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The sustainability of fiscal policy in Italy: A long-term perspective

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The Sustainability of Fiscal Policy in Italy: A Long-Term Perspective

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The Sustainability of Fiscal Policy in Italy: A Long-Term Perspective

Abstract

The recent fears of a sovereign debt crisis have spurred interest in the sustainability of public debt. There are two different approaches to the assessment of sustainability: the use of sustainability gap indicators (Blanchard et al., 1990) and the time series approach (Trehan and Walsh, 1988). In this paper we analyze the sustainability of public debt in Italy following the latter approach. We examine almost the entire life of the Italian State, i.e. 1861-2010, by employing a database containing several statistical novelties: new time series estimates of public debt and GDP (respectively Banca d'Italia, 2008 and Baffigi, 2011) and an original reconstruction of the revenues of the State. The long-term analysis of new homogeneous statistical series has led to a different perspective, in particular when compared with the existing Italian literature on the debt-to-GDP ratio.

Two main issues are addressed. First, we examine the size and dynamics of public finance aggregates. In particular, we carry out a detailed historical analysis, aiming to identify, in a narrative approach, the determinants of public debt and its ratio to GDP. Second, exploiting unit root analysis and cointegration, we test for the sustainability of public debt in Italy following the approach proposed both by Trehan and Walsh (1988, 1991) and Bohn (1991).

JEL-Code: C220, E620, H600, N400, N130, N140.

Keywords: intertemporal budget constraint, unit roots, cointegration, fiscal sustainability, economic history.

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1. Introduction[1]

One of the greatest issues in Italian macroeconomic performance since the birth of the Italian State has been the extraordinary fluctuation in the public debt ratio. This statement sounds somewhat unusual if we consider recent decades, but long-term analysis of Italian finances shows that various phases of imbalance and rebalancing of accounts have followed one another.

Fiscal imbalances have shown tremendous changes in recent years. Large budget deficits in the 1970s and 1980s triggered substantial economic concern in Italian and European institutions, generating a considerable literature on the sustainability of Italian fiscal deficits (see amongst others, Spaventa, 1988; Galli and Giavazzi, 1992; Dornbusch and Draghi 1989; Ente Einaudi 1992).[2]

The empirical literature focuses on testing the sustainability of the intertemporal budget constraint through the use of univariate and multivariate techniques, with particular attention to issues relating to the presence of unit roots. In this context, the articles by Trehan and Walsh (1988), Bohn (1998) can be considered among the most influential in the analysis of sustainability.[3]

In this work, using this time-series approach, we intend to assess the sustainability of the fiscal policy in Italy using a much larger sample than those examined so far, covering the period 1861-2010. To this aim, we refer to different data sources, and in particular to two major reconstructions of public finance aggregates recently made available.

The first source is the Bank of Italy (Francese and Pace, 2008) which has reconstructed the evolution of public debt since the unification of Italy, distinguishing the various components of the General Government sector (consolidated). The second data source is the State General Accounting Department (Ragioneria Generale dello Stato, hereinafter RGS), which has reconstructed the historical series of public expenditure of the State Budget, and the different aggregates that it comprises, including interest payments (RGS, 2011). With regard to State revenues, we were able to reconstruct in this case the entire time series for the period of interest, primarily using the State General Accounting Department (hereinafter SGAD) data.

[1] We thank participants at the Conference of the Italian Economists Society (SIE) held in Rome in October 2011 and participants at the 2012 CESifo Area Conference on Public Sector Economics. We gratefully acknowledge the funding from PRIN 2008, "Tax evasion, irregular employment and corruption: cyclical features and structural problems". Usual disclaimers apply.

[2] Amongst the vast Italian literature see Graziani (1988); Visaggio (1997); De Cecco et al. (1997); Sartor (1998); Bagella and Paganetto (2002); Paesani and Piga (2002); Bernardi (several years).

[3] As regards Italy, the so-called time series approach was used by Galli and Padovano (2005) to investigate the sustainability of public debt within the time span ranging from 1950 to 2002, and to evaluate the effect of the regime change associated with the accession of Italy to the Maastricht Treaty on the various determinants of public deficit.

Finally, as to the time series of GDP, in the present paper we employ the recent reconstruction by Baffigi (2011).[4] The use of a long sample, covering widely divergent historical periods, first requires thorough analysis of the events that have characterized different historical moments.

This paper describes several historical episodes which form the background to the measures that successfully brought drastic financial imbalances under control in our economy in the period examined. The overall aim is to apply a narrative approach to investigate the political and economic shocks which have resulted in the phases of the public debt since 1861. We describe and interpret events which have led to dramatic swings in public debt. In studying such episodes it may be useful to set up a laboratory to analyze changes in the fiscal policy regime. In order to provide the necessary information (political and economic shocks, breaks, outliers) to build and identify the model, this analysis must precede the univariate and multivariate time series analysis.

The paper is organized as follows. Section 2 identifies a broad pattern in the behaviour of debt-to-GDP ratio, showing that there is considerable variation in the debt-to-GDP dynamic, with long waves suggesting that economic and political forces have been at work differently over the various historical phases of the sample. Sections 3 to 6 provide a detailed historical analysis of the several phases sketched in Section 2, describing the political events and economic shocks which have impinged on the dynamic of GDP and debt. Section 7 displays the results obtained using the time series approach and the cointegration approach to test the sustainability of public debt. Section 8 shows some critical issues on the time series approach, proposing a modified version of the policy reaction function *à la* Bohn (1998, 2005). The last section concludes the paper and an Appendix reports the sources of the data and the univariate and multivariate statistical analysis.

2 Italian debt in a long-term perspective

In this section we examine the long-run pattern of public debt, using data reconstructed by Francese and Pace (2008) and updated by the Bank of Italy. [5]In Figure 1 we display the Italian public debt in absolute terms, both at current prices and at 2009 prices, for the period 1861-2009.

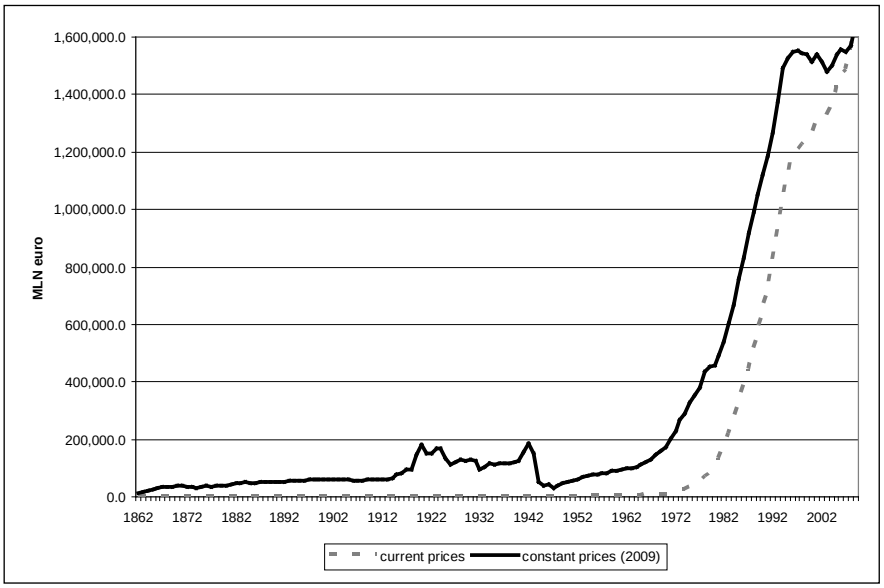
Nominal debt is barely visible until 1914, and very flat until 1970, when the debt level reached 10 billion current euros. With regard to debt at constant price, the data show the same dynamics,

[4] The relevant literature contains several attempts to reconstruct the Italian GDP (see the Appendix). In this paper we calculate the debt-to-GDP ratio using the new series for the per capita GDP estimated by the research group coordinated by Alberto Baffigi (Baffigi, 2011), covering the full sample, 1861-2011. As far as we know, our paper is the first one examining debt sustainability in Italy using a unique source of data for the GDP.

[5] Francese and Pace (2008) provide a monthly time series for the debt of the Italian General government sector, starting from 1861. The authors also disaggregate the debt series, distinguishing the three-level subsector structure defined by ESA95: central government, local government, social security funds. The update of these series is provided by the Bank of Italy, in a Table coded as TCCE0225.

except for the 1915-42 period, which comprises the Fascist era, the Great Recession, and two World Wars.

Figure 1: Italian public debt (central government): current prices and constant prices (2009)



Sources: Data taken from Francese and Pace (2008), RGS (2011).

The post-1970s debt growth reflects the strong increase in deficits due to the large growth in public spending related to the creation of a welfare state (health care and retirement systems), the institution of the local administration (Regioni, in 1972), and large transfers to households and firms. Despite the fiscal reform involving indirect taxation in 1973 and direct taxation in 1974, fiscal receipts were not sufficient to offset the considerable, structural growth in public spending.

Focusing on the 1980s, the pattern of public debt displays a very rapid growth (debt explosion) until stabilization at the end of the 1990s. This is due, in large part, to an important innovation in the of monetary policy conduct: the "divorce" between the Bank of Italy and the Italian Treasury, hence the independence of the monetary authorities.[6]

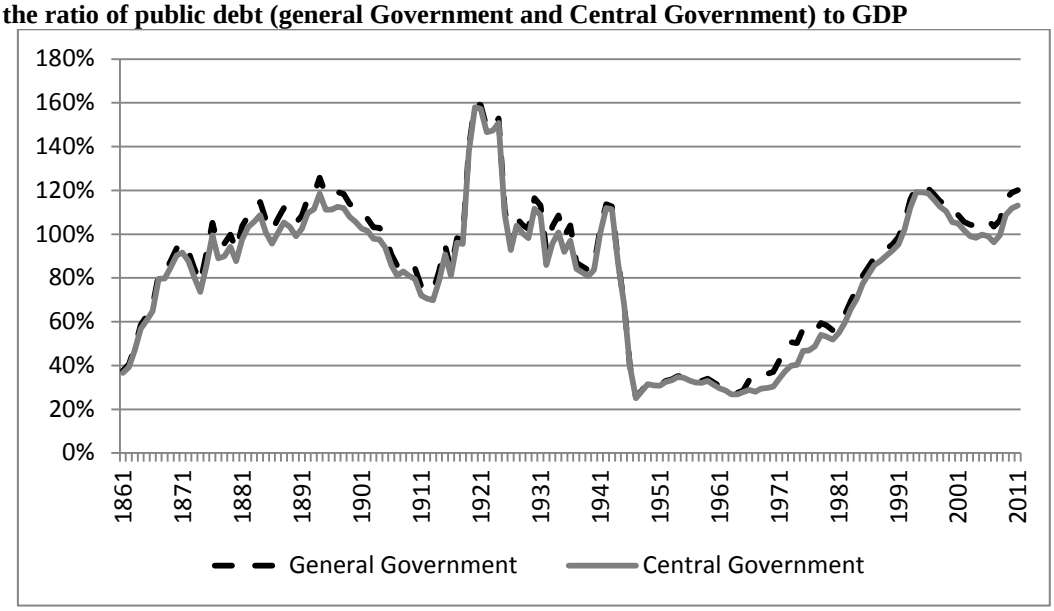
In the mid 1990s, after the currency and financial crisis of 1992 and the disintegration of the European Monetary System, there began an important process of adjustment of public finance accounts. In the last years of the sample period, the conduct of the fiscal policy and pattern of public debt were greatly affected by the budgetary rules imposed by the Stability and Growth Pact.

Nonetheless, this is only part of the true story: the inspection of debt in absolute terms is misleading, since the magnitude of debt has radically varied during the sample period. Hence it is

[6] For a detailed analysis of the monetary policy in Italy and money-financing of fiscal deficit focused on the period 1970-1987 see Cotula (1989b) and Salvemini (1989).

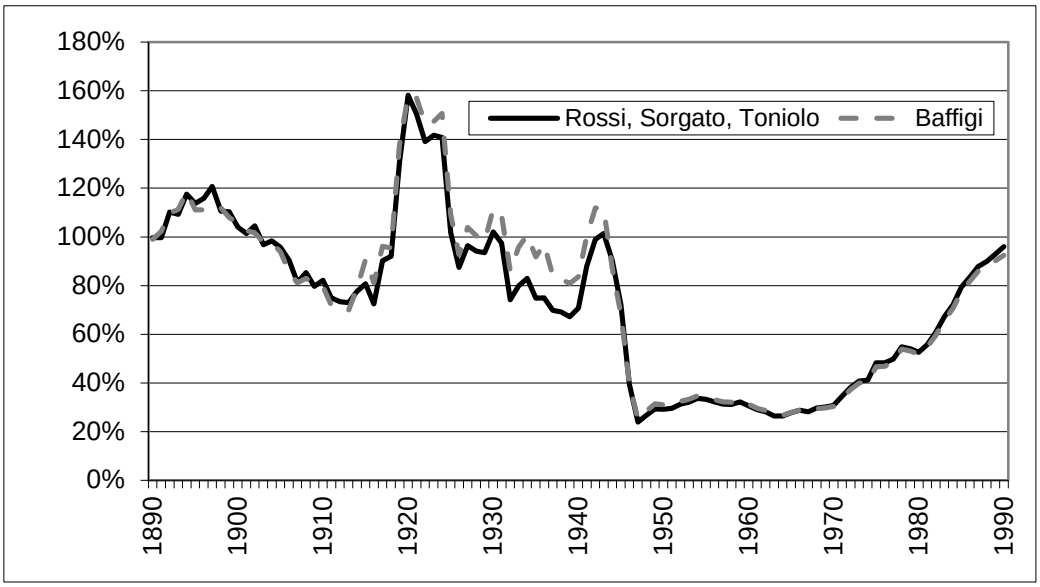
certainly appropriate to proceed in the analysis by examining Italian debt as a proportion of GDP, as depicted in Figure 2.

Figure 2: the ratio of public debt (general Government and Central Government) to GDP



Sources: Data taken from Francese and Pace (2008), Baffigi (2011).

Figure 3: the ratio of public debt to GDP (comparison between estimations made by Rossi, Sorgato, Toniolo and Baffigi)



Source: Data taken from Francese and Pace (2008), Rossi, Sorgato, Toniolo, 1993, Baffigi (2011).

As to the source of data, we draw the attention to two issues: first, there is no substantial difference between the General Government (total) debt and the debt accumulated by the Central Government; second, the measure of GDP used to construct the debt-to-GDP ratio marginally influences the dynamics of the ratio, whereas it has the effect of raising it during the World Wars, as confirmed by

the comparison between our measure of the debt ratio and that we get by using the GDP estimated by Rossi et al. (1993). Hence the new GDP series has introduced important changes with respect to the Italian economic performance during WWI, as well as during the Great Depression (for details, see Baffigi, 2011).

From graphical inspection of Italian debt-to-GDP ratios during the last 150 years we can identify several key issues that are not well highlighted by examining the level of public debt. First, since the early years of the new Italian kingdom the public debt has absorbed much of GDP, with a debt-to-GDP ratio amounting to 39% in 1862 due to the high level of pre-Unification debt among Italy's states and kingdoms. Second, throughout the study period the debt-to-GDP ratio was on average about 82 %, with two large peaks observed in late 19th and 20th centuries: the burden of public debt in Italy observed in the 1990s was comparable to the levels reached during the last two decades of the 19th century: from 1993 to 2011, the debt-to-GDP ratio was on average about 107 %, slightly higher than the level reached from 1876 to 1899.[7]

Finally, there is a cyclical pattern in the debt/GDP ratio, with long waves of recovery and reduction. In all, four main phases may be distinguished:[8]

1. **1861-1913**: during this period we observe a complete cycle, with the rising phase from 1861 until the peak reached in 1894, almost 118%. The subsequent declining phase lasts until 1913, when a new bottom peak is observed, amounting to 70%;
2. **1914-1945**: during this period the two World Wars had immediate effects on the dynamic of the public debt. However, the debt dynamics are very different in the two post-war periods, as will be analyzed in depth in the sections below. WWI caused a jump in the debt-to-GDP ratio, peaking at 158% in 1920, in the postwar period. The decline started only in the mid 1920s (in 1925 the debt-to-GDP had fallen to 109%), and lasted for approximately 15 years, with a level of 81% in 1939. The outbreak of WWII caused a new recovery in the dynamic of debt, peaking at 112% in 1942. Subsequent hyperinflation allowed the debt-to-GDP ratio to fall by 40% in only three years, reaching 68% in 1945.
3. **1946-1970**: 1946 opened a phase of unusually low levels of debt-to-GDP ratio, with a strong reduction and a minimum peak of 25% reached in 1947, after which the debt stabilised around an average of 31%. This favourable performance of the public imbalances was explained by two main facts: first, the flattering economic growth experienced during the period, which is usually referred to as the "economic boom" period (1953-'68); second, the

[7] Balassone et al. (2011) provide an interesting description of the main differences in fiscal policy during the two episodes of large indebtedness observed in the late 19th and 20th centuries. For a recent comment on the persistently high level of public debt during the 150 years of the Italian State compared to the dynamic observed in other developed countries see Pedone (2012).

[8] Interestingly, our phases are consistent with the periodization of financial history adopted by Bordo et al. (2001).

conduct of fiscal policy, which was characterized by falling deficits until the early 1960s, with the average deficit amounting to 3% of GDP.

4. **1971-2010**: during this phase the Italian public debt rose sharply from 34% in 1974 to about 119% in the mid 1990s. The increasingly large deficits observed during the 1980s generated considerable concern. The restrictive fiscal policies started in the early 1990s, and pursued in the decade after, were just sufficient to ensure the stabilization of debt, lowering it from 119% in 1994 to 96% in 2007. However, the recent financial and economic crises and the current crisis of the sovereign debts have caused a resurgence in the dynamic of the Italian debt (as in other countries). Among the main causes of the difficulties experienced in debt management in recent decades is the very high burden of interest payment, especially during the 15 years preceding the EMU, and the poor performance of the Italian economy, which has negatively affected the debt dynamic through the growth dividend.

3 The first wave of public debt: 1861-1913

From Unification until the eve of World War I, two figures seem to deserve special attention: the weight of public debt on GDP was on average 91 % (see Table 1) and, considering only revenues and expenses reconstructed by the State General Accounting Department with reference to the State Budget (RGS, 2011), the average ratio of primary deficit to GDP during the whole period was negative, i.e. the State Budget recorded a primary surplus.

The period in question witnessed many political and economic events that have shaped the dynamic of public finance and growth. In particular, we should distinguish the period of right-wing power (1861-1876) from the left-wing and Giolitti periods.

Table 1 Public debt/GDP, primary deficit, interest spending, real GDP rate of growth, inflation rate (1862-1913)

		1862-1875	1876-1899	1900-1913	1862-1913
Public debt/GDP	**Mean**	73.00	103.2	87.2	90.8
	Min	39.3	87.6	69.8	39.3
	Max	91.7	118.5	105.6	118.5
	St. Dev	16.6	8.1	12.4	17.4
Primary Deficit/GDP	**Mean**	-2.0	-4.1	-2.8	-3.2
	Min	-5.0	-5.3	-4.5	-5.3
	Max	2.3	-2.8	-1.0	2.3
	St. Dev	2.4	0.5	1.4	1.7
Interest spending/GDP	**Mean**	3.3	4.6	3.2	3.9
	Min	1.6	4.2	2.2	1.6
	Max	4.4	4.9	4.3	4.9
	St. Dev	0.9	0.2	0.8	0.9
Real GDP rate of growth	**Mean**	1.2	1.3	2.6	1.6
	Min	-7.8	-2.5	0.9	-7.8
	Max	6.8	3.2	5.2	6.8

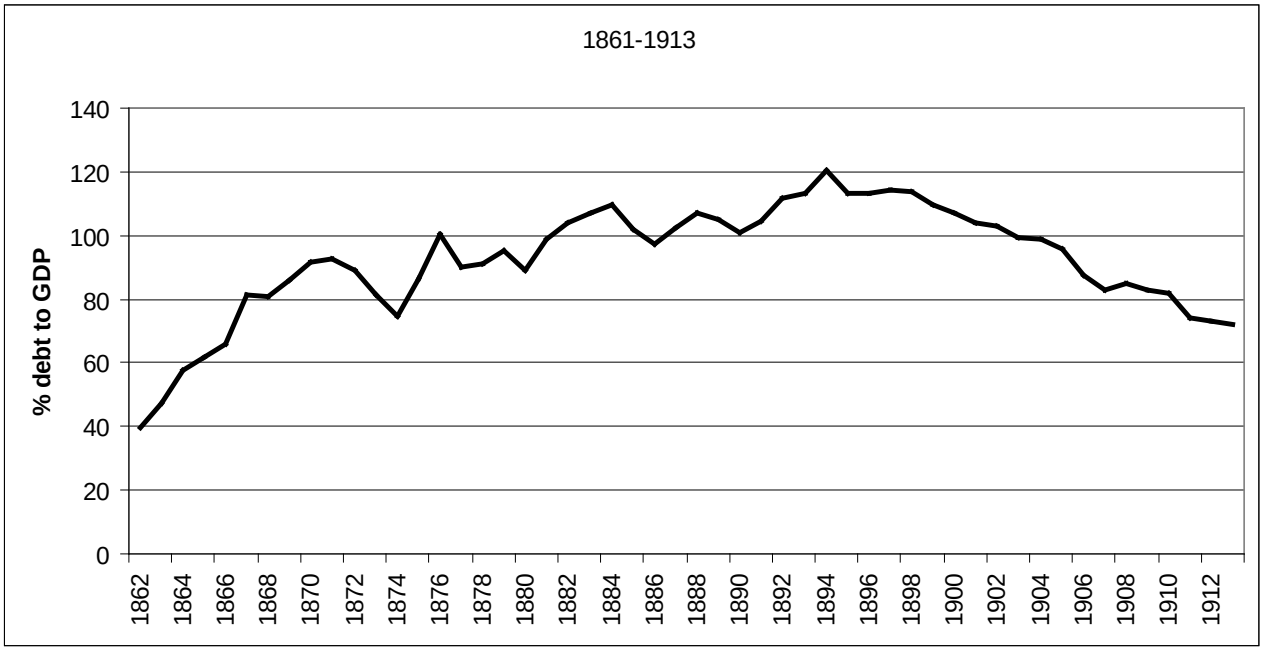
		1862-1875	1876-1899	1900-1913	1862-1913
Inflation rate	**St. Dev**	3.5	1.5	1.2	2.2
	Mean	0.4	-0.0	1.8	0.6
	Min	-14.7	-6.7	-3.4	-14.7
	Max	11.4	10.9	8.7	11.4
	St. Dev	6.5	4.5	3.3	4.8

Source: from Francese and Pace (2008) for national debt; Baffigi (2011) for GDP; RGS (2011) for revenues and expenses. The inflation index is calculated upon the GDP deflator, based on Baffigi (2011).

