey (1996) reject the extended tax smoothing model for a significant number of OECD countries, and Ashworth and Evans (1998) do the same for almost 32 developing countries. Guender and Lees (1999) examine optimal revenue generation over 60 years for New Zealand. The theory is supported until 1989 when the Reserve Bank become independent, therefore the break in the long-run relationship between the rate of inflation and tax rate is attributable to the demise of the omnipotent policy-maker.

As far as we know, there are only three papers that deal with optimal taxation over time in the Italian case. Attanasio and Marini (1988) use an OLS methodology and do not find evidence for tax smoothing for the period 1960-1983: the rate of taxation grows as nominal income increases. This phenomenon, called bracket-creep, is consistent with a progressive and non indexed fiscal system. Although they maintain that it is difficult to prove that this result is consistent with the optimal behaviour of the fiscal authority, they suggest that the government has tried keep constant the growth of government debt with respect to the growth of inflation to increase revenue from taxation and to reduce the real value of the debt. This is in accordance to the hypothesis that reductions of undesired government debt are obtained through money creation. Grilli (1989) argues that there exists a cointegrating relationship between revenue variables and revenue and expenditure variables. However, the stationarity of the residuals of seigniorage regressions is the consequence of stationarity in the dependent variable. This circumstance significantly reduces the meaningfulness of the results. Evans and Amey (1996) reject the hypothesis of revenue smoothing for the period 1955-1989. In contrast, without providing a formal test, Fratianni and Spinelli (2001) maintain that tax rates have been set optimally over time also because of the use of money creation revenue.

4. An overview on the Italian fiscal and monetary policies

Fiscal and monetary policy have been linked each other for most of the analysed period until 1979, when a progressive decoupling of the two policies has taken place through the so-called divorce between the Treasury and the Bank of Italy in the form of the removal on the part of the former to buy unsold Treasury Bills at auction.

Until 1926 a peculiar feature of the Italian monetary policy was that the Bank of Italy did not have a monopoly on issuing bank notes. As the Kingdom of Italy grew, the

Italian Lira became the common currency and a single coinage system was put in place. But the banks of issue in the minor states annexed by Piedmont were allowed to survive alongside the Bank of Italy, leading to a system where several banks of issue competed issuing banknotes. In 1870 there were six banks of issue operating in Italy, then this number was reduced to three in 1893, and finally the Bank of Italy acquired a monopoly of issue in 1926. These various banks of issue were also commercial banks, fulfilling a dual function in the financial system.

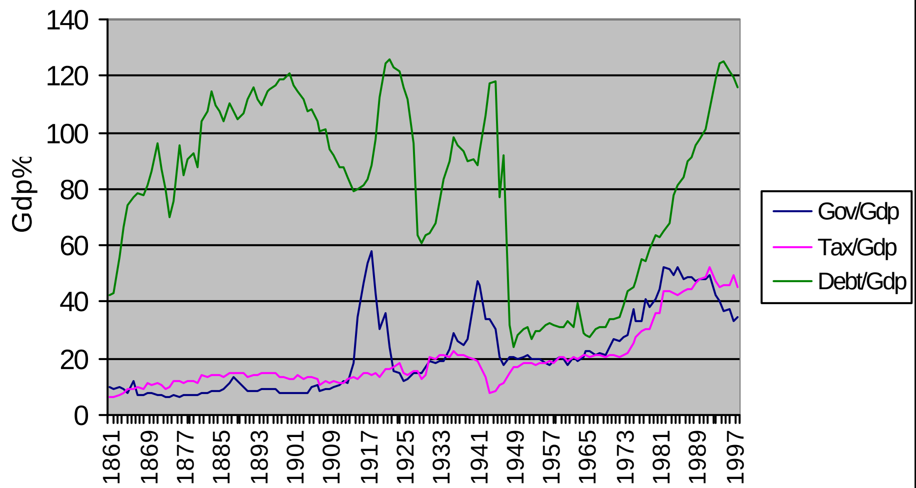
A constant in the monetary policy has been the switching between the convertibility and the non convertibility system, a process usually imposed by the increase in government expenditure caused by an upsurge in military outlay that made it impossible to fulfil the obligation to convert notes in gold. In periods when Italy did not adhere to the rules of the gold standard, the government controlled money creation through two channels. First, it tried to progressively impose some degree of control over the issue of bank notes through several bank laws imposing limits on the amount of paper money that each bank could issue, and imposed minimum reserve ratios which issue banks should have adhered to. Second, the banks of issue official discount rate was increasingly brought under government control. The Italian government controlled the official discount rate of the Bank of Italy and the other banks of issue between 1866 and 1992. For example, convertibility was suspended in 1859-1860 during the straggle for Italian unification, afterwards was suspended again in 1866 during the expansionary fiscal policy needed to fund the war with Austria. During the 1870s a process of fiscal consolidation took place and full convertibility was restored in 1880, but was suspended in the 1883 under inflationary pressures and capital inflows. Monetary stability was slowly rebuild in the period 1894-1913 without a formal return to the Golden Standard, but with a mix of prudent fiscal and monetary policies.

After the unification in 1861, fiscal policy was expansionary. The need to fund the unification of the new State through infrastructure and the nationalisation of railways, the obligation of repaying the debt issued by the Kingdom of Piedmont during the war for unification, and a new war of independence with Austria in 1966 put pressure on the budget policy. In this situation public debt grew until 80% of the GDP and the first fiscal consolidation took place through the increase in taxes.

During the ruling years of the Left (1876-1896), public budget was used to fund investments in railways, iron industry, and military industry. Taxes were not increased accordingly and an increase in government deficit occurred. However, this deficit was not funded through seigniorage, because Italy returned to the Gold Standard in 1883. This decision was not deflationary: it caused a strong inflow of foreign investments, which helped industrial development. The Gold Standard was again abandoned during the economic crisis in 1887-1895, when both government deficit and debt increased because of the active fiscal policy.