3.1 Right-wing economics (1861-1876)

During the period (1861-1876), output growth remained well below the average recorded in the advanced European economies, with a growth rate of 1.2 % a year (see Table 1). Slow economic growth, heavy fiscal pressure and high national debt were the main features of the "new Kingdom of Italy" (De Cecco, 1990). After Unification, the debts inherited from the constituent (pre-Unification) States had been merged and transformed into the new kingdom's public debt. According to the recent reconstruction by the Bank of Italy (Francese and Pace, 2009) of the debt series, and by Baffigi (2011) of the GDP, the stock of debt amounted to 37 % of Italian GDP.[9] High nominal and real debt interest rates[10], together with a low GDP growth rate, kept the ratio of Italian debt to GDP high throughout the period (Tattara, 2003).

Figure 4 the ratio of public debt to GDP, 1861-1913 (percentage)



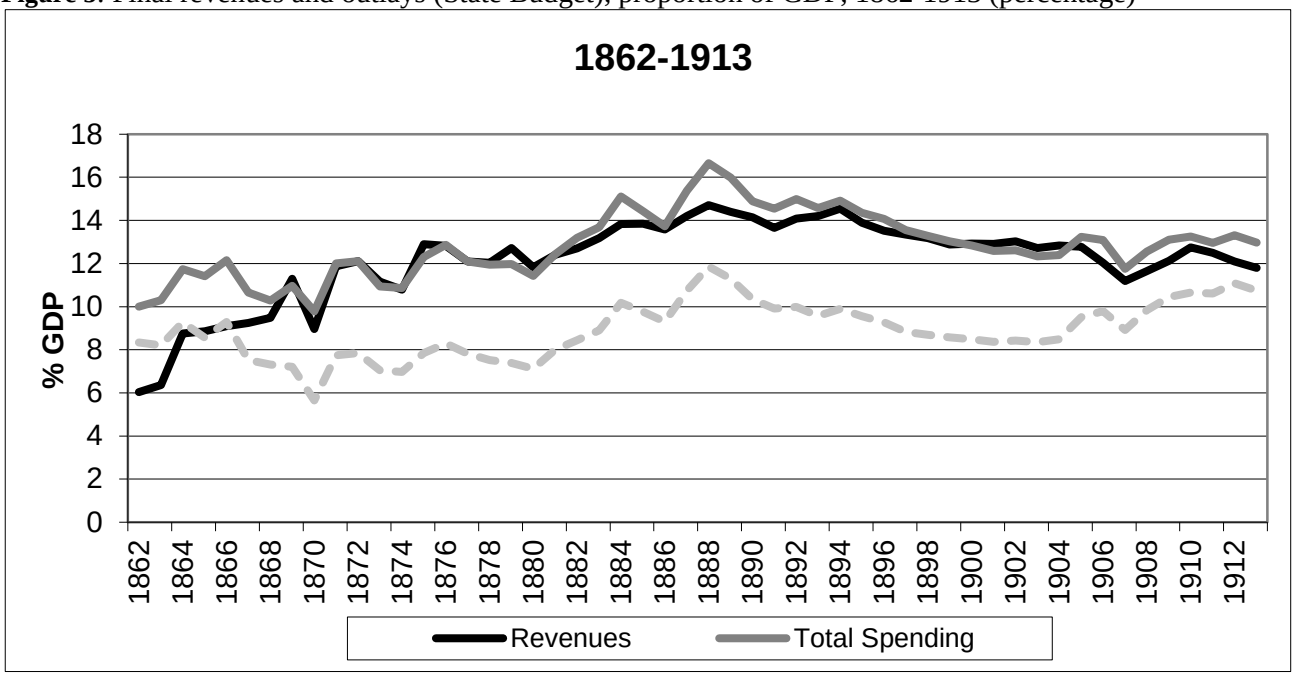
Source: data taken from Francese and Pace (2008), Baffigi (2011).

[9] This figure is slightly lower than the reconstruction by Zamagni (1998). According to Tattara (2003), the size of the public debt of the new kingdom was about 50% of GNP.

[10] From 1868 to 1876, the share of interest spending on the total expenditure was on average more than 35 %, with a peak of 42 % in 1870.

In just five years, from 1861 to 1866, the national debt had more than tripled, from 1 to 3.3 million current euros. The creation of unified infrastructures and railways and the war against Austria in 1866 contributed to the strong growth of budget deficits. By 1867 the debt had reached 81 % of GDP, mainly held by French nationals.

Figure 5: Final revenues and outlays (State Budget), proportion of GDP, 1862-1913 (percentage)



Source: data from RGS (2011), Baffigi (2011).

When war with Austria became imminent, the Italian Prime Minister in vain asked the Rothschilds to assist with a new debt issue.[11] The repatriation of much of the Italian debt held by French nationals worsened the situation, accelerating the collapse of the price of Italian rent ("*rendita Italiana"*)[12] in Paris, and deprived Italy of much of its metallic currency. The year 1866 was very difficult for Italian finances. The diminished confidence in financial markets had a negative impact on foreign investment. The course of consol fell from 64 in 1865 to 41 in June 1866 and the rise in long-term interest rates from 8 % percent in 1865 to 12 % in May-June 1866, along with the drain of metal reserves (on 1 May 1866), associated with the financing of the war against Austria, led the Minister of Finance Scialoja to decree the inconvertibility of paper money (*corso forzoso*). To find

[11] The Rothschilds kept a large stock of Italian debt in their portfolios. They feared that a request for additional funds on the international capital market would reduce *rendita* prices (De Cecco, 1990).
[12] Italian Rent is a *consol*, i.e. a perpetual bond, with no maturity date and no repayment of the principal that makes fixed coupon payments forever.

new sources of revenue, the government decided to privatize land[13] and railways and to issue new debt, to which it was compulsory for Italian citizens, according to their tax liabilities, to subscribe (*prestito redimibile forzoso*). In addition, under government pressure, the purchases of government bonds by the Banca Nazionale, the largest bank of issue, peaked in 1866. [14]

High interest rates further increased the deficit. During the period 1861-1875, the spread between Italian bonds and foreign bonds remained very large: the average interest rate on long-term government bonds stood at 7.5 %, more than double that of England (3.3 %) (Ciocca, 2007). The lack of a central bank made it difficult to manage monetary and financial policies. Several banks could legally issue notes and held metallic reserves, since Italy did not develop a single monetary authority until 1926.[15] The Monetary Act of 1862 adopted a bimetallic standard because France, Italy's closest and most important trading partner, was also on a bimetallic standard.[16]

Until World War I, Italy was legally on a bimetallic exchange rate regime for 15 years (1861-66 and 1883-1893), but the actual period of effective lira convertibility was seven years. However, until 1866 the lira did not deviate far from official parity, and the market exchange rate was remarkably stable, mainly due to the large movement of foreign capital, in turn related to the good, safe return provided by government bonds (see Tattara, 2003). [17]

Public debt on GDP was on average about 73 % during the entire period (1862-1875), though it exceeded 92 % in 1871 and showed discrete volatility (the standard deviation was about 17 percentage points).[18] After 1871, a gradual but steady reduction reversed the trend of the debt series but, as Figure 4 shows, there followed a substantial jump of the public debt/GDP ratio from about 74 in 1874 to 99 % in 1876, the latter mainly caused by the dynamic of the nominal GDP.[19] Actually, the strong contraction in the Italian economy, with the real GDP rate of growth declining

[13] Another important measure to tackle the increasing budget imbalance was the expropriation of church property in 1866.

[14] The Banca Nazionale was forced by the government to lend 250 million *lire* to the Treasury (Zamagni, 1992), and this can be assimilated to an episode of financial repression similar to those commented upon for the Bretton Woods system by Reinhart (2011).

[15] The Banking Act of 1874 recognized six banks of issue: the Banca Nazionale, the Banca Nazionale Toscana and the Banca Toscana di Credito, Banca Romana, Banco di Napoli and Banco di Sicilia. For a detailed analysis of the organization of the banking system see Conte (2001), Della Torre (2001), Toniolo (2003), and Fratianni and Spinelli (2001).

[16] After 1870, with the French defeat in Sedan, the French financial dominance on the continent sharply declined. It also stopped the active phase of continental monetary union led by France with the signing of the Treaty establishing the Latin Monetary Union, of which Italy was a founding member, along with France, Belgium and Switzerland. See De Cecco (2003) and Toniolo et al. (2003).

[17] Although the *rendita* appeared to be a "paper debt", it was in fact a "gold debt", which acted as a stabilizing device for foreign and domestic investors. Italy was able to borrow abroad cheaply, not because of the lira's legal adherence to gold or its convertibility (Bordo and Rockoff, 1996; Eichengreen and Flandreau, 1996) but because of the debt's foreign gold convertibility (Tattara, 2003).

[18] Among factors that aggravated the context of political instability as well as Italian public finance, were the taking of Rome (1870) and the transfer of Italy's capital from Florence to Rome.

[19] According to Francese and Pace (2008), the debt rose from almost 30 to about 38 billion euros (2009 prices).

from 5.7 % in 1874 to -1.9 in 1876, entailed a substantial deflationary process that reduced the inflation rate from about -3.7% in 1874 to -14.7% in 1875, and generated considerable disequilibrium in public finances.

The growing public deficit had been combated by an exceptional increase in fiscal pressure imposed by right-wing governments. The tax burden rose dramatically: from 6 % in 1862 to 13 % in 1875 whereas spending was not sacrificed. To reduce the impact of fiscal tightening on the economy, the government opted for an accommodative monetary policy. Between 1866 and 1876 the money supply increased by more than two thirds. Over the same period, bank deposits increased fivefold (De Cecco, 2003, p. 12). The balanced budget was reached in 1876, but the effort of fiscal consolidation led the Right-wing to defeat and put the Left-wing of Agostino Depretis in office.

3.2 From the Left-wing to the Giolitti period

During the Left-wing government, there was a huge growth in national imbalances, with a steady upward pattern in the debt to GDP ratio. The average public debt/GDP ratio rose to 103% between 1876-1899, compared to 73% recorded in the previous phase (see Table 1). The Italian economy was experiencing slow economic growth and price deflation: the inflation index was on average zero (-0.04%), collapsing to -6.7% in 1892.[20] Other factors, such as the elimination of the *corso forzoso* (1883), the nationalization of the railways, the massive investment in railway construction and an equally large increase in public works, contributed to exacerbate the public imbalance. Public expenses and public debt grew especially during the Crispi government 1888-96) because of very costly military expeditions to Africa. The imbalance was particularly severe in 1888-89, when military expenses accounted for about 32 % of total expenditure. The international crisis of 1893 had serious repercussions on Italian finances.[21]

The increase in national indebtedness, along with the financial crisis and banking system scandals called for a major reform: with the banking act of 1894 the Banca Nazionale, Banca Nazionale Toscana and Banca Toscana di Credito merged to form the Bank of Italy.[22] The new banking act established that only the Bank of Italy, Banco di Napoli and Banco di Sicilia had the right to issue currency. Another important measure to tackle the financial crisis was the end of convertibility of the lira in 1894.[23] With the declaration of *corso forzoso* in 1866 and until its abolition, a significant monetization of debt was recorded. Interestingly, when the *corso forzoso* was reintroduced in 1894,

[20] Until a few years ago the thesis of the 1880s' "crisis" prevailed, especially for wages, consumption, employment and production. More recent studies have shown the opposite, refuting the "general crisis", concluding that the world deflation of grain prices and transportation services was positive for wages, employment and more generally for society (Ciocca , 2007; Fenoaltea, 2006; Cohen, Federico, 2001; Federico 2003).

[21] In 1893 the Banca Romana, one of the issuing banks, went bankrupt.

[22] For an historical summary of banking crises in Italy see Reinhart and Rogoff (2009).

[23] See Fratianni and Spinelli (2001) amongst others.

a similar path did not occur, confirming the position of various authors who interpret the second *corso forzoso* as an instrument of flexibility, not used to expand the monetary base out of line with the maintenance of exchange rate stability.[24] In this period of strong turbulence for the financial system, 1894 also represents the maximum level of debt-to-GDP ratio, amounting to 118.5%, after which there started a phase of debt reduction that would last throughout the Giolitti period.

After the crisis of the 1890s, several governments succeeded one another until the First World War. One such government was that of Giovanni Giolitti, who opened a period known as the Giolitti era: a phase of expansion for the Italian economy, with significant growth in the industrial sector. During this period, many of the main Italian industrial companies were founded and the so-called industrial triangle Milan-Turin-Genoa took shape. The real GDP growth rate rose, on average, to 2.6 %, while inflation was below 2%; the burden of interest spending was lower than the previous period and primary expenses of the State budget surpassed revenues. All these factors led to a reduction in the average public debt/GDP ratio to 87 %, about 15 percentage points lower compared to the previous period (1876-1899). To better appreciate the contribution originating from economic growth, we can write the government budget constraint as a proportion of GDP:

$$\frac{B_t}{Y_t} = \frac{B_{t-1}}{Y_{t-1}(1+g)} + \frac{iB_{t-1} + D_t^p}{Y_t}, \qquad (1)$$

where g stands for the nominal growth rate, B_t and $D^p{}_t$ are, respectively, the level of public debt and primary deficit, both expressed as a share of GDP, Y_t. By reformulating Eq. 1 to highlight the dynamic of the debt to GDP ratio we get:

$$\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}} = \frac{B_{t-1}}{Y_{t-1}} \frac{-g}{(1+g)} + \frac{D_t^{tot}}{Y_t}. \qquad (2)$$

The first term on the right-hand side of Eq. 2 shows that the evolution of the debt ratio can differ from the total deficit, $D^{tot}{}_t$, by a component which is a negative function of the growth rate of the economy, opportunely weighted by the debt ratio (dividend growth). During the period 1894-1912, when the debt ratio fallen from about 120% to 70% of GDP, the contribution of the growth dividend was negative, amounting, on average, to -3.2% per year, compared to a positive contribution by total deficit, to be exact +0.3%.[25]

[24] Zamagni (1998), pp. 207-214.

[25] For further details about the debt accounting see, amongst others, Ballabriga and Martinez-Mongay (2007).

The Giolitti era represents one of the few in which monetary and fiscal policy interacted positively, playing an important role in balancing the national budget and in curbing public debt dynamics (Panteghini, Spinelli 2002). The improved social conditions, and economic policies tailored to respond to development needs, allowed Italy to take advantage of a positive international economic situation. The reduction in military expenditure allowed the State to invest more in other items, such as heavy industry and public works.

One of the measures that contributed to the success of Giolitti's policy was the so-called "rent *conversion*", i.e. consolidation of the debt formerly issued at high interest rates in new bonds issued with a lower rate of interest. Following the example provided by the major European countries, this important financial measure was adopted in 1906 and contributed to shrink the burden of interest spending during the Giolitti period.[26] This structural innovation in the management of public debt, along with the very good economic performance associated to an inflationary environment, motivated a contraction in the debt-to-GDP ratio, which fell in 1913 to 70%, a remarkable reduction of more than 30 percentage points in less than a decade.

4. The period of the two world wars: 1914-1945

During the period 1914-1945, the two World Wars had considerable consequences on the public debt and primary deficit to GDP, which reached, together with the inflation rate, the highest levels of the whole period analysed (1861-2010). From 1914 to 1945 the average growth rate of real GDP was negative, inflation ran on average at about 18 % while the ratio of debt to GDP was 105 %. However, the dynamics of the economic variables were very different during the First World War, the Fascist period and the Second World War. Although the two sub-periods of the World Wars both experienced a severe slowdown in real growth and mainly monetary inflation, they differ in the magnitude of some processes. In particular, money supply and prices grew on average by 50 % more in the second conflict.

4.1 The First World War

Italian participation in World War I led to a severe crisis in public finance. During the period 1914-21, the average ratio of public debt to GDP rose to about 112 %, reaching a maximum of 158 % in 1920. The average inflation rate was about 23%, with a spike of 43% between 1917-18, while real GDP decreased on average by 1% (see Table 2). During the years 1914-21, the trend of economic variables differs significantly from the average for the whole period 1914-1945.

[26] For details on 1906 Italian conversion see De Cecco (1990); Panteghini, Spinelli (2002).

The cost of war was financed mainly with debt. At the signing of the Treaty of Versailles (1919), debt amounted to 138 % of GDP.[27] Internal debt was 72 % (Cotula, Spaventa 2003)[28], more than half of which comprised long-term securities from five large national loan issues, while only one third consisted of ordinary Treasury bonds which matured in less than one year.

Table 2 Public debt/GDP, primary deficit, interest spending, GDP rate of growth, inflation rate (1914-1945)

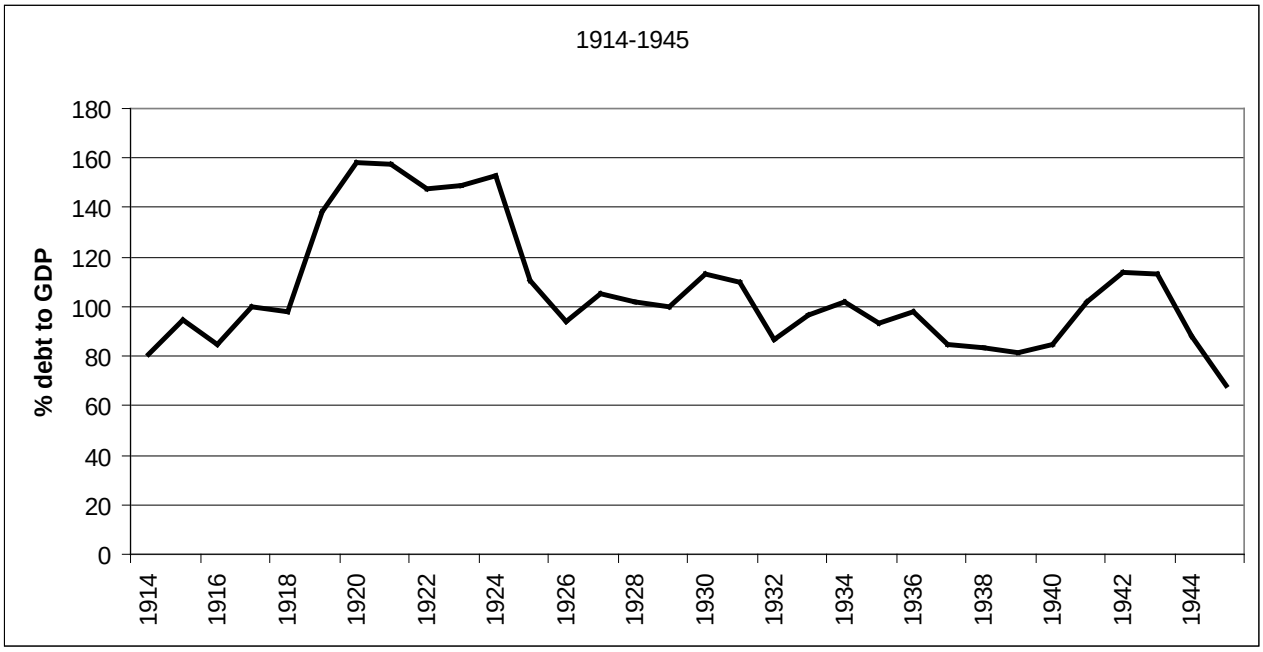
		1914-1921	1922-1938	1939-1945	1914-1945
Public debt/GDP	**Mean**	111.9	106.3	93.0	104.6
	Min	78.8	82.6	68.2	67.9
	Max	158.0	150.8	113.8	158.0
	St. dev	33.51	21.7	17.1	24.5
Primary Deficit/GDP	**Mean**	13.7	0.1	17.4	7.3
	Min	3.1	-4.1	5.4	-4.1
	Max	23.9	6.6	22.8	23.9
	St. dev	8.9	3.3	5.9	9.6
Interest spending/GDP	**Mean**	2.8	3.9	2.6	3.3
	Min	2.1	2.2	0.7	0.7
	Max	3.9	5.9	4.0	5.9
	St. dev	0.7	1.0	1.4	1.1
Real GDP rate of growth	**Mean**	-1.1	2.8	-6.8	-0.3
	Min	-5.7	-4.7	-19.3	-19.3
	Max	9.3	9.9	6.3	9.9
	St. dev	5.0	4.5	8.8	6.8
Inflation rate	**Mean**	23.3	0.0	55.4	18.0
	Min	-0.1	-10.5	3.9	-10.5
	Max	42.7	15.9	142.6	142.6
	St. dev	17.0	8.1	51.4	33.3

Source: from Francese and Pace (2008) for national debt; Baffigi (2011) for GDP; RGS (2011) for revenues and expenses. The inflation index is calculated upon the GDP deflator, based on Baffigi (2011).

Therefore the most delicate problems rested on external indebtedness. For the duration of the conflict, the problem of the external value of the lira constituted a major concern for politicians, businesses and monetary authorities. Given the circumstances, an effective exchange-rate policy could not be conducted independently of strong cooperation between allied countries. However, this policy became effective only from June 1918. Hitherto, the lira had been devalued almost constantly in all markets, with some episodes of veritable currency crisis (October-December 1916, February 1917, June-July 1917, October 1917-March June 1918). Overall, the lira was devalued compared to the GB pound by 20 % in 1915, 5 % in 1916 and 22 % in 1917. By contrast, in the second half of 1918, thanks to inter-allied loans and especially the US, there was an exchange rate appreciation of about 30 % (Toniolo, 2003). When Italy entered the war, few thought that the war would be so long and expensive as it proved to be.

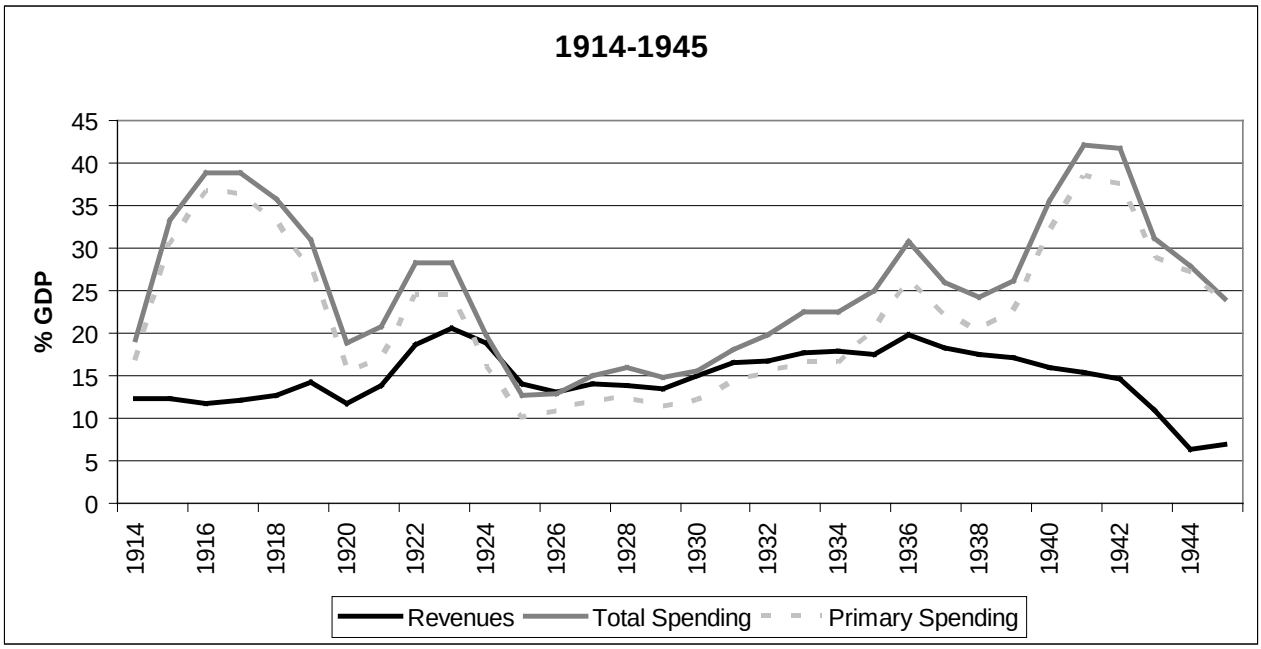
[27] Cotula and Spaventa (2003) report for the same period a ratio of 119 %.
[28] Differently Zamagni (1998) argued that the most part of the war was financed by British and American loans.

Figure 6: ratio of public debt to GDP, 1914-1945 (percentage)



Source: data from Francese and Pace (2008), Baffigi (2011).

Figure 7 Final revenues and outlays (State Budget), proportion of GDP, 1914-1945 (percentage)



Source: data from RGS (2011), Baffigi (2011).

The declaration of war by Austria against Serbia (July 28) opened up a severe banking crisis; in order to curb the banking panic, in August 1914 a moratorium allowed the banks to limit reimbursement of deposits to 5 % of the total amount.[29] As well as in other European countries, the

[29] See Bordo et al. (2001).

Bank of Italy suspended the gold convertibility of the lira, and the official discount rate increased up to 6 % (Toniolo, 2003).

Preparation for the war effort and in particular the strengthening of the army and navy led to a significant increase in defence spending, which added to the cost of maintaining troops in Libya.

The higher costs were financed almost entirely by debt (internal and external) and money emission. During the period 1914-1919 the government authorized six national loans, to be precise in December 1914, June and December 1915, January and December 1917, November 1919. The increasing difficulties encountered placing the securities are evident from the fact that the market prices of the debt instruments (face value=100) decreased from 97 in December 1914 to 87.5 in November 1919, providing a strong increase in the yields. Moreover, not all the capital subscribed corresponded to new cash being raised, since much of it was a consolidation of previously issued bonds or national loans[30].

In the years 1915-16 there was an exceptional increase in manufacturing production and a consequent reduction of debt/GDP from about 91 % in 1915 to 81 % in 1916. However, in the following two years, industrial production declined significantly while defence expenditures continued to grow during the same period. Considerable concerns were raised over foreign supplies of foodstuffs, raw materials and manufactured goods, and hence over the rapid growth of the trade deficit. As a consequence, the ratio of debt to GDP rose sharply to 96% in 1917.

At the end of 1917 a new government came to office, led by Vittorio Emanuele Orlando. The new Minister of the Treasury, Francesco Saverio Nitti, immediately expressed his desire to establish an institute for the control by the state of currency transactions. In December 1917 the decree was promulgated establishing the National Institute for Foreign Exchange. Depreciation of the lira continued until June 1918. The situation was resolved through new loans from the United States, that helped to stop the devaluation of the lira.

4.2 The first post-war crisis

After the armistice was signed (November 4, 1918), Italy had to face the economic and financial problems caused by the war. One of the most urgent problems was that of foreign loans granted by the Allies, without which Italy was unable to import commodities. An extension of the agreements was negotiated in London by Bonaldo Stringher, the Governor of the Bank of Italy, which led to the provision of credit amounting to £50 million, to be repaid by mid-1919. Beyond that date, Italy could no longer rely on official loans (Falco, 1983). In late 1918, the internal public debt had tripled compared to the levels reached before the First World War. The debt with the Allies grew even

[30] For example, for the third and fourth national loans, less than fifty per cent of the nominal value was collected in cash. While the first three issued national loans were redeemable, the last were consolidated (See Repaci, 1962).

more rapidly. In the first post-war period the renewed strong depreciation of the lira multiplied the weight of foreign debt expressed in liras which reached that of the internal debt (Cotula and Spaventa 2003).

The paper money in circulation was quadrupled. The inflation rate was very high and exceeded that of the allied countries. The depreciation of the lira was more serious and costly for Italy because of the need to import raw materials and foodstuffs, and due to the weakness of the industrial and financial structure.

In the first postwar period, social tensions were particularly acute. Unemployment was high and, due to high inflation, real wages and real interest rates were lower than in 1914. To recover the loss of purchasing power, nominal wages were greatly increased, especially in 1920, and this contributed to increase the inflationary process.

Exports significantly decreased and serious problems arose in financing imports of food, coal and raw materials. In January 1919 Francesco Saverio Nitti resigned as Treasury Minister and after a few months the monopoly of foreign exchange ended. From then on, the National Institute for Foreign Exchange only had supervisory tasks in the currency markets.

The end of British and American loans (Asso, 1993) and the abolition of the monopoly of foreign exchange in 1919 produced a sharp fall in the value of the lira against the US dollar and GB pound, and forced the Italian Treasury to increase the debt towards the issuing banks, causing a strong increase in money circulation. The net outflow of capital accentuated the depreciation of the lira, which interacted with inflation, in a dangerous vicious circle. Between November 1919 and April 1920, the lira devalued against the dollar by 92.9 % and 85.3 % against the pound (Cotula and Spaventa, 2003). Consequently, the ratio of public debt to GDP peaked at 158% in 1920-21 (see Table 2). The tax revenues could only cover about a third of government spending, driving high deficits to fuel inflation with additional monetary base. Between late 1919 and early 1920 the sixth *national loan* was issued.

The First World War had led to the collapse of the gold standard in all countries (Feinstein, Temin, Toniolo, 2004). However, the idea of returning to the gold standard met with almost full consensus. Britain returned to the gold standard in 1924, while Italy, as we shall see, adopted the gold standard again later in 1927, during the Fascist regime.

4.3 Fascist Italy and the Second World War

The Fascist rise to power was in October 1922, under critical social and political conditions. Between 1922 and 1938 GDP increased, on average, by 2.8 % per year, while per capita growth was 1.9 % a year.

It is useful to identify four different subperiods in the Fascist era with reference to the financial and economic variables (Table 2). In 1922-1926, the average annual growth of GDP was rapid: 5.6 % in total terms and 4.62 in per capita terms. The subsequent years, 1927-1934, experienced stagnation: the annual total GDP increased by 0.6 percent while per capita GDP decreased (-0.27). The structure of the economy was affected by the 1929 global crisis to the same extent as in other Western European countries, although much less than the limiting cases represented by Germany and the United States.[31] Two significant recessions occurred in 1930 (-4.7) and 1936 (-3.5). There was rapid economic expansion in the period 1935-38, with an average GDP growth of about 4 % (2.8 % in per capita terms). Between 1922 and 1938 the public debt-to-GDP ratio was on average about 107 % but in 1922, when Benito Mussolini was appointed Prime Minister, the public debt to GDP ratio was about 147 % and two years later rose to 151%.

The problem of debt at the end of the First World War was not only a question of size, but also composition. Almost half of the debt was short-term (Alesina, 1988). During the first phase of Fascism (1922-1926), Alberto De Stefani (the Minister of Finance) was able to significantly reduce government expenditure and increase tax revenues.[32] However, in these years, the reduction in expenditures alone did not explain the reduction in the debt-to-GDP ratio, despite the persistence of deficits. The reduction in the debt/GDP ratio was mainly achieved by robust GDP growth (on average 5.6 % between 1922 and 1926) and a strong recovery in inflation. In 1925 the inflation rate reached 16 % whereas between 1922 and 1926 the inflation rate was on average about 3.70 %. In 1926 the objective of a balanced budget was achieved. In addition, between 1925 and 1926 the amount of foreign debt diminished considerably thanks to the signing of treaties, with a significant reduction of war debts towards the United States and Great Britain.[33] Starting from July 1926, funding problems emerged to renew the stock of floating debt. The new Finance Minister, Giuseppe Volpi, who believed that the continuous renewal of short-term debt, the amount of which was considerable, constituted a threat to the stability of the exchange rate, decided on a forced consolidation of debt. All government bonds with a maturity shorter than seven years were mandatorily converted into nine-year bonds, with an interest rate of 5 % (the so-called Littorio loan).[34]

[31] See Toniolo (1980); Feinstein, Temin and Toniolo (2004).
[32] Confalonieri, Gatti (1986); Fausto (1993).
[33] Toniolo (1980).
[34] This episode can be considered, consistently with Reinhart and Rogoff (2009), as a partial default, provided that the Italian government, through the Littorio loan, forced its creditors to accept longer repayment. For further details see Makinen and Woodward (1989) and Toniolo and Ganugi (1992).

In the years 1927-1934, the ratio of public debt to GDP decreased by about 20 % over the previous period. Restrictive monetary policies led to a revaluation of the lira in 1927, [35] which resulted in a deflationary policy that slowed GDP growth, alongside the international Great Depression of 1929-1933.[36] To face up to the crisis of the industrial and banking system in Italy, the IRI was created in 1931[37], and in 1936 the new banking act put an end to the *banca mista* system in Italy.[38]

The economic situation changed radically in 1935, when the government took measures to finance the colonization of Ethiopia. The increase in public spending and arms production drove the recovery of the Italian economy. In 1936, the lira was devalued and military spending was financed largely with money issue. The annual inflation rate increased rapidly, which made it possible to accumulate budget deficits to finance the African colonies while achieving a reduction in the debt/GDP ratio.

During World War II, there was a sharp reduction in per capita GDP. Total expenses of the State budget more than doubled between 1938 and 1942 and military expenses represented more than 50 % of primary spending. In 1942 this figure amounted to 63%. The period from 1943-44 to 1946-47 was characterized by the occupation of Italy by German and Anglo-American forces. The regions in the south were occupied by the Allied forces while northern Italy by Germans, until April 1945. As a consequence there was a split in the financial management. Emissions of AM lire by allied forces[39] contributed to the inflationary process (Fratianni and Spinelli, 2001).[40] Despite the huge budget deficit, due to the sharp increase in public expenditure, the ratio of public debt to GDP rose less than four percentage points over the previous period, due to rapid inflation growth. Between 1943 and 1947, hyperinflation, which soared to 142% in 1944, allowed a far higher nominal income growth than that of debt, with a drastic reduction in the debt/GDP ratio. Hyperinflation wiped out the debt service which had so heavily influenced the previous periods. [41]

[35] The monetary measure was called "quota 90", because the exchange rate of lira to the pound was set at 90 lire (De Cecco, 1993).

[36] Kindleberger (1973); Feinstein et al. (2004).

[37] Through the creation of the Institute for Industrial Reconstruction (IRI), the Italian State acquired significant holdings in many companies belonging to different sectors of the economy. This was the beginning in Italy of the complex mechanism of state-controlled enterprises which would only end after the signing of the Treaty of Maastricht.

[38] Guarino and Toniolo (1993).

[39] The AM-lire (Allied Military Currency), were issued by the Allied Military Government of Occupied Territories until March 1946.

[40] With regard to the external purchasing power of the lira, on the eve of the war the official exchange rate with the dollar was 19 lire. When the Allies landed in Sicily, the exchange rate was about 45-50 lire per dollar. With a decision that would be considered too harsh, the Allied imposed an exchange rate of 100 lire (Fratianni, Spinelli, 2001). Several "exceptional" costs were ascribed to occupation of the territory. We should mention the war indemnity of 180 billion paid to the Germans and 145 billion in expenses incurred by the Allies (Repaci, 1969).

[41] Toniolo (1992).

5 Debt stabilization during the economic boom: 1946-1970

The second post-war (1946-50) experienced stabilization of the ratio of public debt to GDP, which oscillated about 31%, with a low variance during the whole period (Tab. 3). In particular, we can distinguish the reconstruction in the years immediately following the end of the war (1946-50) and the long period of economic boom with moderate inflation (1950-70).[42]

Table 3 Public debt/GDP, primary deficit, interest spending, GDP rate of growth, inflation rate (1946-1970)

		1946-1950	1951-1970	1946-1970
Public debt/GDP	**Mean**	31.2	30.6	30.7
	Min	25.2	26.7	25.1
	Max	39.8	34.6	39.7
	St. dev	5.4	2.4	3.1
Primary Deficit/GDP	**Mean**	4.3	1.1	1.7
	Min	1.6	-0.6	-0.6
	Max	7.4	3.9	7.4
	St.dev	2.3	1.4	2.1
Interest spending/GDP	**Mean**	0.9	1.0	1.0
	Min	0.8	0.7	0.7
	Max	1.1	1.3	1.3
	St.dev	0.2	0.2	0.2
Real GDP rate of growth	**Mean**	15.8	6.3	8.2
	Min	7.7	3.7	3.7
	Max	35.0	9.7	35.0
	St.dev	11.7	1.5	6.3
Inflation rate	**Mean**	27.9	3.7	8.5
	Min	-2.7	-0.6	-2.7
	Max	66.2	8.4	66.2
	St. dev	33.5	2.3	17.0

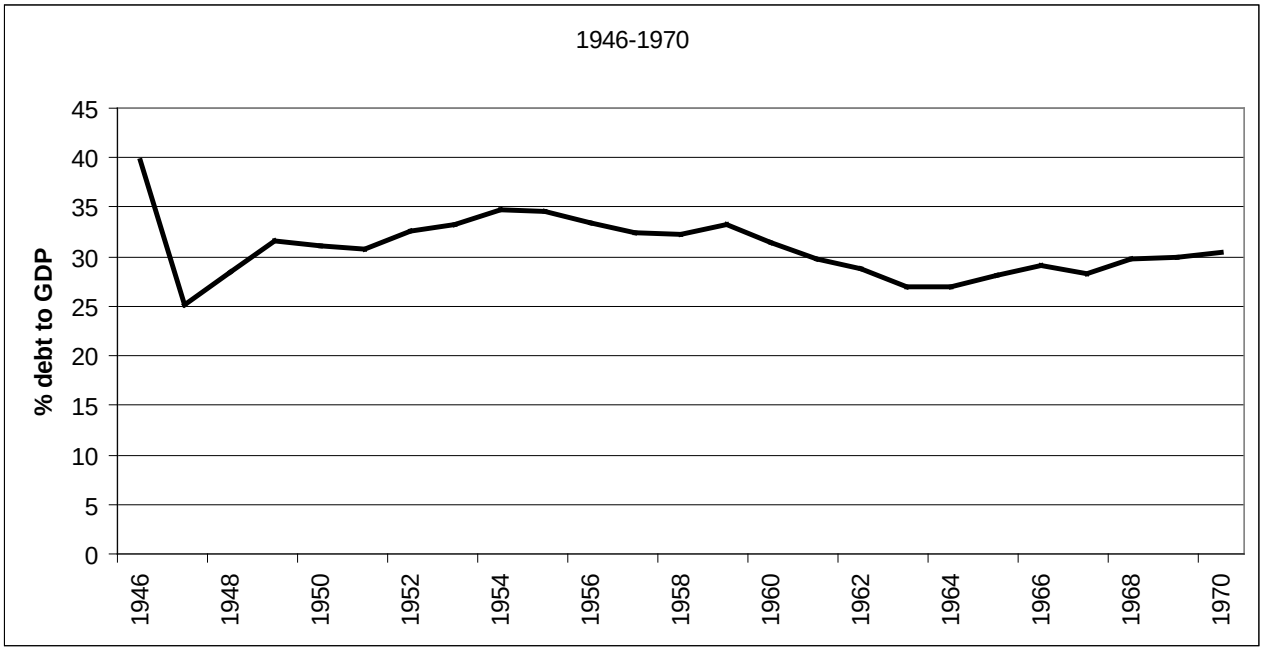
Source: from Francese and Pace (2008) for national debt; Baffigi (2011) for GDP; RGS (2011) for revenues and expenses. The inflation index is calculated upon the GDP deflator, based on Baffigi (2011).

5.1 The reconstruction period and the role of inflation

Nearly five years of war had caused serious structural damage to the transport system, public works, equipment and buildings, and electricity networks. In 1945 the national income, at constant prices, was almost halved compared to that obtained in 1938 (40%), industrial value added fell to less than a tenth and consumption declined by 40 % (Baffigi, 2011).[43] The situation was aggravated by a large balance of payments deficit, with gold reserves which were virtually zero, in part due to requisition by the Nazis. The most urgent problem was to provide for the basic needs of the population. It was absolutely necessary to recover production and resume imports of foodstuffs, raw materials and coal.

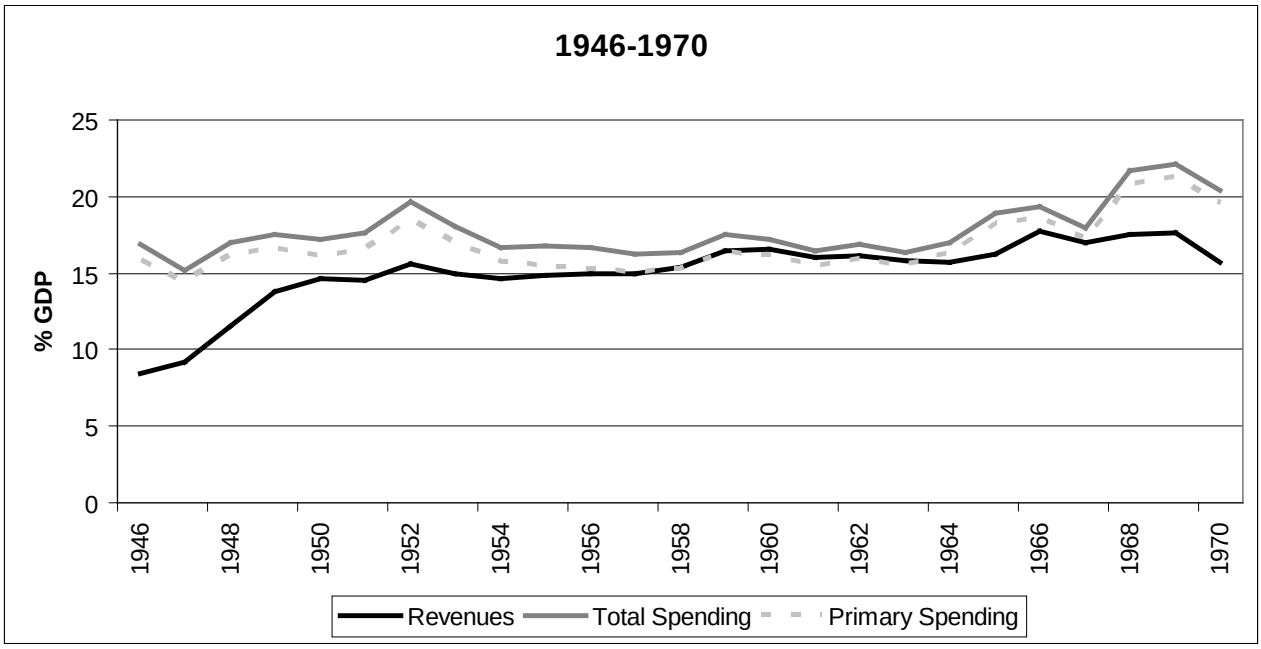
[42] See amongst others, Masera (1979), Graziani (1988), Salvemini (1992), Fratianni and Spinelli (2002).
[43] See also Cotula et al. (2003); Ricossa (2003).

Figure 8: the ratio of public debt to GDP, 1946-70 (percentage)



Source: data from Francese and Pace (2008), Baffigi (2011)

Figure 9 Final revenues and outlays (State Budget), proportion of GDP, 1946-1970 (percentage)



Source: data from RGS (2011), Baffigi (2011)

In 1945, the ratio of expenditures to GDP amounted to 24 % while revenues were about 7 % and the ratio of total deficit to GDP had increased from 6.8 % in 1938 to 17 % by the end of the war (Fig. 9). As a consequence, the State increased funding by the Bank of Italy. In 1945 the loans granted to

the Treasury by the Central Bank represented about 97 % of the consolidated assets of the Bank of Italy-Italian Exchange Office (Cotula, Oliva 2003).