During the Giolitti period (1901-1913) there was a positive interaction between fiscal consolidation and business cycle. Government expenditure was almost constant, while taxes grew in real terms, therefore both were reduced with respect to GDP, but the former at a faster rate. Together with a reduction in international interest rates and in particular of the spread of the Italian ones with respect to those of other major countries,

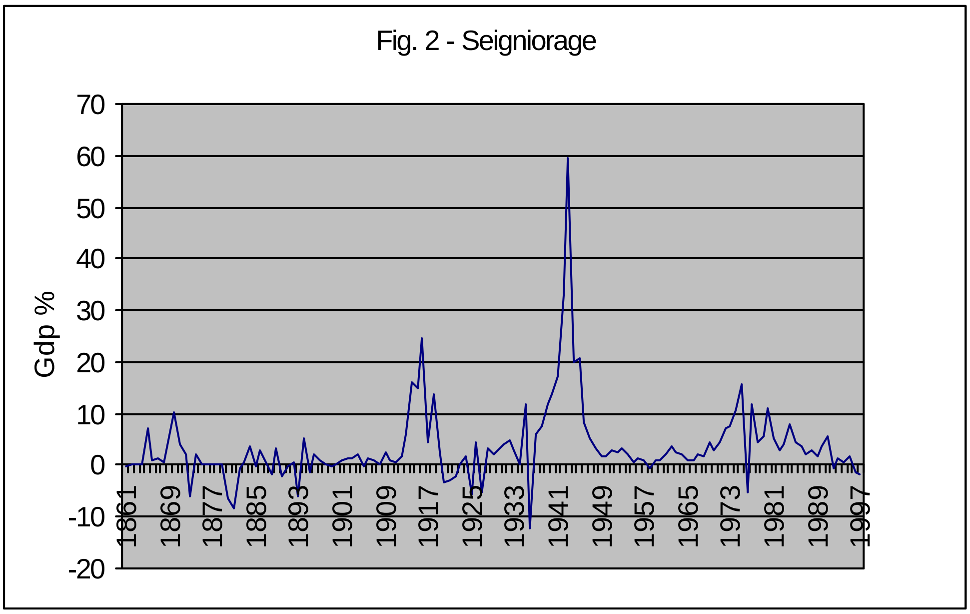
Fig. 1 - Italian fiscal aggregates



this situation made it possible the second fiscal consolidation in 1906, in which bondholders were allowed to choose either to exchange their bonds in a perpetuity yielding a 3.75% interest rate or getting repaid at the par value. Only 6% of bondholders decided of being refunded and this voluntary conversion was successful because the government gained credibility against financial markets and savers.

From 1914 onwards, there are three major episodes of fiscal deficits: before and during the two World Wars, and at the end of the period of increasing fiscal expansion post-1960. During the World War I military expenditure raised at almost 50% of the GDP and in 1920 public debt was over 120% of the GDP. During the Fascist regime there were two episodes of fiscal consolidation. The minor one took place in 1922-1926 through a strong reduction in government expenditure, an high rate of inflation that reduced the real value of the government debt, and a remission of debt from the US and the UK. This resulted in a return to the gold standard at an overvalued exchange rate (the so-called *quota 90*) which, in the light of rising fiscal deficits and military expenditure, could only be defended through the imposition of capital controls and trade barriers. In addition, there was a compulsory switching of all government bonds with a residual duration of less than seven-years in 5% nine-years bond in the second and more important fiscal consolidation of the Fascist government. While the first consolidation was obtained by raising taxes, the second was achieved through credibility of the government and voluntary switching from bondholders, the third one was made possible by the authoritarism of the regime.

The financial needs of Word War II were quite demanding because of the isolation of the Italian government. There was an attempt at funding government expenditure through forced government bond at a low interest rate, but the government debt to GDP ratio skyrocketed again. In 1941 Bank of Italy increased its funding leading to an increase in inflation that reduced the above ratio to a quarter. However, until 1947 the inflation rate was about 100% per year. Fiscal consolidation was mainly achieved through the inflation-tax (see Fig. 2).



In the post-World War II period, Italy joined the Bretton Woods system and, as in many other developed economies, monetary policy continued to be dominated by the stance of fiscal policy, with the stabilisation of interest rates as the main objective. In the 1970s the increase in government expenditure was devoted to the expansion of the Welfare State. However, an increase in government debt did not occur because while the primary deficit increased, the debt service decreased because the interest rate was lower than the rate of growth of the economy. Interest rates were exceptionally low because of restrictions that prevented the diversification abroad of the financial wealth. When these constraints were removed the interest rates increase together with the government debt. The pattern follows that of the high-inflation OECD countries from the mid-1960s to the early 1980s, with rising deficits leading to higher inflation.

The fiscal dominance of monetary policy was only broken in the early 1980s, when the Bank of Italy gradually acquired greater independence in setting monetary policy, and did so independently of fiscal considerations. In addition, in 1978 the entry in the European Exchange Rate System imposed an additional constraint on monetary policy, namely on inflation. In the 1990s the objective of both fiscal and monetary policies has been to achieve inflation convergence with the Euro-area and exchange-rate stability to fulfil the Maastricht criteria. A reduction of the debt over GDP ratio was achieved through a reduction in government expenditure, in particular public employees and pension schemes, and an increase in taxes to obtain a substantial primary surplus.

5. Methodology and data

The theory discussed so far yields to a number of testable restrictions on the data for both tax- and revenue-smoothing. For the former it must be noted that the tax rate, if set optimally, should follow a random walk. The second implication is that the budget surplus should be stationary, even if public expenditure has a stochastic trend. The budget surplus under tax smoothing will be equal to the present discounted value of the stream of anticipated changes to government spending. If the level of government expenditure is $I(1)$, its changes will be $I(0)$. This also implies that the budget surplus will be $I(0)$ too. The third implication is that budget surplus should Granger cause changes in government expenditure. Since a change in the budget surplus implies the arrival of new information concerning future spending plans, the government has more information about the evolution of its expenditure than is contained in its past values of government spending. Then this additional information should be reflected in the budget surplus.

The key time-series variables in the extended tax-smoothing model are: the log of the tax rate (*ln$\boldsymbol{t}$*), the rate of seigniorage ($\boldsymbol{p}$) and the log of the money velocity (*ln*(*y*/*m*)). The testable propositions of the model relate to the properties of these time series variables – whether the variables are stationary or non-stationary - and, if all the variables are non-stationary and have the same order of integration, their cointegrating properties. In particular, if *ln*(*y/m*) is I(0), and both *ln$\boldsymbol{t}$* and $\boldsymbol{p}$ are *I*(1), the last two series have to be cointegrated, while when the three series are I(1), they all have to be cointegrated. One particular inference worth highlighting: if all three variables are integrated of order one, the existence of a *unique* cointegrating vector *denies* that any pair from this set of variables is cointegrated. Thus, if each of the three variables is found to have a unit root, then evidence of cointegration between any pair of variables is sufficient to falsify the extended tax smoothing hypothesis. However, if money velocity has a unit root, then evidence of cointegration between *ln$\boldsymbol{t}$* and $\boldsymbol{p}$ is sufficient to falsify the extended tax-smoothing model. It should also be noted that we now know that, even if the data supports the extended tax-smoothing hypothesis, it is still necessary to consider the matter further. Evans and Amey (1996) demonstrate that support for the extended tax-smoothing hypothesis requires several further criteria to be met. Where a cointegrating vector is found it will take the following form:

$$\ln \boldsymbol{t}_t = a_0 + (\boldsymbol{b}/\boldsymbol{a})\boldsymbol{p}_t + (1/\boldsymbol{a})\ln(y/m)_t . \qquad (14)$$

In addition to evidence of a *unique* cointegrating vector, the estimated coefficients on the three variables must be of the correct sign and size to be consistent with the tax-smoothing hypothesis. With normalisation on the tax rate, the parameters on inflation ($\boldsymbol{b}$/$\boldsymbol{a}$) and velocity (1/$\boldsymbol{a}$) must be positive and be such that their ratio lies between 0 and 1. This is because $\boldsymbol{a}$ > 0 and 1 > $\boldsymbol{b}$ > 0 are necessary conditions for the marginal distortionary costs associated with the two forms of revenue generation to be increasing in the tax rate and inflation respectively.

This analysis is applied to Italian annual data from 1861 to 1998. Expenditure is defined as the sum of total budget outlays less interest payments on debt, calculated as a ratio to GDP. The average tax rate is the ratio of government revenue to GDP. The velocity of money is calculated as the ratio between GDP and monetary base. For seigniorage we have not used the inflation rate but we have calculated it as the ratio of the variation in the monetary base of the Treasury over GDP lagged one period.[4] All data are in nominal terms. Data for GDP, monetary base (defined as the sum of bank deposits and the monetary base of the Treasury), debt, interest payments on outstanding debt are taken from Fratianni and Spinelli (2001). Government expenditure and taxes are taken from Spinelli and Fratianni (1991) for the period 1861-1980, and from Istat (various years) for the remaining period.

6. Empirical results

6.1 Long-run results

Table 1 reports the unit-root tests for the period 1861-1998. We use two tests: the standard Augmented Dickey-Fuller and the Weighted Symmetric[5] (Park and Fuller, 1995). According to Pantula *et al.* (1994), the latter is more powerful than the former and has the best power properties among other alternatives to the Dickey-Fuller test. The statistics in Table 1 are calculated allowing for a drift and a time-trend in the data-generating process, and both are significant in the estimations. In order to test the significance of the test statistics, we report the p-values calculated form the surface estimates in MacKinnon (1994). The lag-length has been chosen using the Akaike Information Criterion + 2, that is, we have considered processes with a number of augmenting lags equal to those that

[4] We have followed this way because this measure strictly refers to the ability of the government to pump money in the economy. Indeed, the two series follow a very similar pattern, although the inflation-tax presents more extremes. The monetary base of the Treasury is made up by notes and coins issued by the Treasury, loans from monetary authorities, Cassa Depositi e Prestiti, state-owned banks and insurance companies, and postal deposits to the Treasury.

[5] The WS test is a weighted double-length regression. First the variable being tested is regressed on the constant/trend variable, and the residual from this is used as Y in the double-length regression. In the first half of this regression Y is regressed on $Y(-1)$ and lags and DY. The weights are $(t\text{-}1)/T$. In the second half, Y is regressed on $Y(+1)$ and leads of $Y - Y(+1)$, using weights (1- $(t\text{-}1)\text{-}T$).

minimise the AIC plus two more lags. Pantula *et al.* (1994), provide support to such a decision rule.

According to these statistics we cannot reject the existence of a unit root in the tax rate series, so it does not follow a random walk, in contrast with the theory. For the government expenditure series, we can reject the null hypothesis of a unit root both in level and in first-differences at the 5% significance level. For the budget surplus series we can reject the null hypothesis of unit root at the 5% and at the 10% significance level according to the test used. Therefore, the budget surplus series fulfils the condition for optimal taxation over time.

Table 1 – Unit root tests for tax smoothing, 1861-1998.

	T_t	G_t	DG_t	Sur_t
Weighted Symmetric	-1.622	-3.723	-5.373	-3.494
	(0.851)	(0.011)	(0.000)	(0.023)
	[2]	[5]	[5]	[5]
Augmented Dickey-Fuller	-1.272	-3.742	-5.247	-3.323
	(0.894)	(0.020)	(0.000)	(0.062)
	[2]	[5]	[5]	[5]

10% and 5% critical values are respectively –3.13 and –3.40 for processes with drift and trend. Number in round brackets are p-values of the associated test statistics calculated from MacKinnon (1994). Figures in square brackets are the lag-lengths obtained using the AIC + 2 rule.

We apply Granger causality analysis to test whether the current budget surplus has a predictive power on future changes of government spending. We have used six lag-lengths and we have chosen lag one, which minimises the Schwarz Bayes Information Criterion. Table 2 reports the results of the test for the full period, both coefficients are highly significant and the value of the F-statistic enables us to reject the null hypothesis of no Granger causality at the 1% significance level. This is consistent with the idea that taxes are raised in advance of predictable increases in government expenditure, so reducing the required size of the tax-increase.[6]

[6] Given the sensitivity of the Granger-causality test to the number of additional lags, we have also considered the test with up to six lags. The above result is always confirmed at the same significance level.

Table 2 – Granger causality test, 1865-1998.

$$\Delta G_t = c + \sum_{i=1}^{p} \boldsymbol{a}_i \Delta G_{t-i} + \sum_{i=1}^{p} \boldsymbol{b}_i sur_{t-i}$$

	lag	$\boldsymbol{a}_1$	$\boldsymbol{b}_1$	F
$sur_t \rightarrow \Delta G_t$	1	0.337	0.114	9.541
		(4.084)	(3.120)	[0.01]

The lag-length has been chosen by minimising the Schwarz Bayes Information Criterion. Numbers in round brackets are t-statistics, the figure in square brackets is the p-value. The F-statistic tests in this case the null hypothesis that $\boldsymbol{b}_1 = 0$.