In January 1945, Luigi Einaudi was appointed Governor of the Bank of Italy. The main objectives of the new Governor were monetary recovery and the autonomy of the Bank of Italy from the Treasury. In April 1946 Einaudi appointed Donato Menichella as general manager of the Bank of Italy. Italy had emerged from World War II defeated but it could nevertheless count on the support of the allies to overcome the economic difficulties and ensure the survival of the population. Since 1943, Italy had been able to rely on foreign economic aid, mostly American.[44] The total aid provided by the United States to Italy between 1943 and 1947 amounted to about 90 % of foreign aid received by the country. The aid programme would run out in the course of 1947, year of completion of the UNRRA.[45] The difficult situation drove the head of government, Alcide de Gasperi and Donato Menichella, to strengthen the aid programme with the United States (Martinez, 2000).

To facilitate the recovery of the European economies, the US launched the Marshall Plan, a comprehensive programme of economic assistance which saw among its aims that of containing the expansion of Soviet influence on Western economies.

Einaudi and Menichella were convinced that to allow the recovery of the Italian economy it was necessary to restore monetary stability and remove the external constraint, represented by the balance of payments deficit and the lack of foreign reserves. To achieve these objectives it was necessary to coordinate fiscal policy with monetary and credit policy and an appropriate wage policy. Rebuilding a suitable level of reserves was among the priorities of monetary policy, in order to stabilize the exchange rate, cope with excess imports and undertake important investment plans. In this period, the government did not hesitate to contract considerable medium and long-term debt with foreign countries to finance major investment projects, such as the extraordinary intervention in less developed southern Italy.

With monetary stabilization, the balance of payments improved rapidly thanks to the return of capital from abroad and the reduction in imports. In 1947, the debt/GDP ratio, resulting from high inflation, reached its lowest record, amounting to 25 %.

The debt structure had changed during the Second World War, with a larger short-term component. Moreover, it was common practice to require the Central Bank to finance part of the debt, so that inflation grew enormously leading to a drastic reduction in the debt-GDP ratio. After the peak of

[44] For an in-depth analysis see Martinez Oliva and Stefani (2000).

[45] The UNNRA (United Nations Relief and Rehabilitation Administration), was an international relief agency, largely controlled by the United States. Italy was able to count on foreign economic aid, especially from the US, since 1943, thanks to the UNRRA relief economic plan. In 1948, the UNRRA plan was largely replaced by the Marshall plan.

143 % in 1944, inflation lowered to 107 % in 1945 and in 1946 it was still 66 %. We can say that at the end of World War II the solution to the problem of public debt had been achieved by inflation tax.

However, hyperinflation and the sharp devaluation of the lira were not compatible with the system of fixed exchange rates established by the Bretton Woods Agreement of 1944. In 1944 the Bretton Woods Conference created the agreements establishing the International Monetary Fund and where Italy decided to adhere.

The expansion of bank credit did not have adequate institutional limits to curb the effect of multiplying the money supply. In this context Einaudi and Menichella carried out a manoeuvre of monetary stabilization in 1947, which was essentially based on the objective of reducing the expansive inflationary role of the bank credit multiplier. To achieve the goal, the official rate of discount was increased and a system of compulsory reserves was introduced, i.e. banks had to lodge a share of their deposits with the Bank of Italy. The Einaudi credit crunch had a strong disinflationary effect, with the real growth rate falling from 19% in 1947 to about 8% in the period 1948-1950, and allowed Italy to join the International Monetary Fund. In 1948 the inflation rate had fallen to 9.3% and in 1949 it became even negative (-2.7%). But the Italian industrial structure was still lagging behind the major industrialized countries.[46]

5.2 The economic boom

The new Italian Republic was born in 1946 with a public debt of about 40 % of GDP (according to our elaboration of data from Francese and Pace, 2008, and Baffigi, 2011), slightly higher than the ratio of the new Kingdom of Italy in 1861, when it amounted to 37%. The massive demand to finance reconstruction, and the need to convert and develop industries required a large savings formation to avoid increasing the current account deficit with foreign countries. The per capita income of the Italians was still very low in absolute terms and in comparison to the more advanced Western economies. At the end of the war, Italy was still an essentially agricultural country. About half of the population was employed in the agricultural sector which provided more than a quarter of the value added. The North-South gap was much wider than today. By 1950 the per capita income had caught up with 1938 levels but still amounted to only half the English per capita income levels and about 2/3 of those in France (Maddison, 1995).

The propensity to save was aided by monetary policy and banking policy implemented by Menichella, designed to defend monetary savings from inflation and preserve the stability of credit institutions. Such policies stimulated the demand for government bonds, also thanks to the structure

[46] See amongst others Ciocca (2007).

of interest rates. The sharp decline in public debt relative to GDP, due to inflation, allowed a margin for increasing public spending, although Menichella and Einaudi supported the need for State indebtedness not to grow excessively. They gave full support to the Vanoni plan, a scheme to develop employment and income in Italy during the decade 1955-64, aiming to spur production and absorb unemployment. From 1951 to 1968, the Italian economy underwent major transformations. This period witnessed exceptional economic growth and the strong growth of industrial production. During the Fascist period, industry's value added had exceeded that of agriculture, but it was during the Italian "economic miracle" (1953-1968) that the number of workers in industry exceeded those working in agriculture.

In the period 1950-61, industrial value added increased at an average annual rate of 9%, average investment by about 13% (Baffigi, 2011). The rapid productivity growth strengthened competitiveness, leading to trade expansion with foreign countries. The strong GDP growth led to a further reduction in the ratio of public debt to GDP, form 31% in 1950 to 27% in 1963 (Francese and Pace, 2008, and Baffigi, 2011).

In the 1950s, the objective of expanding trade with foreign countries was achieved together with the objectives of sustained growth in income and investment and monetary stability. In the second half of the same decade the external convertibility of the lira was restored after the balance of payments had achieved a strong position and restrictions on capital movements were eased. The balance of payments and the availability of reserves were no longer an obstacle to the possibility of improvements in infrastructure and industrial facilities and the reduction of unemployment.

After inflation reduction in the autumn of 1947, the central bank constantly pursued the goal of monetary stability (Gelsomino, 1998). Wages in manufacturing, lower than in most European countries, increased at an average annual rate of 6.6 % between 1951 and 1961 (Cotula and Martinez Oliva, 2003). Since during the same period, the growth of output per worker was only slightly lower, the increases in wage led to a modest increase in labour costs per unit of product during the period 1952-61. Inflationary pressures led to an increase in the cost of living between 1950 and 1961 of about 3 % per year, despite the stability of wholesale prices, and stemmed from the inefficiency of the service sector and public administration. The latter inefficiency, combined with high housing costs and wage drift affecting the purchasing power of wages, caused higher wage demands and led to a strong growth of wages in the early 1970s, generating inflation and loss of competitiveness.[47]

[47] See Nardozzi (1980), Sylos Labini (1972), Rey (1998).

6 Fiscal indiscipline: 1970-2011

The peak in public debt recorded nowadays is the consequence of an almost uninterrupted rise beginning in the early 1970s, with fiscal consolidation starting only in the mid 1990s. A succession of primary deficits lay at the origin of debt growth, but several aspects, such as the effects of the real interest cost of debt and of the GDP growth rate, have affected the debt dynamics.

6.1 The 1970s: debt is inflated away

In the 1970s major changes occurred with respect to the post-war period, not only in the Italian productive structure and its ability to increase employment, but also in the average returns of financial assets. This change was mainly due to the acceleration of the inflationary process heavily fuelled by the oil shocks.

Table 4 Public debt/GDP, primary deficit, interest spending, real GDP rate of growth, inflation rate (1971-2009)

		1971-1990	1991-2010	1971-2010
Public debt/GDP	**Mean**	60.9	106.5	83.7
	Min	33.9	95.3	33.9
	Max	92.4	119.3	119.3
	St. dev	20.4	37.0	27.2
Primary Deficit/GDP	**Mean**	5.05	-2.57	1.34
	Min	0.52	-10.13	-10.13
	Max	8.67	-0.07	8.67
	St. dev	1.99	2.29	4.40
Interest spending/GDP	**Mean**	4.61	7.27	5.90
	Min	0.96	4.36	0.96
	Max	8.69	11.41	11.41
	St. dev	2.69	2.47	2.88
GDP rate of growth	**Mean**	3.16	0.9	2.08
	Min	-2.28	-5.2	-5.09
	Max	7.06	3.7	7.06
	St. dev	2.20	1.8	2.31
Inflation rate	**Mean**	12.75	3.1	8.12
	Min	5.64	0.6	1.78
	Max	20.81	7.5	20.81
	St. dev	5.32	1.5	6.19

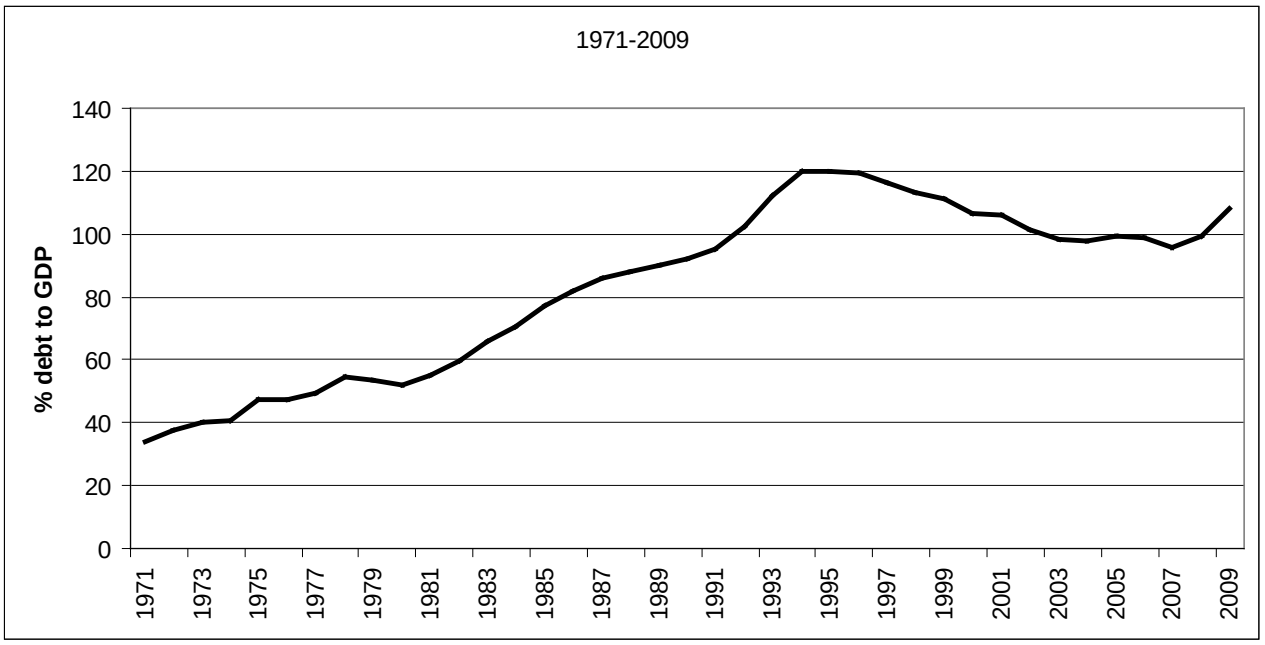
Source: from Francese and Pace (2008) for national debt; Baffigi (2011) for GDP; RGS (2011) for revenues and expenses. The inflation index is calculated upon the GDP deflator, based on Baffigi (2011).

The early 1970s marked an important turning point for the Italian economy. The ultimate failure of the system of Bretton Woods, occurring in the early months of 1973, and the energy crisis in the autumn of that year exacerbated the already high inflation rate and the imbalance in external accounts. In addition, for the first time, there was a sharp drop in the growth of sectors related to the use of petroleum products. Thereafter, until the end of 1975, the most severe postwar crisis

occurred. The period was also characterized by a high rate of devaluation of the lira. In 1974 and 1976, within a few weeks, the effective exchange rate of the lira lost about 7 and 18% respectively, creating the conditions for an increase in exports and changes in relative prices, with an increase of profits that contributed to the recovery of' economy, once again halted by a second oil shock.[48]

Data from the Bank of Italy, reported in Masera (1979), show that in the period 1949-70, the returns on financial assets (government securities, bonds and stocks) were all positive. By contrast, in the first half of the 1970s, government bonds reported a negative real return equal to -11.3%, the returns in short-term bonds were -9.3% and those in stocks fell by more than 15%.

Figure 10: the ratio of public debt to GDP, 1971-2009 (percentage)



Source: data from Francese and Pace (2011), Baffigi (2011).

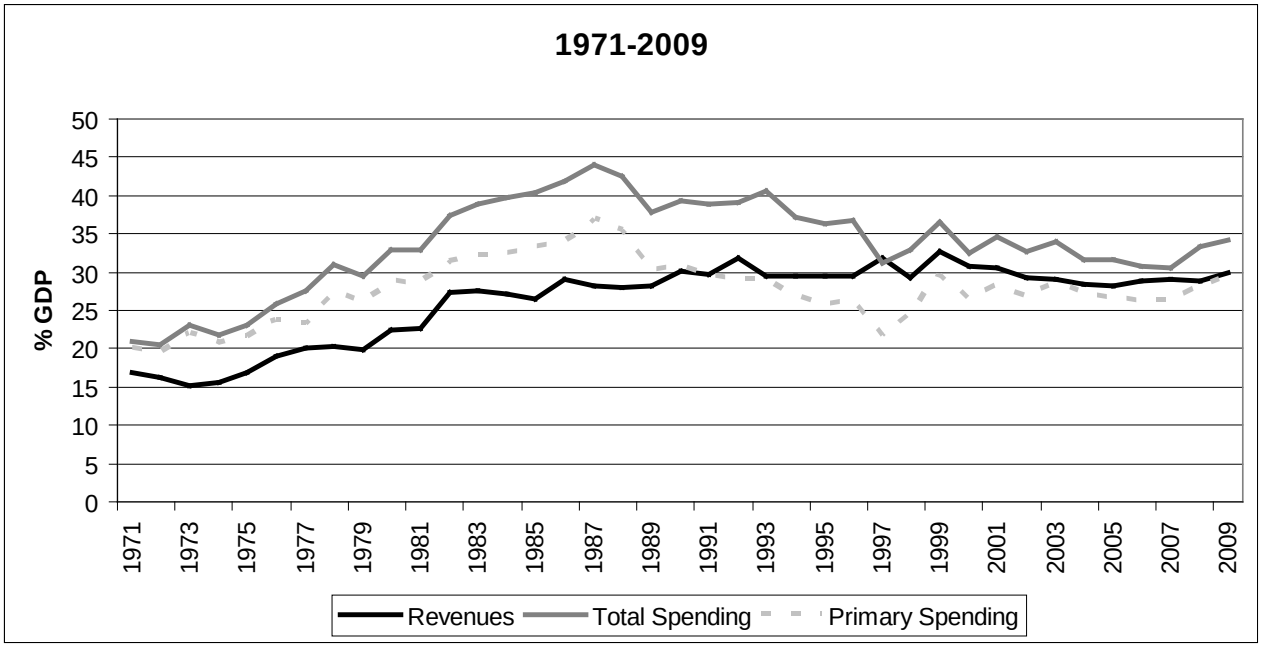
The price dynamics generated negative real returns and had a strong impact on the dynamics of public debt. These circumstances were made possible by a strong monetary base creation through the channel of the Treasury. Until the mid-1970s, this component amounted to about 80% of the State sector borrowing requirement. Only in 1977 was this source of funding cut off but, in the late 1970s, it still reached 30% of State requirements.

According to Masera (1979), the price dynamic in the 1950s and ’60s was marked by substantial stability: the average annual rate of inflation (using the GNP deflator) was 4.1% in the period 1949-1960 and 4.5% in the period 1960-70. Under these conditions, it was reasonable to assume that cumulative experiences conferred a high level of stability to the system. This allowed a medium-

[48] See, for instance, Nardozzi (1980) and Valli (1979).

long term expected rate of increase in prices to be formulated between 4 and 5% which could be regarded as the "national tendency" to inflation.

Figure 11: Final revenues and outlays (State Budget), proportion of GDP, 1971-2009 (percentage)



Source: data from RGS (2011) and Baffigi (2011).

The advantage of this situation was precisely to allow the financial markets to rely on a "defined" interest rate (as a normal threshold). Indeed, future expectations on inflation (even in the long run) could be reliably based on the set of information contained in past history. This is a prerequisite to attract capital and grow. Moreover, the mechanism for determining the nominal yield curve could be directly represented by schemes of formation and revision of expectations on the short-term evolution of nominal interest rates.

The experience of the 1970s is sharply different. The dynamic of prices, at the beginning of the decade, showed changes of about 7% and rose to 18% in 1974-77. The explosion of the inflationary process may well have destroyed the confidence in the experience acquired in the 1950s and '60s. The creation of a monetary base through the Treasury generated a weakening of the currency and the high inflationary pressures, especially after the drop in the external value of the lira in 1974 and 1976.

Obviously, in those years, long-term securities were secured only through administrative measures (pushing banks to hold securities in their portfolios), as "free" investors virtually abandoned the market. As a consequence, Italy approached the 1980s with a short and rapidly declining maturity of public debt. In 1981, about 60% of the debt had a maturity of less than a year, a figure certainly

dangerous for the years to come.[49] As pointed out by numerous studies of the time (for instance, Alesina et al. 1990), there exists a close and positive relationship between short and concentrated maturities and crises of confidence .[50]

6.2 The 1980s: The worsening of the fiscal imbalance

From the second oil shock to the late 1980s, the Italian public deficit hovered around 10% of GDP. No other Western country reported similar results.[51] As shown in Figure 10, public debt grew very rapidly (debt explosion) until its stabilization at the end of the 1990s. This was due, in large part, to an important innovation in the conduct of monetary policy: from 1950 to the 1970s, a large part of public debt was financed by an expansion of the monetary base; by contrast, starting from 1981, with the "divorce" between the Bank of Italy and the Italian Treasury, the contribution of the monetary authorities to the funding of fiscal policy considerably reduced.[52] Financing deficits with the placement of securities on the market led to a growing weight of government securities in the portfolio of the private sector, requiring a risk premium for their placement and giving a boost to the whole structure of interest rates. Unlike the 1970s, when real interest rates were largely negative, there were positive real interest rates for the whole period 1980-1992, with short-term rates averaging 4% and long-term 4.22%.[53]

Public expenditure policy underwent a significant change, facing strong demand for social spending and the construction of a Welfare State which had already been developed by other Western countries. Moreover, social and economic demands from the late 1970s onwards and tensions on the labour market gave rise to a series of redistributive policies with the launch of huge transfers to households, and disbursements of free services. The institutional characteristics of the Italian labour market and its segmentation in terms of age, gender, skill and regions, along with the lack of flexibility and the rise in wages, led the unemployment rate to increase continuously, rising from 7%, to 12%.[54] At the same time, a series of long-term plans were carried out for public investment and an increase in the number of public employees, while bureaucracies were developed extensively throughout the country and in all public services. [55] This strong growth in public spending occurred

[49] See Masera (1979). See also Pagano (1988), Vaciago (1990) and Salvemini (1992), Visaggio (1997) and the papers in Sartor (1998).
[50] See also, amongst others, Giavazzi and Pagano (1990).
[51] For an analysis of public deficits in the Western economies in the 80s, see amongst others Boltho (1992) and Wyplosz (2012).
[52] For a detailed analysis of the monetary policy in Italy and money-financing of fiscal deficit in the period 1970-1987 see Cotula (1989b) and Salvemini (1989). On the 1981 Italian monetary reform, see Tabellini (1987) amongst others.
[53] See, the Bank of Italy data in Morcaldo (1993).
[54] See, amongst the literature, De Luca and Bruni (1993).
[55] During the 1970s, the direct intervention of the State in the economy through the system of the *Partecipazioni Statali* further contributed to raise public spending (Bianchi, 2002).

in the presence of an inadequate tax system which was unable to follow the changes in income flows.[56]

The other factor that drove public expenditure in the 1980s was the increase in prices of raw materials and oil at the beginning and end of the 1970s. The change in the terms of trade imposed a real burden on the economy, which suffered a balance of payments crisis and produced a situation of stagflation. The balance of payments was also supported by measures to control currency movements and with a massive use of international loans. Those of the IMF in 1974 committed Italy to a severe deflationary policy. The crisis of 1975 led the policy-makers to pursue more expansionary policies. In this context, fiscal policy became expansionary, maintaining a GDP growth rate in line with the European average, but fuelling inflation. All this led to a sustained imbalance of public accounts and took over 10 years the debt/GDP ratio from 40% in 1973 to over 60% in 1983.

A further key element of this fiscal imbalance is that fiscal policy decisions were far from being taken by rational players. Fiscal deficits were the outcome of a great many short-sighted decisions, taken during a redistributive struggle between many players. The policy equilibrium set up in those decades was framed by extremely fragile political coalitions, sensitive to any change such as a monetary regime change, a domestic or international shock or changes in policy or/and economic preferences.[57] Schematically, Italian governments comprised a large number of players (parties, wings and various private and institutional supporters), a partitioning process of the players into randomly selected groups and a reshuffling of the members of each group in office over a brief span of time. Equilibrium and dynamics of this situation might be directly related to budgetary decisions: from 1970 until the end of the 1980s, there was continuous reshuffling of the coalition in office with more than 24 new governments along with high and growing government budget deficits. As Roubini and Sachs (1989), Alesina and Perotti (1995) and many others have stressed, the political fragmentation, the income inequality and other sources of heterogeneity produce fiscal disequilibrium.

Government spending in the 1980s grew in an uncontrolled manner because the present and future associated burden was systematically underestimated by the decision-making process.

Pressure to reduce deficits in Italy was in fact lower than in several other countries during the 1980s. This was also due to the presence of large household savings that allowed easy financing of the deficit. In addition, in Italy, from the 1980s onwards, the presence of a significant informal

[56] See, for instance, Nardozzi (1980), D'Adda and Salituro (1989), Franco (1993) and Visaggio (1997).