The dynamic relationships between government expenditure and government debt may be studied in a VAR framework, tracing out the impulse response functions derived from unexpected shocks on the variables of interest. We estimate a non-structural VAR (Sims, 1980) with four lags, as suggested by the Akaike Information Criterion, with intercept and trend. To capture possible data heterogeneity we add a non linear time trend, that is a Chebichev time polynomial of order three (Bierens, 1997). Dots represent plus and minus one and two standard errors bands, and the standard errors of the innovation responses are computed according to the method proposed by Baillie (1987). The time-span is set in ten years. Inspection of the four panels (shown in Appendix A) reveals a substantial confirmation of the above results. In ten years time the variables absorb almost completely the shocks hitting them. A shock of government expenditure on itself has considerable effect in the first year, then stays rather steady for two other years, to decrease and return to the original level at the ninth year. A very limited but permanent effect has a shock of government debt on G. When hit by a shock on government expenditure, debt stays almost constant at the beginning, reaches its maximum at the sixth year, then starts falling toward its original level. This is the only case in which a shock appears to last more, but still without permanent effects. A shock on debt on itself is recovered in about seven years.

Finally, we test for the extended tax smoothing model. We cannot reject the hypothesis of a unit root for lnT_t and $lnMV_t$, [7] but not for $Seign_t$. Therefore, according to the theory only taxes follow a random walk, but we cannot test for cointegration among

[7] Money velocity displays a clear downward trend that is the result of several financial innovations occurred in the period (see, Fratianni and Spinelli, 2001).

these series. However, the circumstance that the two series cannot have a common long-run behaviour, does not prevent us to see whether they show any short-run common behaviour.

Table 3 – Unit root tests for tax smoothing and seigniorage, 1861-1998.

	lnT_t	$LnMV_t$	$Seign_t$
Weighted Symmetric	-2.507	-1.698	-4.489
	(0.288)	(0.819)	(0.001)
	[2]	[3]	[3]
Augmented Dickey-Fuller	-2.571	-3.489	-4.326
	(0.293)	(0.127)	(0.003)
	[2]	[3]	[3]

10% and 5% critical values are respectively –3.13 and –3.40 for processes with drift and trend. Number in round brackets are p-values of the associated test statistics calculated from MacKinnon (1994). Figures in square brackets are the lag-lengths obtained using the AIC + 2 rule.

Equations (11) and (12) imply the absence of Granger causality between taxes and seigniorage. We can fit this test in a VAR framework. Therefore, an impulse response function analysis is conducted, between seigniorage and the log of taxes. We perform a non structural VAR with intercept, linear trend, and a nonlinear trend that takes the form of a Chebichev time polynomial. Because the series have different integration order, we have decided to first-difference the $I(1)$ series.[8] In this case the results (shown in Appendix B) are quite supportive of the exogeneity of each variable with respect to the other. After a shock, its effects are small and absorbed in a few years, and variables return to their normal values.

[8] As Harvey (1990, 83) noted, when estimating in level a VAR of $I(0)$ and $I(1)$ series, one should "recognize the effect of unit roots on the distribution of the estimators". We have also performed a VAR in levels. Generally speaking the results indicate that a shock tends to last a bit more with respect to the all stationary series. However this does not qualitatively changes the conclusions. This procedure has also been applied in the next VAR analysis on the same variables but on a reduced time-span. Details are available from the author upon request.

6.2 The post-World War II period

In the previous Subsection, the presence of the two World Wars can be seen as a temporary increase in government expenditure that lasts for some years and then return to its normal value. In the period after the World War II, an upward tendency in government expenditure has occurred without any clear exogenous reason, so it is likely to believe that this increase is permanent. It is therefore useful to test whether tax-smoothing still holds in this period, with and without the support of the inflation tax.

Unit root tests in Table 4 are different to those presented in Table 1. While we cannot reject the existence of a unit root in taxes and government expenditure at the 5% significance level, ΔG_t is once again $I(0)$, and we cannot reject the non-stationarity for the budget surplus.[9] With respect to the full period, two indicators of optimal taxation yield to results in contrast with the theory.

Table 4 - Unit root tests for tax smoothing, 1950-1998.

	T_t	G_t	DG_t	sur_t
Weighted Symmetric	-0.551	-2.079	-4.838	-0.648
	(0.993)	(0.593)	(0.000)	(0.991)
	[2]	[2]	[2]	[3]
Augmented Dickey-Fuller	0.051	-2.305	-3.926	-2.663
	(0.995)	(0.431)	(0.011)	(0.252)
	[7]	[3]	[3]	[2]

10% and 5% critical values are respectively –3.13 and –3.40 for processes with drift and trend. Number in parentheses are p-values of the associated test statistics calculated from MacKinnon (1994). The number in brackets are the lag-lengths obtained using the AIC + 2 rule.

Granger-causality is analysed in Table 5. Here again the lag length chosen according to the Schwarz-Bayes Information Criterion is 1, the coefficient of ΔG_t is negative but insignificant and the F-statistic yields to the rejection of the null hypothesis of no Granger-causality at the 10% significance level. Therefore, with respect to the whole period, there is less evidence of precedence between budget surpluses and future changes in government expenditure and then of optimal taxation over time. In addition, this result

[9] This result may also be interpreted as a lack in fiscal policy sustainability (see Hamilton and Flavin, 1986).

is not consistent: when one considers specifications from two to six lags, the null hypothesis of no Granger causality cannot be rejected at the 10% significance level for three, four and five lags, at the 5% significance level for two lags, and at the 1% significance level for six lags. Given the high sensitivity of these results to the lag-length, they should be taken with some caution, but overall are less supportive to Granger-causality between budget surplus and changes in government expenditure than those of the large period. Appendix C shows the dynamic relationship between government expenditure and government debt, highlighting the existence of a short-term effect of shocks.

Table 5 – Granger causality test, 1950-1998.

	lag	a_1	b_1	F
$sur_t \rightarrow \Delta G_t$	1	-0.228	0.128	3.327
		(-1.633)	(1.824)	[0.10]

The lag-length has been chosen by minimising the Schwarz Bayes Information Criterion. Numbers in round brackets are t-statistics, the figure in square bracket is the p-value. The F-statistic tests in this case the null hypothesis that $b_1 = 0$.

For the extended tax smoothing model we end up with the same previous situation. Again, both log of taxes and log of money velocity have a unit root at the 5% significance level and $Seign_t$ does not. Therefore, it does not exist a cointegrating vector between lnT_t and $Seign_t$.

Table 6 – Unit root tests for seigniorage, 1950-1998.

	lnT_t	$lnMV_t$	$Seign_t$
Weighted Symmetric	-0.404	-0.670	-4.066
	(0.995)	(0.990)	(0.004)
	[2]	[3]	[2]
Augmented Dickey-Fuller	1.513	-2.286	-3.867
	(1.000)	(0.442)	(0.013)
	[10]	[4]	[2]

Number in round brackets are p-values of the associated test statistics calculated from MacKinnon (1994). The figure in square brackets are the lag-lengths obtained using the AIC + 2 rule.

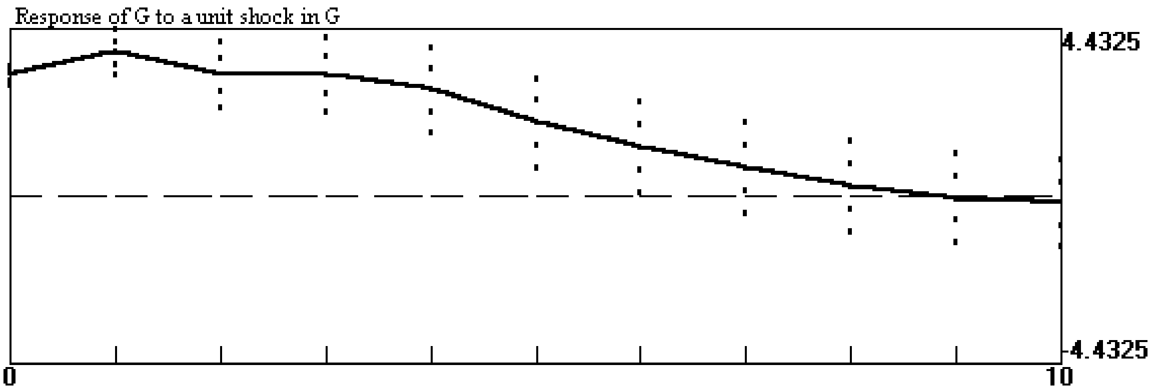
A short-run analysis on the shocks concerning these variables, obtained performing a non-structural VAR with a unit lag-length according to the AIC, and shown in Appendix D, reveals that the cross-effects of a shock on a variable on the other are quite negligible, while the effect of a shock on taxes on itself causes an about five-years deviation from its normal value.

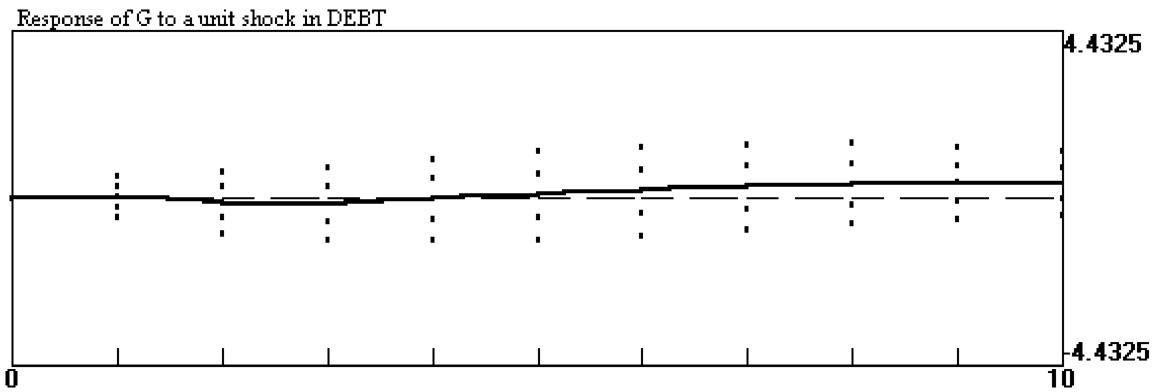
7. Conclusions

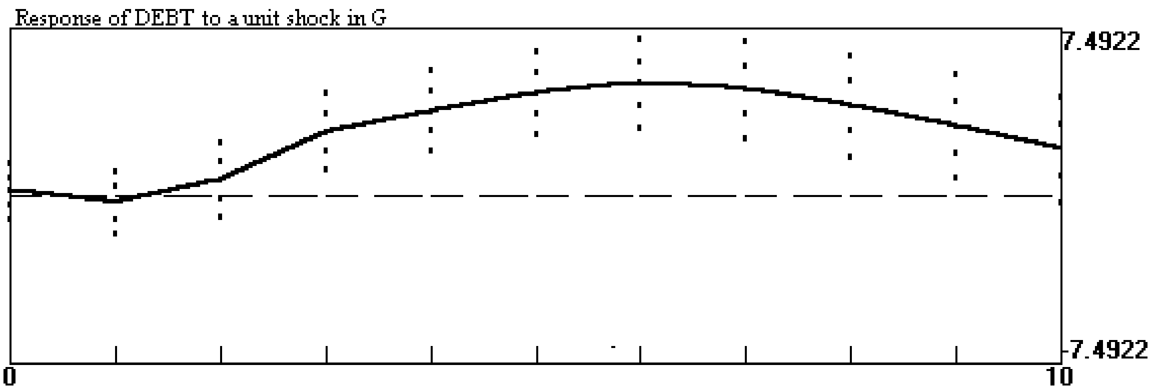
We have shown some evidence that fiscal policy has been set in an optimal fashion in the period 1861-1998, and not in the 1950-1998 period. When we extend the analysis to revenue from money creation, even if we cannot obtain any result for long-run behaviour, we find that revenue from implicit and explicit taxation behave quite independently each other for both periods.

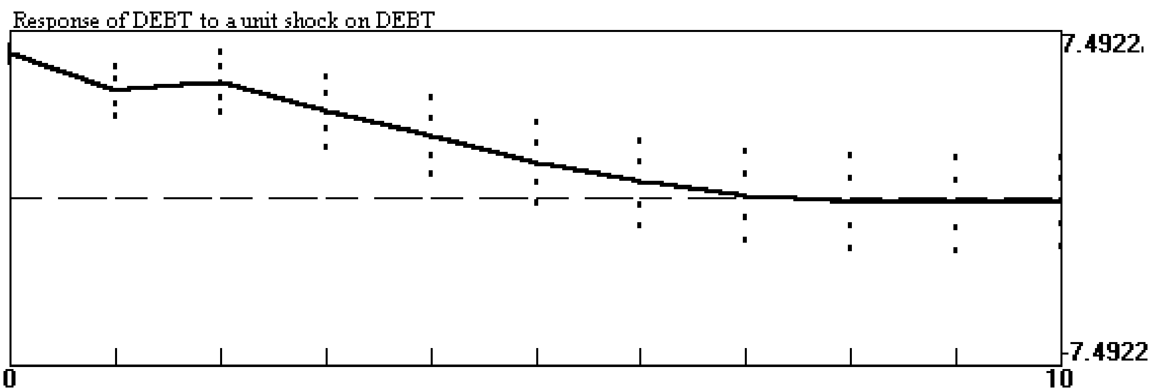
To some extent we have *a priori* imposed a structural break in 1950. A throughout analysis would include an explicit study of structural breaks, for examples by the use of the Kalman filter, a method that allows a continuous change in the parameters. This method may be combined to the VAR analysis. Another possible extension may consist in a VAR with more variables (i.e., money velocity, money growth rate, etc.) to overcome problems related with missing variables.