[57] Much has been written on the relationship between government structure and fiscal policy. See the papers in Giavazzi and Spaventa (1988) and Dornbusch and Draghi (1990) for historical and theoretical considerations. See also Roubini and Sachs (1989) and Persson and Tabellini (1989; 2000).

sector and hence serious tax evasion are statistically proven. This is an important factor in the formation of the deficit and also helped to generate higher rate of savings with which to finance the deficits.[58] Finally, the economic crisis and social conflicts required government intervention to support the production system and redistribution.[59]

6.3 EMU as a discipline device

In the early 1990s, after the currency and financial crisis of 1992 and the disintegration of the European Monetary System, there began an important process of adjustment of the public finance disequilibrium. The decade started with the government's dramatic financial position, with a public deficit of about 9-10% of GDP and a public debt exceeding 90% of GDP. Moreover, Italy suffered from an equally dramatic political crisis. In these circumstances, Giuliano Amato (a socialist Prime Minister) undertook a "healing process" of public finance.

The financial act of 1992 was a fiscal contraction amounting to 6% of GDP, and helped avoid the bail-out of public debt (see Figure 10). The restoring of the public finance equilibrium was pursued through major cuts to public spending, with some structural reforms, such as privatization and the end of the system of *Partecipazioni Statali* and the reform of the social security system.[60] In particular, in 1992, expenditure on public pensions had reached almost 13% of GDP with some dramatic and unsustainable projections for the next decades. The Amato reform first, and later on, in 1995, the crucial reform of Lamberto Dini who steered a pension system mostly based on a pay-as-you-go scheme towards a contribution-based system, contributed to bring pension spending under control.[61]

The process was also accompanied by stronger fiscal pressure, with a sharp rise in the tax rate with a peak reached in 1997, mainly due to extraordinary revenues connected to the so-called "tax for Europe", raised by the government to comply with the requirement to join the European Monetary Union (1997). Finally, a process of lengthening of the debt maturity structure and declining interest rates led to a sharp decline in the average cost of debt (the ratio of interest payments to overall debt) from 1993.

At the beginning of 1990s, joining the Economic and Monetary Union was agreed with the aim of setting a proper balance between fiscal discipline and the macroeconomic stabilization role of fiscal policy. It was for Italy a "discipline device" which was to ensure budgetary balances close to balance or in surplus, while keeping or even reducing gross debt levels in terms of GDP. Many

[58] See, for instance, Boltho (1992) and Morcaldo (1993).
[59] See Franco (1993) for a survey.
[60] Between 1992 and 1999, privatization in Italy produced a value equal to 12.3% of 1992 GDP. For a detailed analysis see the papers in De Nardis (2000).
[61] See Ferrera and Jessoula (2007) for a survey on the pension system and pension reforms in Italy.

authors claimed that EMU would actually reduce the occurrence of country-specific shocks, also because it would limit the possibility of policy-induced shocks. EMU fiscal rules would limit the scope for major fiscal slippages by national governments.[62]

In the past 15 years, the conduct of the fiscal policy and the pattern of the public debt has been strongly affected by the budgetary rules imposed by the Stability and Growth Pact. However, Italian governments face growing demands to increase public expenditures and fulfil promises of retirement and health care benefits to retirees, whereas growth in the workforce and production of goods and services have slowed and the population has aged rapidly. The EMU, with the Maastricht treaty parameters, has placed huge conflicting pressures on the Italian national budget, pointing toward growing debt levels: a very modest economic growth (almost zero in several years, 14% from 1995 to 2009) did not allow an improvement in the financial imbalance that stayed close to 110% of GDP during the decade 1996-2005.[63] During the period 1995-2010, the average contribution of the growth dividend to the dynamic of the debt to GDP ratio (defined in Eq. 1), was negative, -3.8%, but the positive contribution of the total deficit (which amounted to +3.6%) choked off the growth effect on the dynamic of the debt/GDP ratio (on average -0.7%). The most important component of the growth dividend was inflation, around 3%, while the growth in real terms did not reach 1%. The budget rules imposed by the Monetary Union have been successful in attaining fiscal discipline (on average, total deficit decreased from 12% of GDP in the decade 1980-1990, to 3.3% in the period 2000-2010) but they have severely restricted the growth of the economy.

Comparing these figures with those obtained during the period 1894-1912, we can explain the striking reduction of a similarly high level of debt: the dividend growth was, on average, -3.2%, decomposed by an average inflation amounting to 1.6% and a growth of the real economy by 2%. Most importantly, during this period, the contribution of the deficit was negligible, +0.3%, which allowed the debt ratio to be reduced by on average 2.1% per year.[64]

Over the past 50 years, the growth of public debt has been curbed and, at times, reduced, inflating the economy (during the 1970s and 1980s) or increasing growth (1960s). Over the past 10 years, the lack of growth (fundamentally linked to the fixed exchange rate) and inflation targeting by the

[62] There exists an enormous literature on the costs and benefits of EMU, the Stability and Growth Pact etc. See, for instance, the very large number of papers of the European Commission. We quote Emerson et al. (1992) and Buti and Sapir (1998). Views on EMU address three main questions. Does the single European currency satisfy "Optimum Currency Area" (OCA) conditions? Do heterogeneous economic and financial structures create undesired differences in the local impact of the single monetary policy? Do the area-wide considerations generate conflicts in the decision-making process of the European Central Bank (ECB)? On these issues see, amongst others, Eichengreen (1992), Bayoumi, and Eichengreen (1993), Feldstein (1997 a,b) and Angeloni and Dedola (1999) just to cite a few.

[63] On Maastricht treaty parameters see Buiter, Corsetti and Roubini (1993) and Corsetti and Roubini (1993). See also the papers in the Bernardi reports on public finance (1998-2000).

[64] See also Balassone et al. (2010).

European Central Bank (ECB) have necessarily led to a stabilization of the debt mainly based on primary surpluses.

7. Is the Italian public debt sustainable? An answer based on the time series approach

From the above description of the complex succession of events that have occurred over the long time span of the Italian State, it clearly emerges that coping with budget imbalances has been a feature common to the entire life of the Italian State. However, a very variegated pattern for public debt over the observed sample has emerged from the reading of the previous sections. Here we try to place the evidence of facts described above within a unitary statistical-framework, to ascertain whether there has been a common strategy, perhaps not always conscious, by Italian fiscal authorities, aiming to run a sustainable fiscal policy.

7.1 The time series approach to sustainability

In the time series approach to sustainability, a number of stationarity and cointegration tests are recommended to verify whether the Present Value Budget Constraint (PVBC) holds:

$$B_t = \sum_{j=0}^{\infty} \frac{-D^P_{t+j}}{(1+i)^{t+j}} \quad ; \qquad (3)$$

where D^P stands for the net-of-interest deficit, and i is the appropriate interest rate.[65]

However, the PVBC is not unanimously accepted as a signal of fiscal solvency. An alternative view is the so-called indicator approach, which pays less attention to the PVBC, focusing instead on indicators of sustainability that are not grounded in theory (Blanchard, 1990; Blanchard et al. 1990; Chalk and Hemming, 2000).

Within the time series approach, Trehan and Walsh (1988, 1991) demonstrate that if public debt is difference stationary, a simple test of intertemporal budget balance reduces to a check for the stationarity of the deficit inclusive-of-interest. According to Trehan and Walsh (1988), this condition is necessary and sufficient under the assumption that the expected value of the real interest rate, *r*, be constant. In this case the debt and the net-of-interest deficit are of the same order

[65] The government budget identity can be stated in terms of real variables, nominal variables, or relative to a scale variable, like GDP. Accordingly, the appropriate definition of the accumulation factor, *i*, would be: the real interest rate, the nominal interest rate, the real interest rate net of the economic growth rate. The assumption of a constant interest rate simplifies the algebra, and it is the most common in the literature (Bohn, 2007). However, it is not neutral with regard to the analysis of sustainability, as well demonstrated by Trehan and Walsh (1991) and Bohn (1995).

of integration and cointegrated, with the cointegrating vector being *(1, -r)*, or, equivalently, that revenues, non-interest spending and debt are cointegrated with vector *(1, -1, -r)*.

Moreover, Trehan and Walsh (1991) show that the test based on the stationarity of the deficit inclusive-of-interest continues to be valid, i.e. it is a sufficient condition to ensure intertemporal budget balance, as long as the expected real rate of interest is allowed to vary but is strictly positive. This latter result is independent of any assumption about possible cointegration between the debt and the net-of-interest deficit.

Bohn (2007) casts doubt on the necessity of stationarity and cointegration restrictions, claiming that the class of tests commonly used in literature (Hamilton and Flavin, 1986; Trehan and Walsh, 1988; Quintos, 1995;) are special cases of a more general sufficient condition for sustainability, i.e. that a debt series is integrated of any finite order $m \geq 0$. Bohn (2005) criticizes the definition of sustainability based on the PVBC (*"ad hoc sustainability"*), claiming that there is no *"economic argument why potential buyers of government bond should care"* about it. Alternatively, the author recommends adopting a "model-based" approach to sustainability, suggesting that sustainability can be tested by estimating an appropriate policy rule, i.e. a reaction function for the primary surplus to the debt-GDP ratio. However, if the debt-to-GDP ratio is a variable integrated of order one, I(1), the policy rule would imply cointegration between debt and primary surplus, satisfying the sufficient condition, in the presence of a constant interest rate, stated by Trehan and Walsh (1988).

7.2 The sustainability of fiscal policy in Italy since reunification

In this section we investigate whether fiscal policy in Italy has been following a sustainable pattern by testing the unit root properties of the public debt and deficit. Since the PVBC, to which Trehan and Walsh (1988, 1991) refer, is valid both for variables expressed in nominal/real terms and for GDP-ratios, and given that Bohn (2005) recommends using variables scaled by GDP in order to avoid misleading results due to excessive non-stationarity in variance, our tests are based on fiscal variables all scaled by GDP (see the Appendix).[66]

7.2.1 Unit root analysis

First of all we test for the presence of unit root in the debt series.[67] Standard tests, such as the augmented Dickey-Fuller (ADF) and the KPSS (Kwiatkowski et al., 1992) provide statistically

[66] Therefore, the discounting factor is the real rate of interest net of the growth rate of the real GDP. Bohn (1998, 2005) emphasises that the unit root tests for the debt series (nominal or real) are biased towards non-rejection of the unit root hypothesis, and that the most correct method to avoid problems of covariance non-stationarity is to construct fiscal variables scaled by GDP. This is confirmed in our data set, as shown in the Appendix.

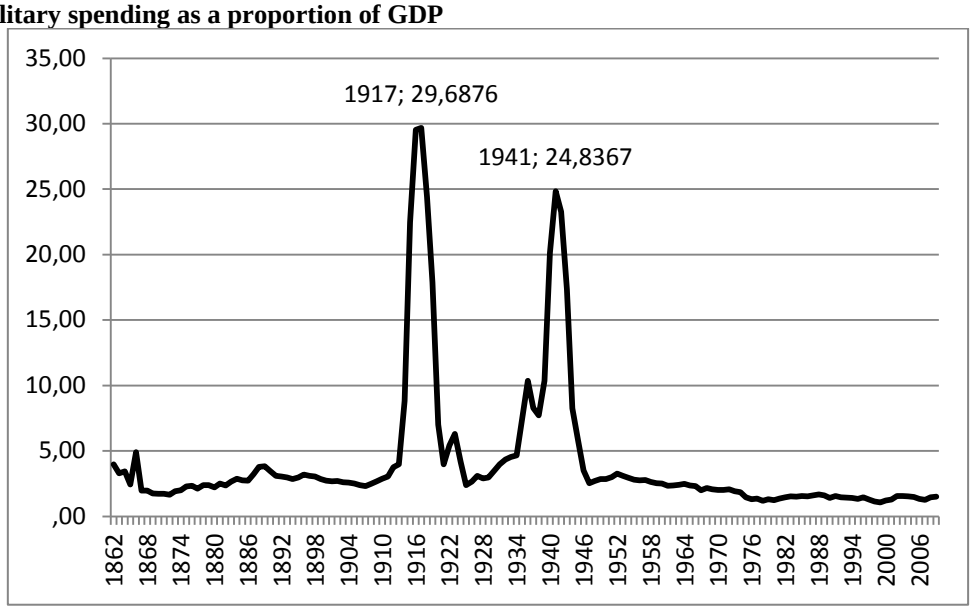
[67] The detailed analysis of the Univariate properties of the time series and the test statistics are described in the Appendix.

clear-cut results for debt-to-GDP ratio, which appear to be I(1): the KPSS rejects trend-stationarity whereas the ADF does not reject unit roots.

As to the deficit, both with and net of interest payments, the two tests display contrasting evidence: while ADF rejects a unit root there is some weak evidence for the KPSS rejecting level stationarity. Similarly, with regard to public spending, again the two tests provide contrasting evidence, and the choice of the deterministic component seems to be crucial in the ADF test: with a linear trend, the with-interest spending seems to be I(0), whereas the test statistic suggests that total spending has a unit root when keeping only a non-zero mean.

The ambiguous results we get from the unit root tests with regard to public spending and deficit can be better understood by careful analysis of the components of these time series. In particular, a crucial role is played by public spending for military purposes. In Figure 12 we plot the observed pattern for military spending as a proportion of GDP.

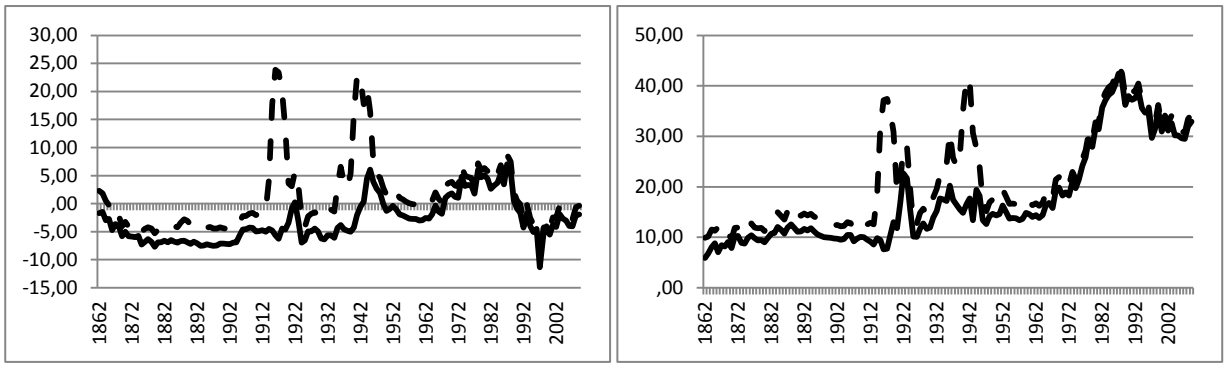
Figure 12: military spending as a proportion of GDP



Source: data from RGS (2011), Baffigi (2011).

The graph in Figure 12 suggests that military spending (as a proportion of GDP) might be considered a stationary variable, since it displays, with the exception of the World Wars I and II, constant mean and variance. However, the two large spikes occurring during the two World Wars may alter the reliability of the unit root tests when summed with other spending variables, as is clearly shown by looking at Figure 13, where we compare the primary deficit as well as total spending with and without the military component.

Figure 13: primary deficit (left) and total spending (right), with and without military spending



Source: data from RGS(2011), Baffigi (2011).

Actually, by repeating the unit root test for the primary deficit and total spending net-of-military outlays, both the ADF and the KPSS test support the hypothesis for primary deficit and total spending being I(1), since they are the sum of a stationary component, military outlays, plus a difference stationary series (see the Appendix).

The previous results assume that there is no structural break in the series, whereas the historical analysis reported above depicts a debt dynamics with swings, peaks and notable changes in trend. In the presence of structural changes, the basic ADF test is biased towards non-rejection of the unit root.

The stock of debt, like all stock variables, usually displays a slow dynamic, though it can change suddenly in response to exceptional events, such as wars. Availability of a long sample, during which two World Wars occurred and a myriad of political and economic events have impinged upon the stance of fiscal policy, allows us to control for possible structural breaks.

Saikkonen and Lütkepohl (2002) and Lanne et al. (2002) propose unit root tests for the following model:

$$y_t = \mu_0 + \mu_1 t + f_t'\gamma + x_t \qquad (4)$$

where the term f_t identifies a structural break, γ is an unknown parameter and the errors x_t are generated by an *AR(p)* process with possible unit root. In our case the break is simply a shift in the level starting in date T_B:

$$f_t^{(1)} = d_{1t} := \begin{cases} 0, & t < T_B \\ 1, & t \geq T_B \end{cases}$$

The test is based on estimating the deterministic term first by a generalized least squares (GLS) procedure under the unit root null hypothesis and subtracting it from the original series. Then an ADF type test is performed on the adjusted series which also includes terms to correct for estimation errors in the parameters of the deterministic part. As in the case of the ADF statistic, the asymptotic null distribution is non-standard. Critical values are tabulated in Lanne et al. (2002), and the results for the above-listed variables are shown in Table 5.

Table 5: Unit root test with structural break (Lanne et al., 2002). Null Hypothesis: unit root

	Test statistic	Deterministic (lags)	Break Date	Type of break
Public Debt	-1.78	intercept, time trend, (1)	1944	level shift
Total deficit	-3.41**	intercept (1)	1915	level shift
Primary deficit	-3.40**	intercept (1)	1915	level shift
Government total spending	-2.94*	intercept, time trend (2)	1920	level shift
Government total revenues	-2.20	intercept, time trend (0)	1925	level shift

Thresholds (constant, trend, level shift): 1% (-3.55) 5% (-3.03) 10% (-2.76)
Thresholds (constant, level shift): 1% (-3.48) 5% (-2.88) 10% (-2.58)

The break dates endogenously found are: 1915 for the deficit series, accounting for the sudden increase in the deficits caused by the huge rise in the military spending; 1920 for total outlays, recording an upward movement starting in the first post-war crisis; the break date highlighted for total revenues is recorded during the first phase of the Fascist period, in 1925. Finally, as to the debt series, the break is imposed in 1944, a year which saw a drastic reduction in the debt-to-GDP ratio explained by the huge inflationary process, peaking at 142%.

Once we account for the above-mentioned structural breaks, the overall evidence provided by the ADF test does not change at all: with-interest deficit as well as primary deficit are both stationary, whereas debt and revenues display a stochastic trend. By contrast, the evidence for public spending is still controversial, since the null hypothesis can only be rejected with confidence lower than 95%. Given the peculiar pattern of military spending, we show in Table 6 the unit root properties of the deficits and expenditures, tested though the Lanne et al. (2002) procedure, by excluding military spending: without military expenditure, primary deficit and total spending are both driven by stochastic trend, whereas for total deficit the unit root hypothesis can be rejected with 5% significance.

As for the break dates, it is interesting to note that once the anomalous pattern of military spending is excluded from the analysis, the break dates occurring for the deficits both refer to recent decades. Actually, 1989 is the break date endogenously found for the primary deficit, when the upward trend is reversed into a negative sloped one. As for total deficit, in 1973 (the first oil shock) it experienced a jump, reaching an average value higher than that recorded previously and also very high compared to the experience of other European countries.

Table 6: Unit root test with structural break (Lanne et al., 2002). Null Hypothesis: unit root

	Test statistic	Deterministic (lags)	Break Date	Type of break
Net-of-military government spending	-2.23	intercept, time trend (0)	1924	Level shift
Total deficit net of military spending	-3.38**	Intercept (0)	1969	Exponential shift
Primary deficit net of military spending	-2.65	intercept, time trend (0)	1989	Level shift

To sum up, the results shown in Tables 5 and 6 suggest that total outlays are the sum of stationary (military spending) plus an I(1) process (net of military spending). Hence we can conclude that total outlays are driven by a stochastic trend, and a similar result is obtained for the primary deficit, which can be considered to be I(1) as well. Conversely, as for the with-interest deficit, unit root tests suggest that it is still stationary when considered net-of-military spending.

Therefore, analysis of fiscal policy in Italy, over the 150 years since Unification, shows that public debt is driven by a stochastic trend, i.e. it is potentially unbounded. However, we have also provided evidence for a stationary with-interest deficit in a setting with non-stationary revenues and outlays, a configuration that satisfies Trehan-Walsh's (1988) sustainability condition.

7.2.2 Cointegration analysis

So far we have not discussed the issue of cointegration among the component of the public deficit, but we have shown that the latter is mean reverting. One of the possible long-run relationships to be investigated is that between public expenditures and revenues, which we examine in this Section. The previous analysis of the univariate characteristics of the public deficit-to-GDP ratio helps to correctly model the cointegration relationship between revenue and spending, both taken as a percentage of GDP. First, since the total deficit does not seem to show a deterministic trend, then in testing for cointegration we can exclude the trend in the vector. Second, with regard to structural breaks, which are usually difficult to identify, we can once again exploit information from Univariate analysis, and control for one level shift in 1915.

Hence, we carried out a trace test, controlling for one level shift in 1915 (Johansen et al., 2000), in order to check whether total spending and total revenues are cointegrated. The null of no cointegration can be rejected with a level of significance of 5%, whereas the null of one vector cannot be rejected (*pi-value 0.94*).

According to Afonso (2005), the intensity of the relationship between revenues and expenditures becomes relevant to sustainability. In particular, having normalized the cointegration vector on revenues, (*1*,*-b*), where *b* is a cointegrating coefficient, the condition ensuring sustainability reads as follows:

$$b \leq 1,$$

and if the constraint is non-binding, the pattern of revenue cannot cover that of expenses.

This restriction is necessary also to comply with the issue of weak sustainability raised by Quintos (1995). The cointegration between revenues and total spending, with some vector *(1, -b)*, implies that the first difference of public debt may, or may not, be stationary depending upon the size of *b*:

$$\Delta B_t = G_t - T_t = \varepsilon_t + (1-b)G_t \approx \begin{cases} I(1) & \text{if } b \neq 1 \\ I(0) & \text{if } b = 1 \end{cases} . \qquad (5)$$

In our case the estimated *b-coefficient* amounts to *0.85* and the Wald test for the restriction *b=1* cannot be rejected, with a *pi-value* equal to *0.20*.