Appendix A - Impulse response functions of the VAR between government expenditure and government debt, 1861-1998.

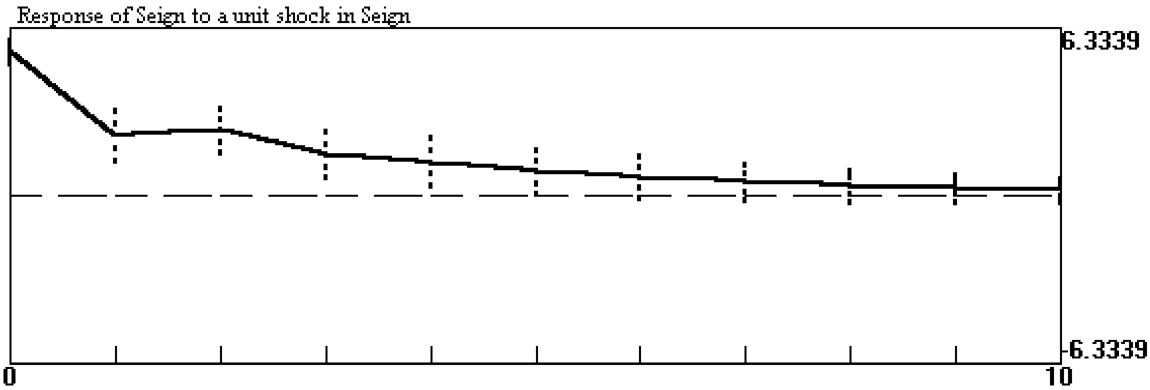


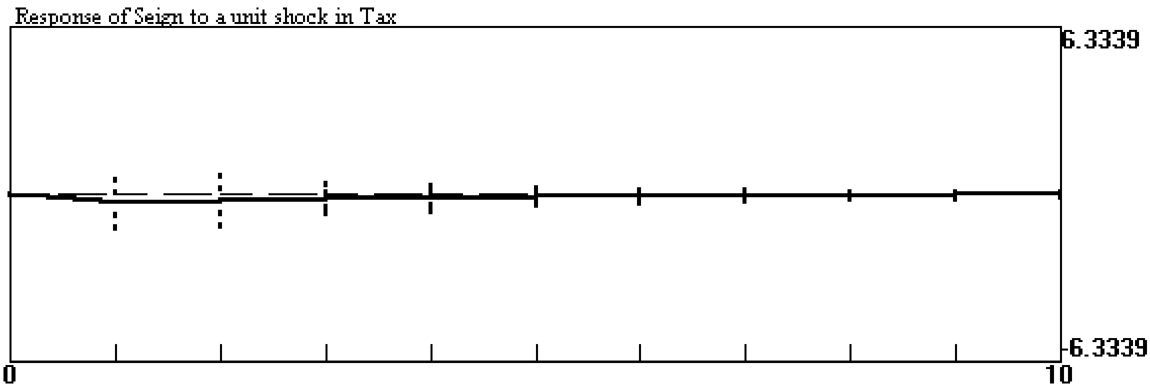


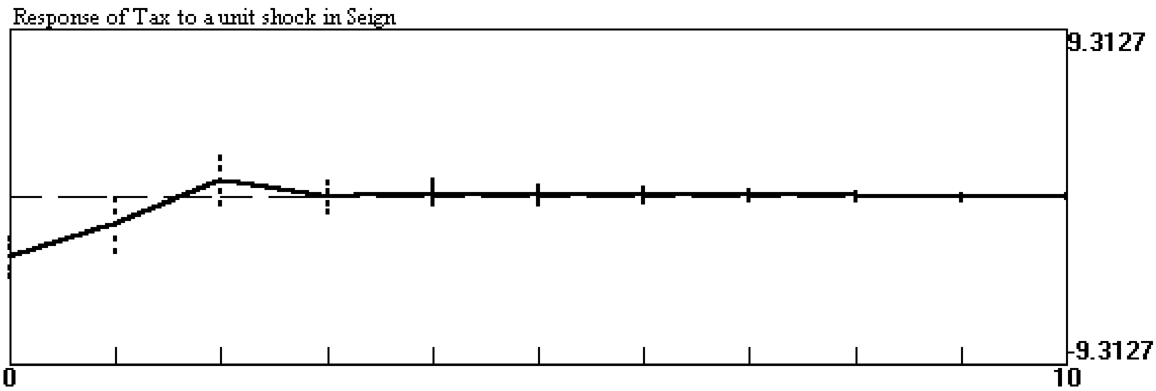


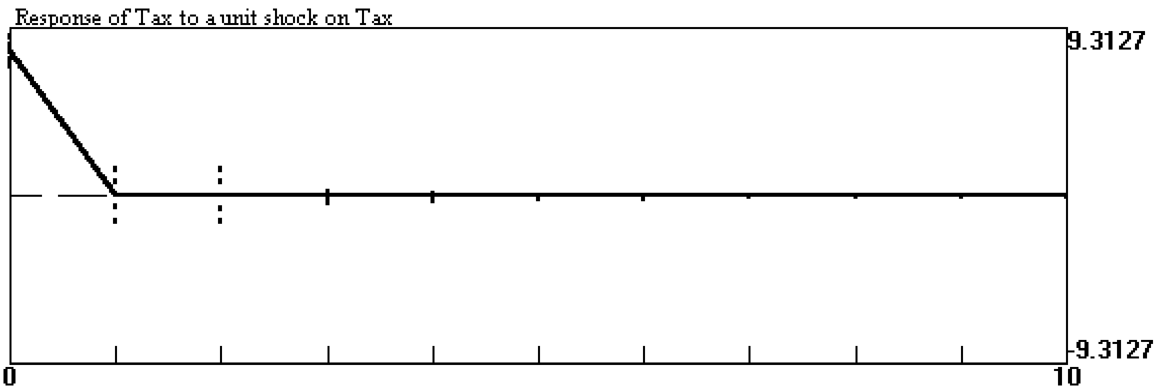


Appendix B - Impulse response functions of the VAR between taxes and seigniorage, 1861-1998.

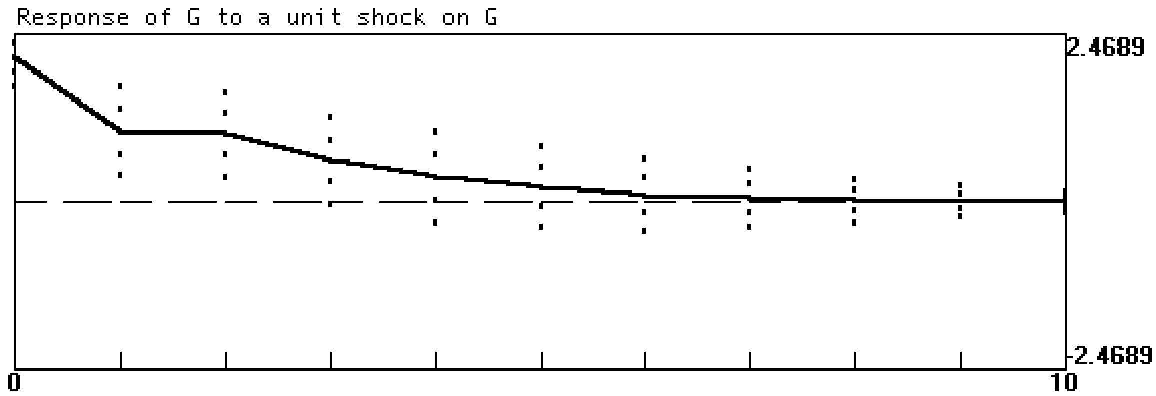


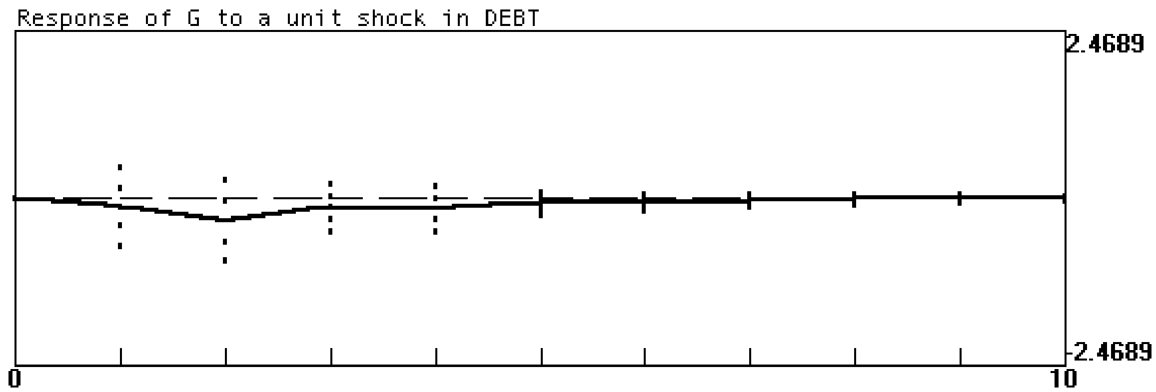


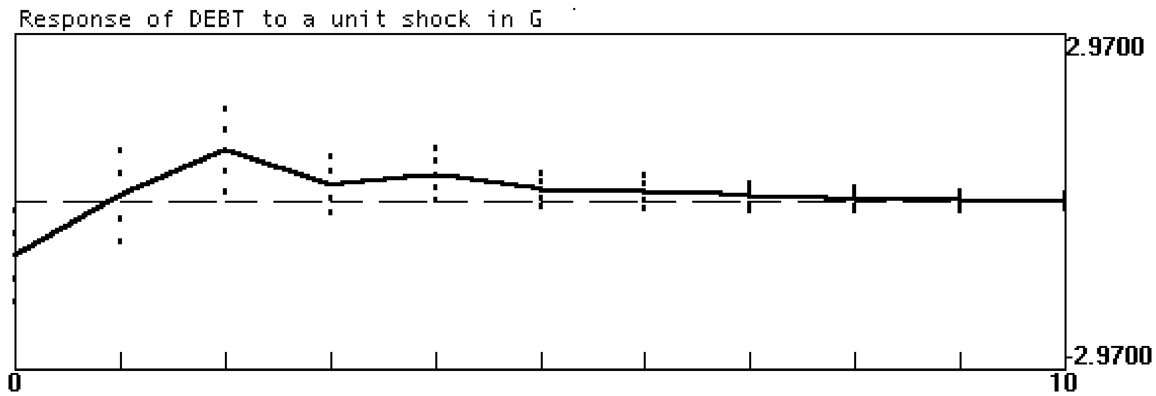


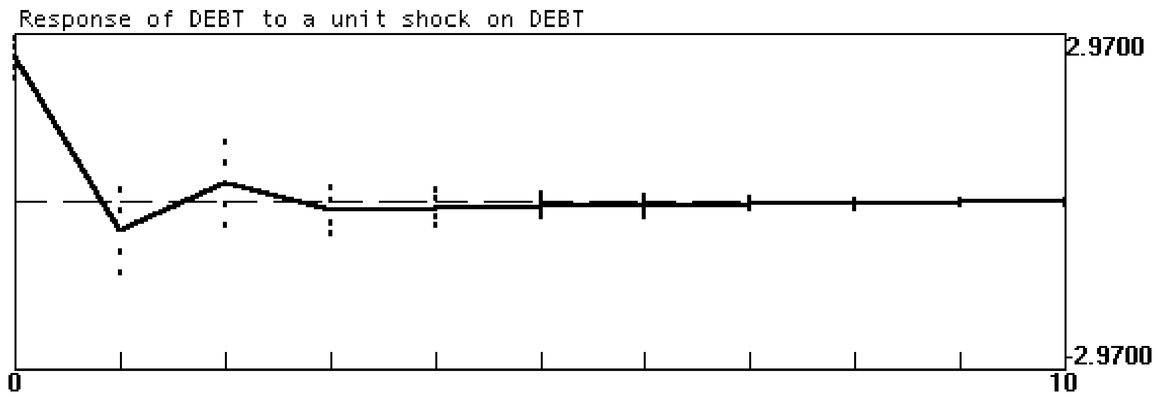


Appendix C - Impulse response functions of the VAR between government expenditure and government debt, 1950-1998.