This finding suggests that, during the period 1861-2009, government deficit followed a pattern consistent with sustainability in the government accounts, since the test for cointegration supports the existence of a long-run equilibrium between outlays and revenues, and the estimated cointegration equation suggests that public revenues have been managed to balance the evolution of public expenditures.

8. Some critical issues about public debt sustainability in the time series approach

In the time series approach to sustainability, a no-Ponzi game restriction is typically regarded as being synonymous with sustainability; as shown in the previous Section, a number of stationarity and cointegration tests are recommended to verify whether the PVBC holds. However, the consequences of the sustainability tests are worth better clarifying.

Theoretically, and consistent with the PVBC, the government could issue any level of debt to pursue its own goals, provided that in some instant of time it starts to raise positive surpluses. Actually, the transversality condition on the terminal debt stock constrains the debt to grow no faster than the real interest rate (adjusted by the growth rate), but does not exclude an unbounded ratio of debt-to-GDP (amongst a vast literature, see McCallum, 1984).

However, a clear limitation to this never-ending debt policy lies in the fact that it is not possible to raise tax revenues beyond a threshold consistent with the macroeconomic framework and sound economic development. This raises serious doubts about the existence of sustainability in the presence of a stochastic trend for public debt since, in this case, by definition, the level of public debt is unbounded, and every shock has a permanent effect. Therefore, in the presence of upper

bounds to public debt imposed by political agreements, compliance with the PVBC is not necessarily a condition ensuring that lenders will be ready to subscribe public debt.[68]

The most intuitive representation of debt sustainability refers to a relationship between public debt and primary surplus: when the debt rises, a sustainable fiscal policy requires an increase in primary surplus. This is the point raised by Bohn (1998, 2005, 2007), who critically examines the time series approach to sustainability, doubting both the necessary conditions stating the random walk nature of the public debt and the theoretical foundations of the approach, namely the "ad hoc assumptions" about the discount factor in the PVBC. Rather than focusing on stationarity and cointegration restrictions, Bohn (1998, 2005) suggests estimating a reaction function between primary surpluses and the debt-income ratio, demonstrating that stable, positive feedback from debt to surplus would be consistent with the intertemporal budget constraint.

Here we follow the approach recommended by Bohn (1998, 2005), but with a different set of econometric tools, namely cointegration analysis, given that we have found evidence for debt and primary deficit/surplus to be both non-stationary time series.[69]

8.1 Vector auto-regression between debt and primary deficit

The primary objective of this Section is to quantify the reaction of the policy maker, through the primary deficit, to a rise in debt-to-GDP ratio. In the presence of stochastic trends, once the existence of a cointegrating relationship between debt and deficit has been ascertained, two alternative paths are available: to estimate a single equation, i.e. the long-run equilibrium; to estimate a full VEC model and the size of the impulse response of the primary deficit to a shock in debt. We first show the results of this latter strategy, and then compare the size of the Impulse Response function with a policy reaction function estimated in a single-equation setting.

The time series of debt and deficit behave, over the observed sample, as random walk with drift and exhibit long swings away from their mean value (especially the debt series), accelerations and sudden "jumps" (both the series), and broken trends (especially the deficit series). Moreover, the VEC model contains variables both in levels and in differences. To cope with these dynamics, careful analysis of the dummy variables is a linchpin of a sound modelling strategy (see Juselius

[68] It comes as no surprise to see that the PVBC plays almost no role in the current debate about the sovereign debt crisis, which is mostly focused on limits to the debt-GDP and /or deficit-GDP ratios. For instance, the recent "Six-Packs" that came into being on 13 December 2011 establishes that each Member State must fill the gap between its debt and the 60% reference by $1/20^{th}$ annually. For a survey of the method currently used by the IMF to assess fiscal sustainability see Chalk and Henning (2000).

[69] Though we fully agree with Bohn (2006) about his claiming that the economic analysis of debt and deficit cannot be substituted by econometric tests of the PVBC, we didn't find support, for the Italian data, to his result (Bohn, 1998) that once controlling for temporary variation in government spending and for the business cycle the debt would be a stationary process, as shown in the paragraph devoted to the analysis of the debt series in the Appendix. For details about the covariate augmented Dickey-Fuller tests see Hansen (1995) and Lupi (2009).

2006). Our strategy identifies the outliers which, like swings, accelerations, jumps and reverse trends, cause sudden changes in the variables.

This analysis suggests augmenting the VEC by seven dummy variables. One dummy was included for describing a transitory shock in 1997, which implies a negative outlier in the levels of the public deficit observed in 1997 (possibly subsequent to the collection of the revenue from the tax for Europe, and the introduction of the local business tax -IRAP- in 1998). All the remaining dummies are impulse dummies, describing a permanent intervention/shock that affects the level of the involved variable.[70]

In particular, we augment the VAR for permanent shifts in the debt ratio corresponding to:

- the sudden rise in 1919, a difficult year characterized, as shown above, by the Lira's depreciation and the real GDP contraction, with debt jumping to 138% compared to 98% in the previous year;
- the sudden drop observed in 1925, with the debt-to-GDP ratio declining by 42%, from 152% recorded in 1924, thanks to the good economic performance during the first years of the Fascist period, the high inflation rate and the significant reduction of war debts towards United States and Great Britain due to the signing of treaties;
- a downward adjustment, though less marked than that observed in 1925, occurred in 1932 (-23%);
- the regime shift starting in 1944, with a reduction in public debt amounting, at first, to 25%, which was mostly due to hyperinflation after World War II.

One further impulse dummy, matching a permanent change in the deficit series, is set in 1940, corresponding to an upward jump in primary deficit, from 5% in 1939 to 16%, which is mostly explained by the large expansion of military outlays, rising sharply to more than 50 % of primary expenses.

Finally, a shift dummy variable was included in the system, with shift date 1915:

$$Shift1915 = \begin{cases} 0, & t < 1915 \\ 1, & t \geq 1915 \end{cases} . \qquad (6)$$

[70] As already stressed in the main text, all the public finance series are profoundly affected by wartime periods, and military spending during these periods accounted for a very considerable part of GDP (larger than 20%). Therefore, the spikes associated to WWI and WWII obscure any potential outlier recorded in peace time, for instance the more recent ones associated to exogenous events such as the oil crises or the institution of the EMU.

This shift function was included (and restricted in the cointegration space) to account for the "regime" change in fiscal policy after WWI, to cope with the upward jump into the deficit series. [71]

In order to test for cointegration, we conduct our analysis using a VAR with four lags on all stochastic variables.[72] The VAR model can be represented in a vector error correction form:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma \Delta y_{t-i} + B z_t + \varepsilon_t \qquad (7)$$

where $\Pi = \sum_{i=1}^{p} A_i - I; \quad \Gamma_i = -\sum_{j=i+1}^{p} A_j .$

In our case, y_t is a vector containing two non-stationary variables (I(1)), z_t is a vector of conditioning variables (non-stochastic variables such as dummies and the exogenous real GDP growth rate) and ε_t is a vector of innovation. A_i and B are matrices of coefficients to be estimated. It is well known that if the coefficient of the (*2x2*) matrix Π has a reduced rank *(r<2=1* is the number of cointegrating relations in our case), there exist matrices α and β (both *1x2*) such that $\Pi = \alpha\beta'$ where β is a cointegrating vector and α are the adjustment parameters.[73]

Estimation is carried out over the period 1862-2009 using a two-stage procedure (S2S).[74] Testing for cointegration (Johansen Trace statistic) with a constant and a structural break, and controlling for the above-mentioned dummies, provides evidence of one cointegrating vector in our data set, which reads as follows (t-statistics in brackets):

$$\frac{Def}{GDP} = \underset{(0.97)}{2.55} - \underset{(-2.32)}{0.058}\frac{Debt}{GDP} + \underset{(2.12)}{3.39}\, shift1915 . \qquad (8)$$

The sign of the coefficient linking the debt-to-GDP ratio to the primary deficit ratio is consistent with the idea of sustainability as claimed by Bohn (1998, 2005): a larger debt implies a reduction in the primary deficit.

[71] Of course, since the shift dummy is restricted to lying in the cointegration space, its difference (current and lagged) is also included as unrestricted in the VEC equations.

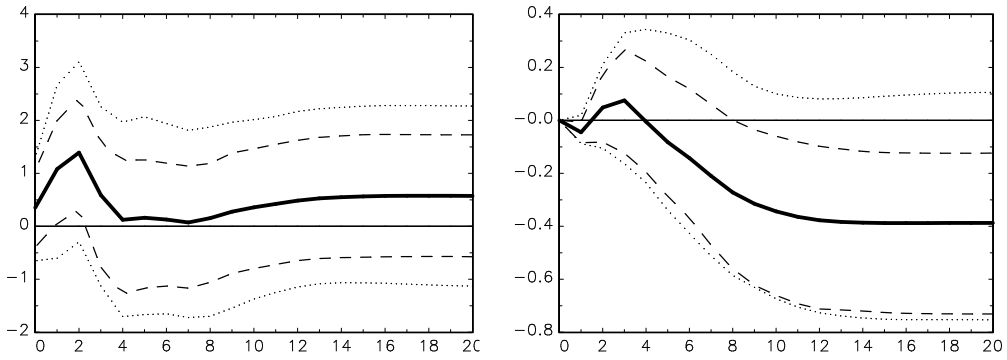
[72] The appropriateness of the lag order was consistent with the Hannan-Quinn Criterion, Akaike and Final Prediction Error criteria would recommend using five lags, while the Schwartz criterion identifies two lags as optimal.

[73] See Johansen (1995) and Juselius (2006) amongst others.

[74] See Lutkepohl and Kratzig (2004). Diagnostic tests do not show a good performance of the system, especially with regard to the normality of the residuals. Diagnostic tests are presented in the Appendix. Further results may be provided by the authors upon request.

Caution should be used to interpret the estimated coefficients. They cannot be considered as elasticities, because all the other dynamic relations between the variables which are specified in the VAR model are ignored. Impulse response analysis, taking into account the full system, may provide a more reliable conclusion. Therefore, in Figure 14, we display the effect of an exogenous shock to debt on the dynamic of the primary deficit, and vice versa.

Figure 14 The response of public debt (left) and primary deficit (right) to each other's one S.D. shock



As well established by the dynamic budget constraint, a rise in the primary deficit generates an immediate increase in the debt-to-GDP ratio.

Interestingly, the impulse response analysis seems to suggest that the sustainability *à la* Bohn has been occurring during the observed sample, but only when accepting a delayed adjustment: after seven years the deficit response becomes significant, and it reaches a stable value amounting to –0.1 when simulating a debt-to-GDP increase of one percentage point. This digit is larger than the elasticity of the ECM, where the estimated coefficient was -0.056, thus confirming that the full dynamic of the VEC system plays a crucial role. By contrast, according to the Impulse Response function, there is only a moderate evidence of a contemporaneous response of the primary deficit to an increase in the debt ratio, amounting to -0.01.[75]

To further assess whether this latter result is robust, and since the estimated loading factor for the debt-to-GDP ratio is not significant, i.e. the debt ratio seems to be weakly exogenous, we can estimate a single consistent OLS equation between the primary deficit and the debt. Moreover, given that the debt time series, which is collected on a monthly basis, has been annualized by taking the value recorded at the end of the calendar year, in order to respect the algebra of the budget constraint, debt is considered with one lag length in the policy reaction function estimated through

[75] Though the deficit and debt ratios are both expressed in absolute value and not in logs, the level of the responses displayed in the graph of the IR functions have to be transformed to take account of the fact that the simulated shock is about one standard deviation, amounting, for debt-to-GDP and for the deficit ratio, to, respectively, 4.27 and 1.59 percentage points.

the OLS regression. Consistent with the results of the cointegration tests, we run the OLS regression by controlling for a level shift in 1915, omitting the linear trend; moreover, we still control for the rate of growth of the Italian economy and for several impulse dummies accounting for the exceptional events connected to the two world wars and to the outlier for the primary deficit recorded in 1997. By using the OLS regression (t-statistics in brackets):

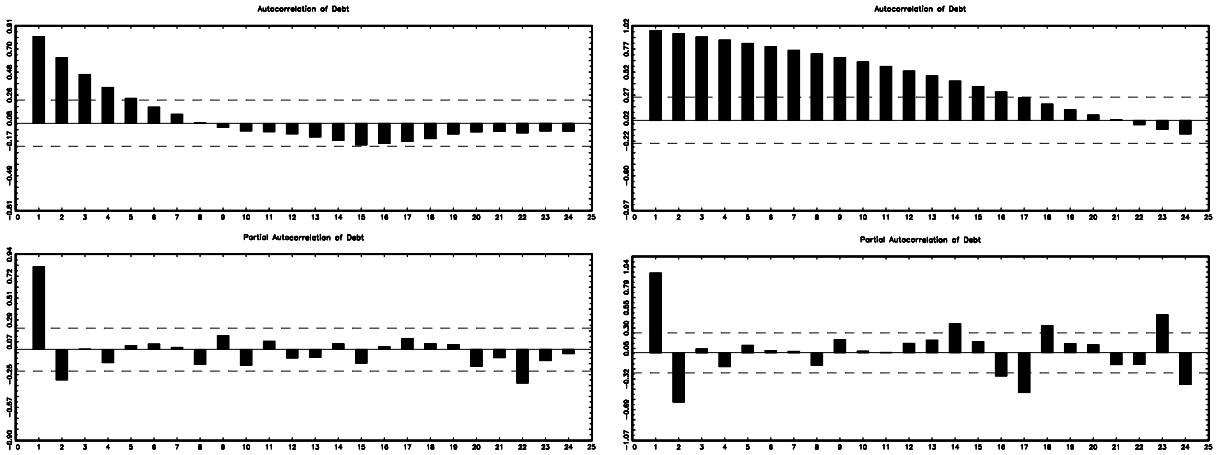
$$\frac{Deficit}{GDP} = \underset{(0.74)}{0.81} - \underset{(-3.81)}{0.04}\left(\frac{Debt}{GDP}\right)_{-1} + \underset{(7.89)}{5.19}(shift1915) - \underset{(-4.33)}{0.29}(realGDPgrowth), \quad (9)$$

we do find evidence of sustainable management of the Italian fiscal policy (*à la* Bohn) during the observed sample, since there is a significant and negative coefficient linking the debt-to-GDP and the net-of-interest deficit, amounting to -0.04 per year (lower than that recorded through the IR function).

In the previous sections of the paper, we learned from the historical and statistical analyses that the period 1861-2009 contains very different patterns for both debt and deficit series. In particular, the debt series seems to be a stationary one until the second post-war period, with two long waves occurring around an average value of about 80% of GDP. This led us to check whether the weak contemporaneous response of the deficit to the debt innovations can be a signal of some data characteristics that are obscured once we take the whole sample. These features may be better appreciated by splitting the observations in two periods: 1861-1946 and 1947 until 2009.

The plots of the autocorrelation function (ACF) reported in Figures 15 and 16, confirm that the series display very different statistical properties during the two sub-samples. In particular, the debt and deficit data show a long memory in the postwar period.

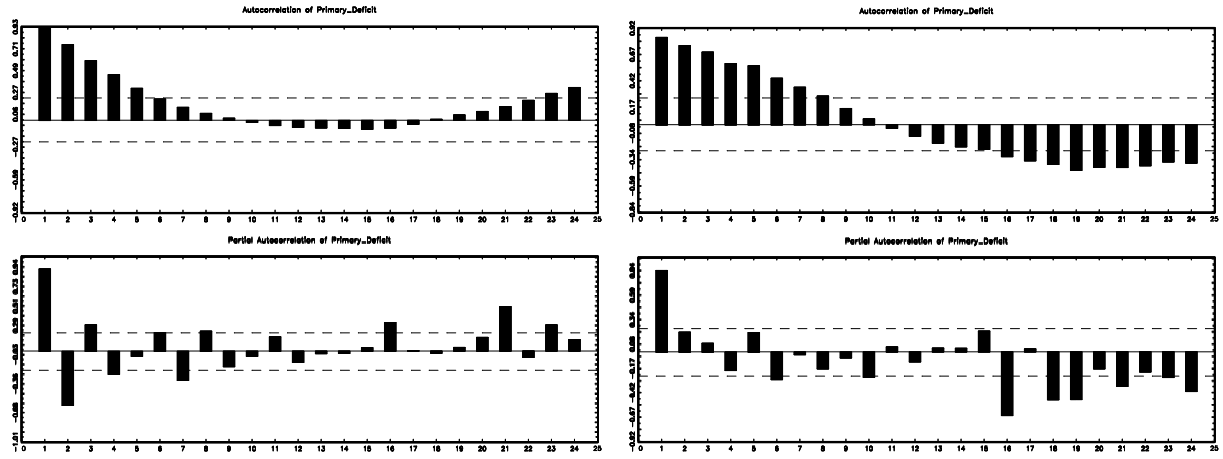
Figure 15: autocorrelation function for the debt-to-GDP series, periods 1861-1946 (left) and 1947-2011 (right)



The very low persistence of the debt series in the left-hand panel of Figure 15 suggests that during 1861-1946 the government had recourse to debt to finance exceptional events (e.g. wars) with a strategy consistent with tax smoothing. As depicted in Figure A.7 in the Appendix, spending, in particular military spending, causes taxes: the path of government expenditure is exogenously given and taxes are adjusted ("smoothed") to minimize distortions, while the budget is balanced intertemporally.

Conversely, the very high persistence displayed in the period 1947-2009 implies that every sudden change in the debt ratio had permanent effects on the debt dynamics. As for the deficit, two issues deserve to be mentioned. First, the autocorrelation function is always significantly different from zero in the second sub-sample (right-hand panel of Figure 16) whereas it quickly decays in the first period, thus suggesting that the deficit is stationary in this latter period. Second, in the most recent decades (the right-hand panel in Figure 16), it is interesting to see that the ACF changes its sign, from positive values until 10 years to negative ones. This dynamic clearly signals what we emphasized in the historical section, that deficit spending periods (until the 1980s) have been replaced by a process of budget restrictions (after the EMU) to cope with a growing public debt.

Figure 16: autocorrelation function for the primary deficit-to-GDP series, periods 1861-1946 (left) and 1947-2009 (right)



The results of the unit root tests reported in Appendix not surprisingly support the idea that the important differences in the two historical periods, 1861-1946 and 1947-2009, have non-negligible effects also on the statistical properties of our public finance time series. For the period 1861-1946, the null hypothesis of a random walk with drift can be rejected at 10% significance for the debt ratio, whereas the KPSS cannot reject the null of level stationarity. As to the deficit, both with and net-of interest spending, the unit root tests rejects the null of the stochastic trend against the alternative of a stationary process with a level shift in 1915. Conversely, during the period 1947-

2009 the statistical properties of the examined series change dramatically, and the tests implemented unanimously suggest all three series are driven by a stochastic trend.

This evidence is particularly problematic with regard to the with-interest-deficit, since according to Trehan and Walsh (1991) the test based on the stationarity of the deficit inclusive-of-interest is a necessary condition to ensure intertemporal budget balance. Therefore, we should conclude that fiscal policy has been conducted in a way which is consistent with long-term sustainability, as stated by the PVBC, only until WWII, whereas from the second part of the 20th century up to now fiscal solvency has not been guaranteed.

With regard to the existence of an appropriate policy rule *à la* Bohn, the stochastic trend found for the with-interest-deficit in the second part of the sample excludes any possible cointegrating relationship between debt and primary deficit. Unlike Ballabriga and Martinez-Mongay (2007), who test flow reaction to government debt accumulation for the period starting in 1977, we are unable to test for the model-based sustainability for the period 1947-2011 since spurious correlation could affect the estimates. By contrast, during the period 1861-1946, it is possible to investigate the intensity of the policy reaction function, as will be illustrated in the next subsection.

8.1.1 The linkage between deficit and debt during the period 1861-1946

During the first sub-period, both the debt and the primary deficit series display statistical properties consistent with stationary evolution, as suggested by the correlogram and largely confirmed by the tests illustrated in the Appendix. Therefore, following the strategy already employed for the full sample (Equation 9), we proceeded to model a single-equation OLS regression between the deficit and the debt for the period 1861-1946, and we get the following coefficients (t-statistics in brackets):

$$\frac{Deficit}{GDP} = \underset{(2.36)}{4.9} - \underset{(-3.79)}{0.08}\left(\frac{Debt}{GDP}\right)_{-1} + \underset{(8.92)}{8.92}(shift1915) - \underset{(-4.52)}{0.35}(realGDPgrowth). \qquad (10)$$

The comparison between the two estimates reveals that the policy reaction function has played a relatively more important role in the first sub-sample, with an estimated coefficient which is, in Eq. 10, twice that estimated for the full sample (Eq. 9). Another force that has helped governments to balance the public budget, as well as to control the debt-to-GDP ratio, is economic performance, as summarized by the growth rate of the real GDP. Comparison between Eqs. 10 and 9 indicates that the effect of economic growth on fiscal imbalances was more powerful in the first sub-sample.

As a further test, in order to better appreciate the intensity of the policy reaction function, we repeated the regression by including, following Bohn (1998), explanatory variables accounting for temporary government spending, and a business cycle: respectively, the military component of public spending and the Hodrick-Prescott cycle of real GDP.[76] Since, in this case, we directly control for the exceptional increase in military spending during the two world wars, we can exclude the exogenous upward shift in the regression, although a linear trend is necessary. The estimated equation reads as follows:

$$\frac{Deficit}{GDP} = \underset{(-26.71)}{-0.08}\left(\frac{Debt}{GDP}\right)_{-1} + \underset{(6.5)}{0.04}(Trend) + \underset{(43.39)}{0.98}(MilitarySpending) - \underset{-5.01}{0.11}(GDPcycle) \quad (11)$$

suggesting a quite robust, though moderate, value for the systematic response of the government deficit to changes in the debt-to-GDP ratio, meaning that a 1% increase in government debt reduces the primary deficit in the subsequent year by 8 base points (0.08 %). As expected, a very strong effect on the primary deficit is generated by military outlays (+0.98).