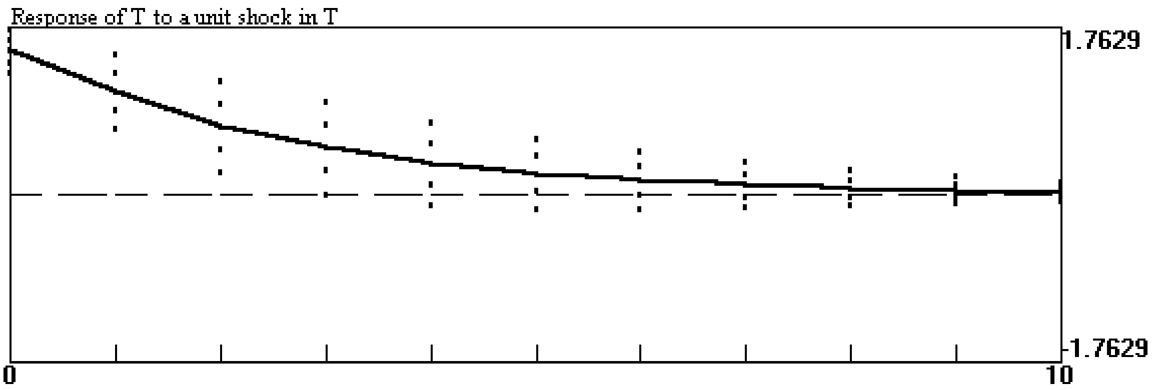


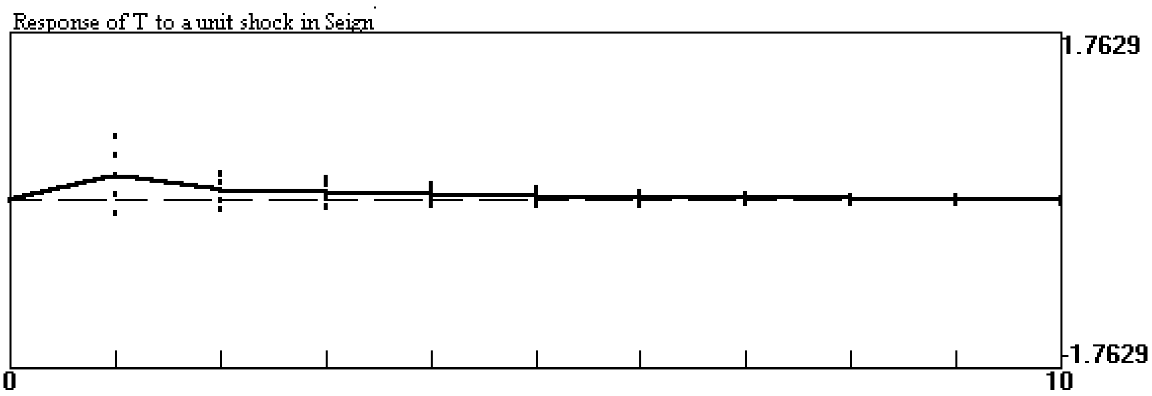


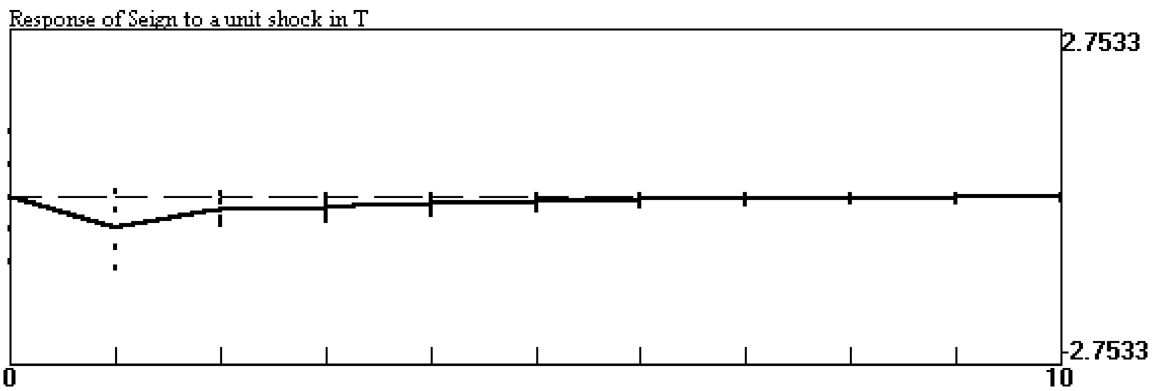


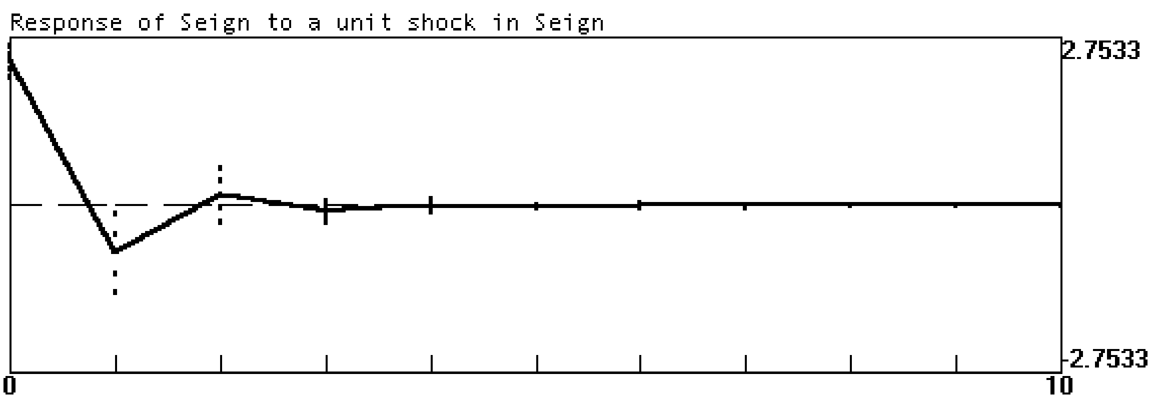


Appendix D - Impulse response functions of the VAR between taxes and seigniorage, 1950-1998.









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