The larger coefficient estimated for the period 1861-1946 compared to that obtained for the full sample, suggests that the quite intense, though delayed adjustment of the primary deficit to the debt increase found in the VEC model (-0.1 after seven years for the full sample) may be due to a structural change over the observed period of time.

Overall, the comparison among the estimates for the fiscal policy reaction function confirms that during the period 1861-1946, and differently from the second part of our sample, fiscal policy was systematically managed to respond to changes in the debt-to-GDP ratio.[77]

9. Concluding remarks

In this paper we analysed the dynamic and the effects of the Italian public debt on fiscal policy since Italian Unification in 1861. We tackled this task with three different approaches, namely using a historical, statistical and econometrics analysis. However, a preliminary task was to compare different sources on the available data (GDP, taxation, public spending and public debt) and to reconstruct them.

[76] In a recent paper Ghosh et al. (2011) emphasize that a primary balance which always reacts positively to lagged debt (a weak sustainability criterion) does not exclude an ever increasing debt-to-GDP ratio. They propose a stricter sustainability criterion based on the definition of *debt limit* (beyond which fiscal solvency is in doubt) and the corresponding *fiscal space* (the distance between the current debt level and debt limit).

[77] Ghosh et al. (2011) find a non linear relationship between primary balance and debt: as debt increases, the primary balance also increases, but the responsiveness first weakens, and then decreases. This is a characteristic of the *fiscal fatigue*.

The first part of the work was essentially an historical analysis, aimed at identifying the political elements and economic shocks (both domestic and international) which impacted upon the debt (and its dynamics) and its determinants. The second type of analysis was statistical, namely univariate analysis of each time series of debt and its components. This study was particularly important to define the various breaks and trend reversal in the various series of public expenditure, revenue and debt (in nominal terms and relative to GDP). As the historical analysis produces a valuable aid to interpreting the dynamics of the statistical series, together they contributed to the third part, which aimed to analyze the sustainability of Italian public debt. To this end we followed Trehan and Walsh (1988), Bohn (1998) and several other authors and performed an integration and cointegration analysis of the Italian series.

Various aspects of the comparative dynamics of debt and its economic determinants emerged, in particular the role of primary surpluses, inflation and growth for the reduction of fiscal imbalances in different historical periods. The time-series econometric analysis emphasized that the dynamics of debt can be considered essentially sustainable, the with-interest deficit appears to be stationary whereas the debt shows a stochastic trend. Thus, the dynamic of the debt in the last 150 years seems to be unbounded although, during the period examined, the patterns of government expenditures and total revenues seem to be consistent with fiscal policy sustainability as defined by compliance with the Present Value Budget Constraint.

Using a model approach *à la* Bohn, this result is more problematic: the response of primary deficit to debt innovation is significant only in the medium term. This weak evidence of a policy reaction function associated with the PVBC holdings seems at first counterintuitive and two remarks might help to reconcile the empirical evidence. First, we stressed that the PVBC looks at sustainability in a long-term perspective, with a debt-to-GDP ratio which can potentially be unbounded, whereas the policy reaction function is mostly related to short-term adjustment. Second, our evidence is based on linear regressions which are averaged over very different historical periods, but we also showed that fiscal policy was managed in a way which is consistent with long-term sustainability, as stated by the PVBC, only until WWII, whereas from the second part of the 20th century up to now fiscal sustainability has not been guaranteed.

APPENDIX

A1 SOURCE OF DATA

The measure of public debt is the one officially recorded by Bank of Italy, Table TCCE0225, as reconstructed by Francese and Pace (2008). The monthly time series for the debt of the Italian general government sector is also partitioned into the three-level subsector structure defined by ESA95: Central Government, Local Government, Social Security funds. Since we use an annual data set, we refer to the level of debt recorded at 31/12 of each year.

As for the public deficit, we have no measure consistent with the definition of General Government (GG), since to our knowledge the only long time series of public expenditures and revenues is the one recently reconstructed by the State General Accounting Department (RGS), covering the period 1862-2009, which refers to the State Budget, a subsector of the GG which includes many, though not all, of the statistical units belonging to the Central Government sector (ESA95). Therefore, we are able to compare a measure of the deficit, as approximated by data recorded in the State Budget, with the time course of Central Government debt starting from 1861. Though the Ministry of Economics and Finance (through the State General Accounting Department) has recently provided the reconstruction of the time series of public spending (RGS, 2011) we are not aware of any similar official reconstruction for revenues, with the exception of the period 1862-1967 (Ministero del Tesoro, 1967). Therefore, we have collected, starting from 1968, the data for final revenue items as officially recorded in the *Rendiconto Generale dello Stato (General Statement of State Accounts)*, so that we have a complete data set containing the level of debt, public spending and total revenues, all at current prices.[78] In addition, since RGS (2011) also provides a measure of public spending at 2009 prices, we are able to calculate the deflator of public spending, which can be used to convert to 2009 prices all the public finance variables.[79]

All the budget data are annual and collected on a fiscal year basis. Fiscal years are calendar years for most of the sample, with the exception of 1884-1965, when the fiscal year dated *t* covered the period from July of calendar year *t-1* to June of year *t*. Following RGS (2011) we converted to calendar years, summing half of the spending (revenues) recorded in two subsequent fiscal years, assuming in each fiscal year spending (revenues) are equally distributed.

[78] For the time series of revenues until 1967 see Ministero del Tesoro, Ragioneria Generale dello Stato, Il bilancio dello Stato Italiano dal 1862 al 1967, Volume II, Table 5, pp.140-170, in particular the row "Operazioni Finali".

[79] It should be stressed that our measure of the public deficit is consistent with the net borrowing monitored by National Accounts for the European Union excessive deficit procedure, since we exclude from the deficit the financial aggregates pertaining to debt reimbursement.

Finally, as for GDP, there are several reconstructions in the literature covering different periods. The standard reconstruction of Italian National Accounting was published in 1957 by the Italian National Institute of Statistics (ISTAT) which covered a long period, from 1861 to 1956. The ISTAT time series formed, for many years, the basis of studies and debate on the Italian economy. Moreover, since their publication, ISTAT series have undergone several revisions (Fuà 1969, 1974) because they were inconsistent on several accounts, and information on methods and sources used to collate data were not clear.

At the end of the 1980s, the Bank of Italy promoted a completely new reconstruction of Italian National Accounting, whose results were published in four volumes edited by Guido Rey (1992, 2000). The revision concerns four benchmark years (1891, 1911, 1938, 1951) and involved scholars such as Stefano Fenoaltea for industry, Giovanni Federico for agriculture, and Vera Zamagni and Patrizia Battilani for services. These series were then subject to further revisions (Fenoaltea, 2003, 2006; Federico, 2003; Malanima, 2006a, b; Daniele-Malanima 2007, 2011). Of extreme importance was the reconstruction of nominal GDP for the period 1891-1990 by Rossi, Sorgato and Toniolo (1993), which has long been the basis for analysing the national debt-to-GDP ratio. In 2011 a new series of GDP at current and constant prices was estimated by a research group coordinated by Alberto Baffigi (2011).

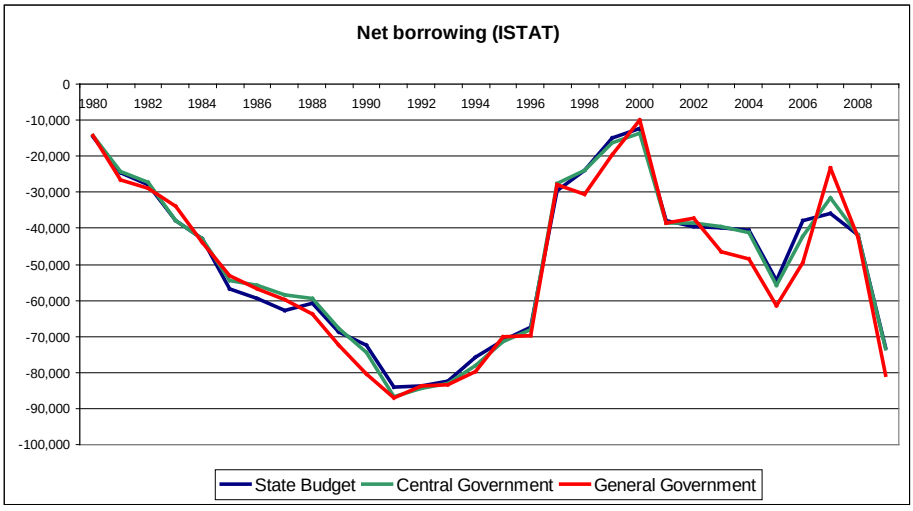
For our analysis we decided to use this last series because it covers the entire period we examined (1861-2010). Thus in our paper we analysed debt sustainability in Italy using a unique source of data for the GDP. Moreover, in figure 2, we show differences in the ratio of debt to GDP by using the series of Rossi, Sorgato and Toniolo, as well as those of Baffigi (2011). We did not use the series of GDP produced by ISTAT since they have several limitations for the period 1861-1951, as shown by new reconstructions.

A2 Available sources of the public deficit: a comparison for the period 1980-2009

It is possible to compare our series for the public deficit, as constructed by using the data available for the State Budget revenues and expenditure provided by the State General Accounting Department, with the time series provided by the National Institute of Statistics for Net lending/Net borrowing, a key parameter to comply with the Stability and Growth Pact.

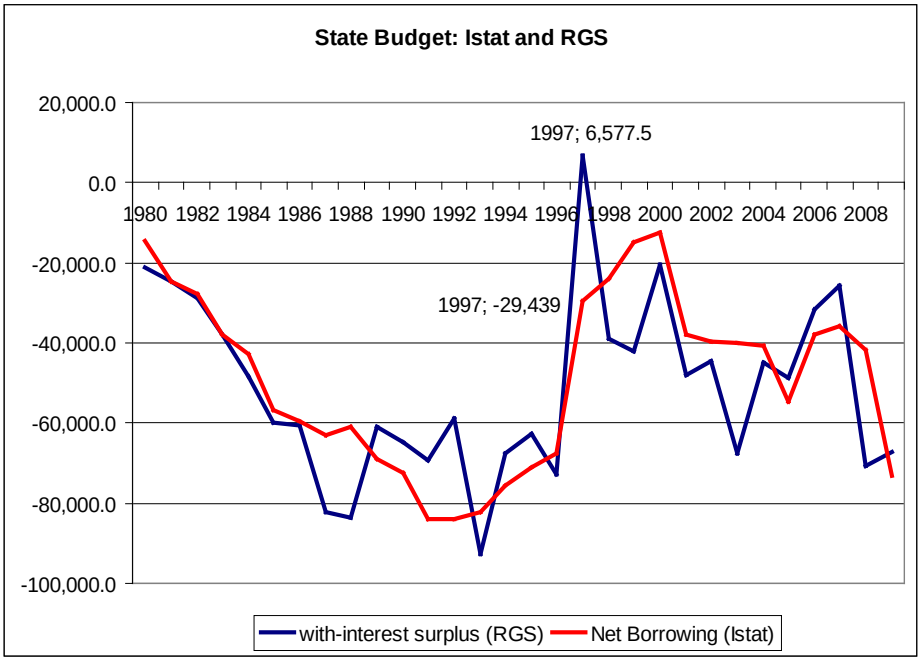
The pattern for Italian Net borrowing as recorded by ISTAT is shown in Figure A1, which clarifies that there are no major differences in the dynamics of this aggregate when comparing different statistical units: the State Budget, the Central Government and the General Government. Net borrowing by the General Government is the reference variable to be controlled under the Stability and Growth Pact.

Figure A 1: Net Borrowing by Central Government, General Government and State Budget



In Figure A2 we compare our measure of the with-interest-surplus, i.e. the difference between total final revenues and total final expenditures as recorded by State General Accounting Department for the State Budget, and net borrowing, as recorded by ISTAT for the State Budget. The figure shows that while the long-term dynamics is very similar for the two series, short-term volatility is far more accentuated for the series recorded by the State General Accounting Department. Moreover, in 1997 the discrepancy between the two series is very large, with a positive surplus recorded by the State General Accounting Department amounting to 6.6 billion compared to net borrowing recorded by ISTAT of -29 billion.

Figure A 2: comparison between the State Budget surplus (RGS) and State Budget Net Borrowing (ISTAT)



A2 DESCRIPTIVE ANALYSIS

As shown in Table A1, the time series of fiscal policy variables, observed over a such long time span, suffer from non-stationarity in variance. In the table, the standard deviations are calculated for selected sub-samples. In each cell, in parenthesis, the ratio is recorded of the S.D. of the cell to the S.D. recorded during the first period (1862-1913). Clearly, the volatility has grown considerably over the observed historical period. Such a large non-stationarity in variance has serious consequences in testing for the presence of unit root, casting doubts on the reliability of the test results. Scaling fiscal variables by GDP (see Table A2) largely compensates for this instability. Hence we prefer to base our econometric analysis on fiscal variables expressed as a share of GDP.

Table A 1 Standard Deviations of fiscal variables, real values

	1862-1913	1914-1947	1948-68	1968-87	1988-2009
Final revenues	1835	5804 (3)	19385 (11)	73295 (40)	42737 (23)
Final spending	1836	13264 (7)	21143 (12)	114760 (63)	26332 (14)
Debt	12584	39173 (3)	27170 (2)	224037 (18)	186182 (15)
Interest spending	452	1691 (4)	753 (2)	26948 (60)	23724 (53)
Total deficit	465	11355 (24)	4052 (9)	42607 (92)	39954 (86)
Primary deficit	797	11309 (14)	4045 (5)	18962 (24)	44656 (56)

Table A 2 Standard deviations of fiscal variables, GDP share

	1862-1913	1914-1947	1948-68	1969-87	1988-2009
Final revenues	1.89	3.52	1.29	4.81	1.13
Final spending	1.49	8.17	1.28	7.98	3.35
Debt	17.2	29.97	2.36	16.4	9.21
Military spending	65.5	8.44	31.3	29.04	13.01
Total deficit	1.03	8.72	1.35	3.4	3.51
Primary deficit	1.71	9.17	1.39	1.5	3.09

A3 UNIVARIATE ANALYSIS, CONSTANT PRICE LEVEL

Figure A 3 Spending and revenues

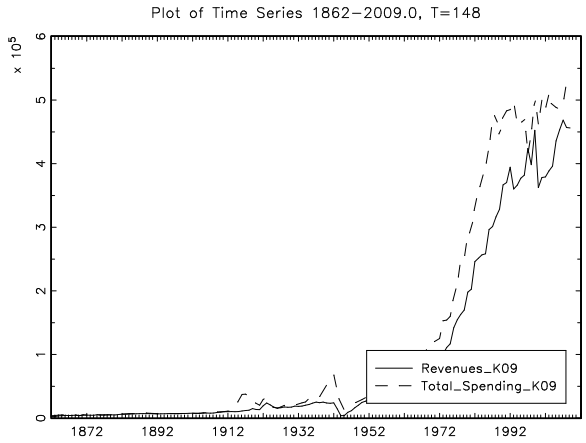


Figure A 4: Debt

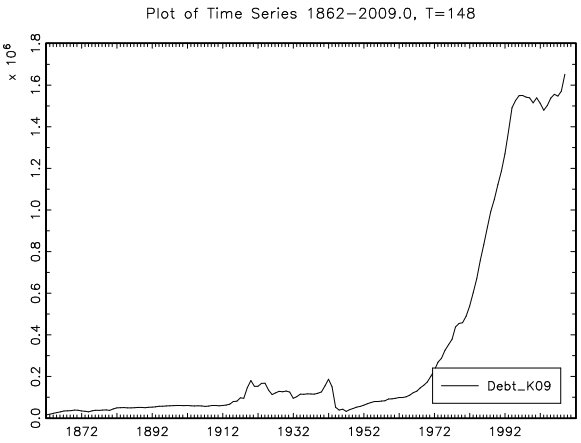


Figure A 5: with-interest deficit

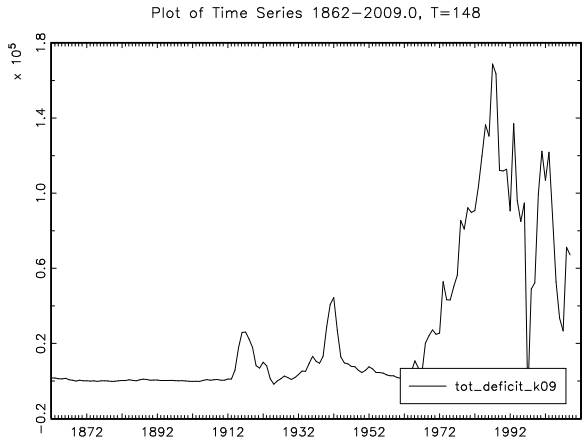
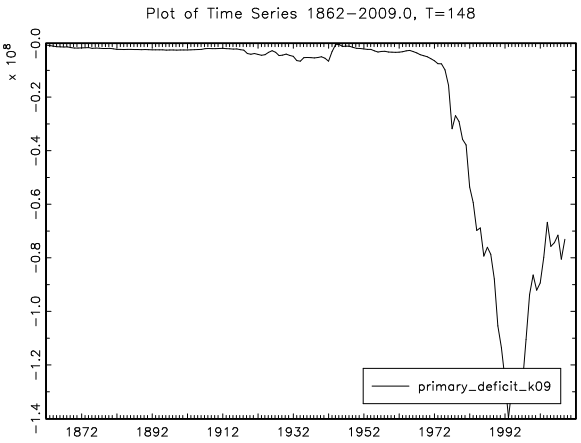


Figure A 6: net-of-interest deficit



A4 UNIVARIATE ANALYSIS, GDP SHARES

Figure A 7: total revenues, primary and total spending

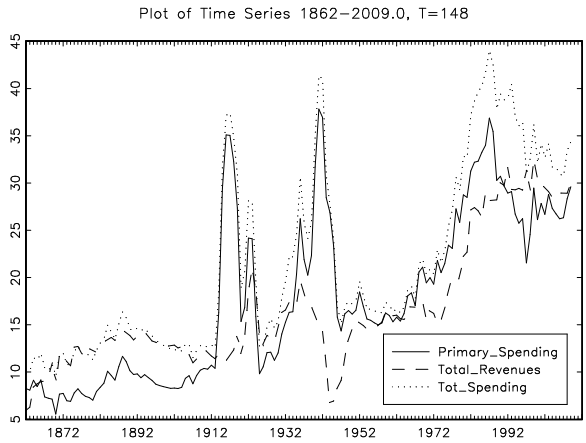


Figure A 8: public debt

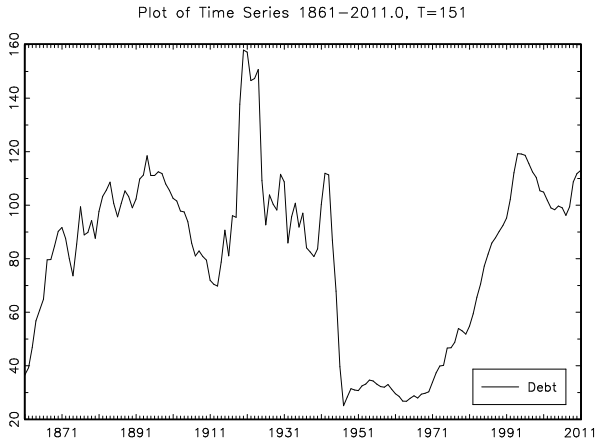


Figure A 9:primary spending: with and without military

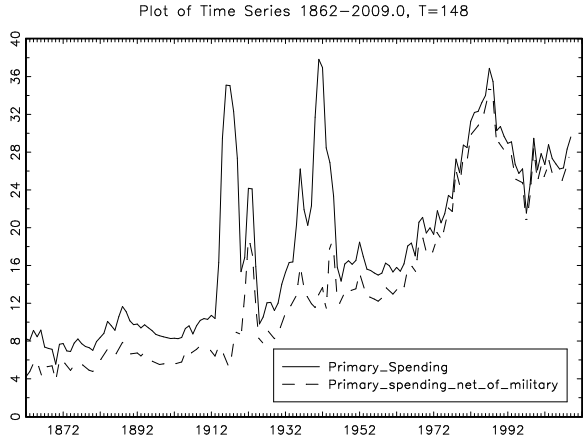


Figure A 10: total spending: with and without military

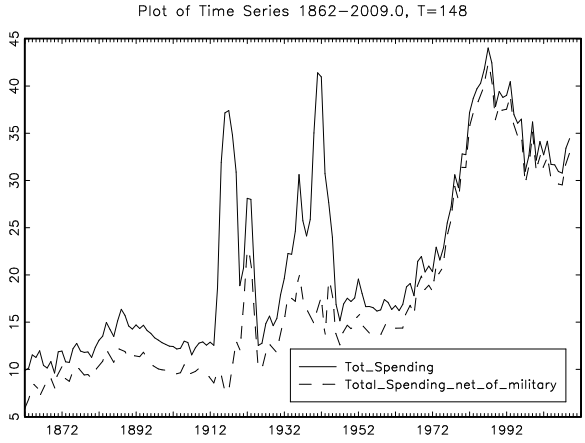


Figure A 11: primary deficit: with and without military

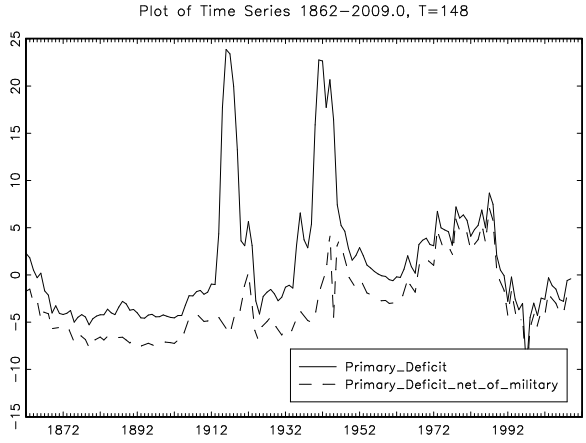


Figure A 12: total deficit: with and without military

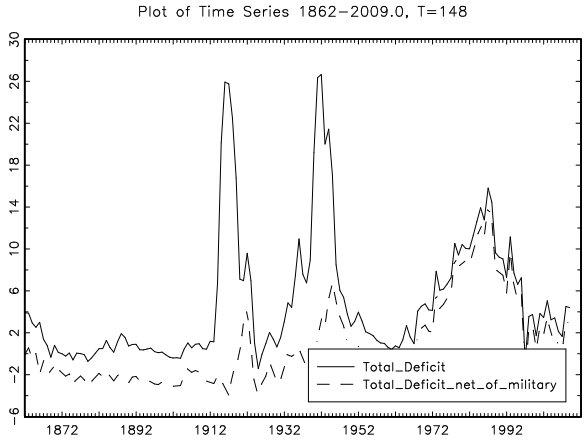


Table A 3 Summary of descriptive statistics, endogenous variables as a proportion of GDP

Variable	mean	min	max	std. dev.
Public debt	8.15558e+01	2.50962e+01	1.58014e+02	3.16683e+01
Primary Deficit	1.09669e+00	-1.00560e+01	2.38748e+01	6.37947e+00
Total Deficit	4.88984e+00	-1.42164e+00	2.66666e+01	6.15742e+00
Total Revenues	1.67612e+01	5.95272e+00	3.24553e+01	6.65946e+00
Total expenditure	2.16510e+01	9.61137e+00	4.40243e+01	9.77130e+00
Primary expenditure	1.78579e+01	5.55365e+00	3.78320e+01	8.80360e+00
Military expenditure	4.09047e+00	1.08513e+00	2.96876e+01	5.26605e+00
Prim. Deficit net of mil. Exp.	-3.14990e+00	-1.13492e+01	7.05414e+00	3.68980e+00
Tot. Deficit net of mil. Exp.	7.15046e-01	-3.92645e+00	1.41961e+01	4.00142e+00
Total exp. net of mil. Exp.	1.75605e+01	5.88358e+00	4.24092e+01	9.61527e+00
Primary exp. net of mil. Exp.	1.37674e+01	3.81213e+00	3.52673e+01	8.38861e+00

Table A 4: KPSS and ADF Unit root test, endogenous variables as a proportion of GDP, full sample

VARIABLE	TEST	LAGS	DETERMINISTIC	T STATISTICS
Public debt	*ADF*	1 (all)	C, trend	-2.39
		1 (all)	constant	-2.33
	KPSS	4 (13)	trend	0.29*** (0.13*)
Total expenditure	*ADF*	2 (AIC, FPE, HQ)	C, trend	-3.22*
		2 (all)	c	-1.94
	KPSS	4 (13)	trend	0.11 (0.06)
Military expenditure	*ADF*	2 (all)		-2.94***
	KPSS	4 (13)	c	0.32 (0.22)
Total expenditure net of military exp.	*ADF*	0 (all)	C, trend	-2.25
	KPSS	4 (13)	trend	0.39*** (0.17**)
Total revenues	*ADF*	0 (all)		-0.99
	KPSS	4 (13)	c	2.13*** (0.86***)
Primary deficit	*ADF*	1(all)		-3.67***
	KPSS	4 (13)	c	0.42* (0.25)
Primary deficit net of military exp.	*ADF*	0 (Schwarz, HQ)		-1.92*
		7 (AIC, FPE)		-1.77*
	KPSS	4 (13)	C	1.38 (0.6**)
Total deficit	*ADF*	1(all)	c	-3.79***
	KPSS	4 (13)	c	0.48* (0.3)
Total deficit net of military exp.	*ADF*	0 (Schwarz)	C	-2.25
		4 (HQ)	C	-1.56
	KPSS	4 (13)	C	1.65 (0.69**)

ADF thresholds (NO C, no trend):	-2.56	-1.94	-1.62	(1%, 5%, 10%)
ADF thresholds (C):	-3.43	-2.86	-2.57	(1%, 5%, 10%)
ADF thresholds (C and trend):	-3.96	-3.41	-3.13	(1%, 5%, 10%)
KPSS threshold (C):	0.739	0.463	0.347	(1%, 5%, 10%)
KPSS threshold (C and trend):	0.216	0.146	0.119	(1%, 5%, 10%)

Table A 5: Unit root test with structural break (Lanne et al. 2002), endogenous variables as a proportion of GDP, full sample

VARIABLE	LAGS	DETERMINISTIC	T STATISTICS
Public debt	1 (all)	constant level shift:1944	-2.45
	1 (all)	C, trend level shift:1944	-1.78
	1 (all)	C, trend level shift:1925	-1.75
Total expenditure	2 (all)	C, trend, level shift:1920	-2.94*
		C, level shift:1920	-1.46
Military expenditure		C, level shift:1915	-3.23**

VARIABLE	LAGS	DETERMINISTIC	T STATISTICS
Total expenditure net of military exp.	0 (all)	C, trend, level shift 1924	-2.23
Total revenues	0 (all)	C, trend level shift:1925	-2.20
Primary deficit	1(all)	C, level shift:1915	-3.40**
Primary deficit net of military exp.	0 (all)	C, trend, level shift 1989	-2.65
Total deficit	1(all)	C, level shift:1915	-3.41**
Total deficit net of military exp.	0 (all)	C, exp shift 1969	-3.38**

Lanne et al (2002) threshold (c): -3.48 -2.88 -2.58 (1%, 5%, 10%)
Lanne et al (2002) threshold (c and trend): -3.55 -3.03 -2.76 (1%, 5%, 10%)

Table A 6: Unit root tests for separate sub-samples: 1861-1946 and 1947-2009 (lags in parenthesis)

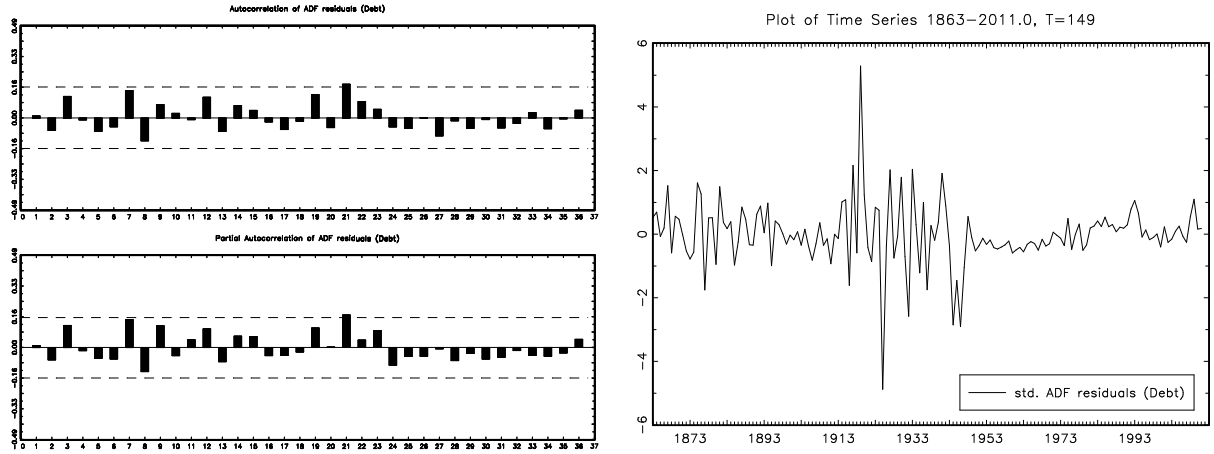
VARIABLE	ADF (ONLY CONSTANT)	ADF (CONSTANT AND TREND)	KPSS: LEVEL STATIONARITY	KPSS: TREND STATIONARITY	LANNE ET AL. (2002)
1861-1946					
Debt-to-GDP	-2.96* (1)	-2.51(1)	0.33 (4) 0.23 (11)	0.16** (4) 0.11*** (11)	-
Primary Deficit-to-GDP	-2.83* (3)	-3.67** (3)	0.71** (4) 0.47** (11)	0.10 (4) 0.08 (11)	-3.43** (3 lags, shift 1915)
Total Deficit-to-GDP	-2.56 (2) -2.74* (6)	-4.37*** (1) -3.79** (6)	0.71** (4) 0.48** (11)	0.09 (4) 0.08 (11)	-4.04*** (1 lag, shift 1915)
1947-2009					
Debt-to-GDP	-0.37 (1)	-2.13(1)	1.27*** (4) 0.58** (11)	0.18** (4) 0.10 (11)	-2.12 (1 lag, shift 1975)
Primary Deficit-to-GDP	-1.81 (1) -1.74 (5)	-2.39 (0) -1.88 (5)	0.38* (4) 0.21 (11)	0.20** (4) 0.11(11)	-2.02 (1 lag, shift 1989)
Total Deficit-to-GDP	-1.40 (1)	-1.42 (1) -1.99 (0)	0.37* (4) 0.19 (11)	0.22***(4) 0.1185 (11)	-0.8 (5 lags, rational shift 1989)*

* The deficit series has been adjusted to remove the anomalous peak in 1997
ADF thresholds (NO C, no trend): -2.56 -1.94 -1.62 (1%, 5%, 10%)
ADF thresholds (C): -3.43 -2.86 -2.57 (1%, 5%, 10%)
ADF thresholds (C and trend): -3.96 -3.41 -3.13 (1%, 5%, 10%)
KPSS threshold (C): 0.739 0.463 0.347 (1%, 5%, 10%)
KPSS threshold (C and trend): 0.216 0.146 0.119 (1%, 5%, 10%)
Lanne et al (2002) threshold (c): -3.48 -2.88 -2.58 (1%, 5%, 10%)
Lanne et al (2002) threshold (c and trend): -3.55 -3.03 -2.76 (1%, 5%, 10%)

Public debt

One of the critical issues in using the ADF tests to investigate the presence of unit root is whether an intercept and /or time trend has to be included in the regression equation. The power of the DF test is negatively affected by misspecification concerning the deterministic part of the regression. When the form of the data generating process is unknown, Enders (1995) suggests, as an appropriate strategy, starting from the less restricted specification, i.e. with a trend and a drift, and, in case of non-rejection of the unit root hypothesis, to proceed to determine whether too many deterministic terms are included. This may be done, by using the appropriate test statistics tabulated by Dickey and Fuller (1981), to test joint hypotheses on the coefficients. Since for the public debt it is not clear whether the Data Generating Process includes a linear trend, we follow the above estimation strategy. If we consider the debt variable as driven by a linear trend, the ADF statistics for the hypothesis of the unit root is -2.4, suggesting a unit root. However, as the *t*-statistic for the trend is very low (-0.58), we repeat the ADF test by omitting the trend component. Again, the unit root hypothesis cannot be rejected (-2.33); moreover, the *F* test statistic is very low (0.31), suggesting that the null hypothesis, i.e. that the data are generated by the restricted model, without the trend, cannot be rejected.
In order to check the adequacy of the lag order, we display the graphs of the standardized ADF residuals, and the correlogram of the residuals. Looking at Figure A13, there is some evidence of structural change in the late 1940s, with a reduced variance; focusing on the serial correlation, there is no evidence of it, as confirmed by inspection of the correlogram, which does not show significant autocorrelations until lag 36.

Figure A 13: ADF test for Debt/GDP, plot of the residuals and their autocorrelation



The presence of structural changes makes the basic ADF test biased towards the non-rejection of the unit root. To control for this problem, related to the power of the test, Saikkonen and Lütkepohl (2002) and Lanne et al. (2002) propose unit root tests for the following model:

$$y_t = \mu_0 + \mu_1 t + f_t'\gamma + x_t$$

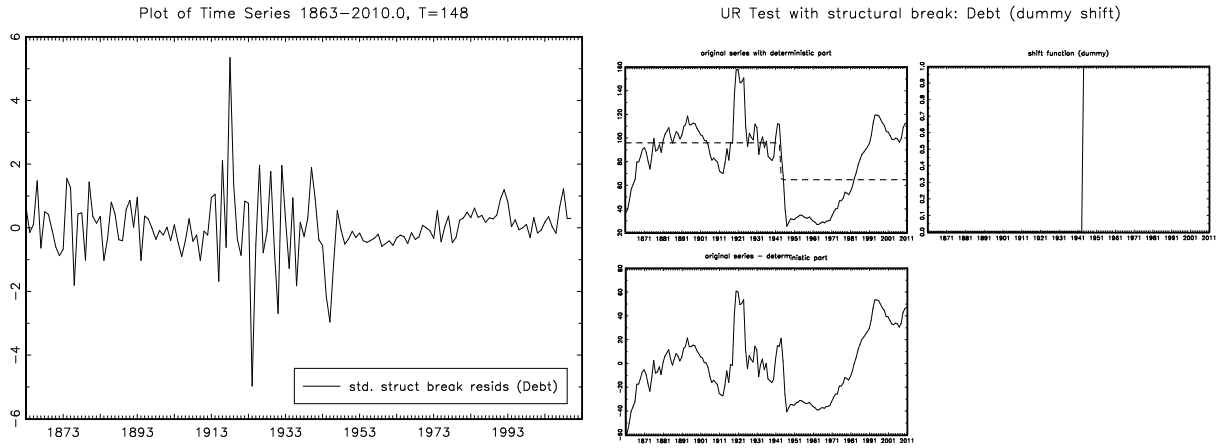
where the term f_t identifies a structural break, γ is an unknown parameter and the errors x_t are generated by an *AR(p)* process with possible unit root. In our case the break is simply a shift in the level starting at date $T_B=1944$:

$$f_t^{(1)} = d_{1t} := \begin{cases} 0, & t < T_B \\ 1, & t \geq T_B \end{cases}$$

The test is based on estimating the deterministic term first by a generalized least squares (GLS) procedure under the unit root null hypothesis and subtracting it from the original series. Then an ADF type test is performed on the adjusted series which also includes terms to correct for estimation errors in the parameters of the deterministic part. As in the case of the ADF statistic, the asymptotic null distribution is non-standard. Critical values are tabulated in Lanne et al. (2002), and the results are shown in Table A5. However, our sample size is smaller than that used by Lanne et al. (2002) to tabulate the *t* statistics (1000 versus 130).

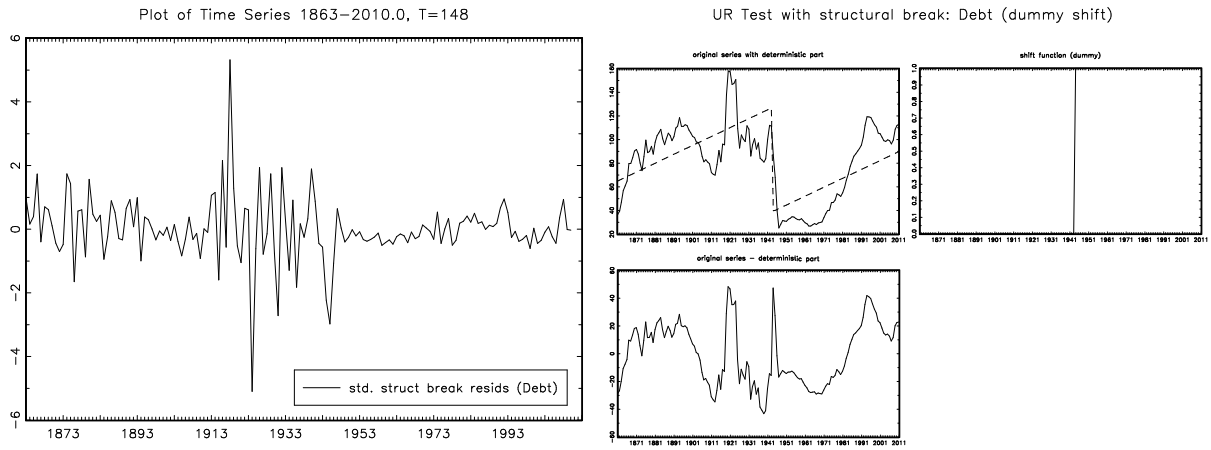
Also in this case the test statistics suggest not rejecting the null hypothesis. In Figure A14 we show the graph of the standardised residuals and the pattern of the debt net of the estimated structural break.

Figure A 14: Lanne et al (2002) test for Debt/GDP, plot of the residuals and structural break, no trend



However, the right-hand graph in Figure A14 shows that modelling the deterministic component as a drift plus a structural shift does not seem appropriate in catching the true DGP. Given that the choice to exclude the linear trend is based on ADF statistics, which have a low power in the presence of structural breaks, we decide to reintroduce the linear trend in the Lanne et al. (2002) test, and the test's residual diagnostics are plotted in Figure A15, suggesting a better fit to the data than the deterministic component modelled in Figure A14.

Figure A 15: Lanne et al (2002) test for Debt/GDP, plot of the residuals and structural break, with trend



As a further check, we repeated the ADF test by regressing the difference of the debt-to-GDP ratio on its lagged level and, as recommended by Bohn (1998), on the "non-debt component of the primary surplus". We use military expenditures as a measure of temporary government spending, and the cyclical component of the real GDP (HP filter) as a measure of the cyclical variation in output. By using a regression similar to an ADF specification with one lagged term and a constant we get the following estimates:

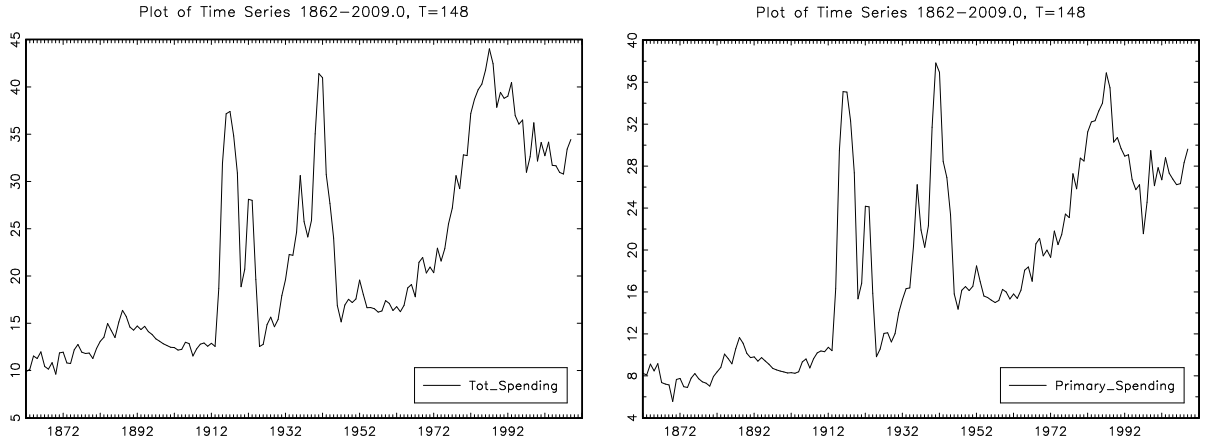
$$\Delta b_t = \underset{(1.66)}{3.19} - \underset{(-2.12)}{0.05}\left(b_{t-1}\right) + \underset{(1.76)}{0.21}\left(Mil.Exp\right) + \underset{(1.95)}{0.25}\left(Buss.Cycle\right) + \underset{(3.34)}{0.26}\left(\Delta b_{t-1}\right).$$

Using the Dickey-Fuller distribution, the t-statistic calculated from the coefficient on the lagged debt-to-GDP ratio, i.e. -2.12, is lower than the critical value tabulated for the ADF test, -2.57 at 10% significance and -3.43 at 1% significance, thus confirming that the debt ratio is I(1).

Public expenditures

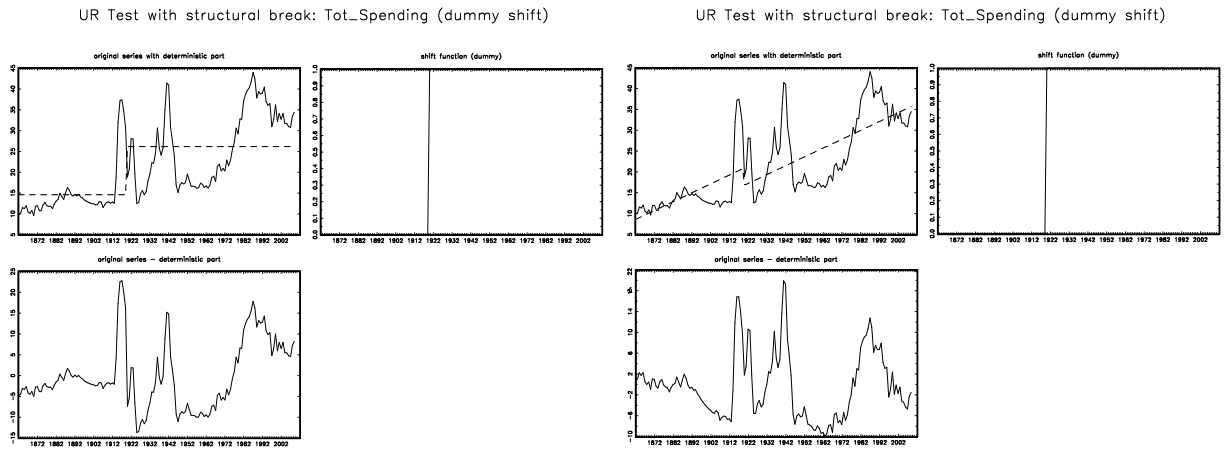
Figure A7 displays the two measures for the public outlays: total (with interest) final expenditures and net-of-interest final expenditures. As shown in Table A4, the result of the ADF crucially depends upon the deterministic components included in the regression: when testing the unit root hypothesis allowing for a linear trend the null is rejected with 10% confidence, whereas when modelling a unit root with only a drift the null cannot be rejected. Given the above-mentioned test's power problems with the ADF, it is necessary to check the appropriate deterministic components. By using the Φ_3 statistic to test the null of no trend, we find the *F* statistic equal to 3.63, whereas the Φ_2 statistic amounts to 3.2. Both values suggest that it is inappropriate to include a time trend in the regression.
Another problem with the outlays series is the presence of two important shocks, corresponding to the jump in military spending during the two World Wars, clearly discernible in Figure A17.

Figure A 16: total and primary spending (total final outlays)



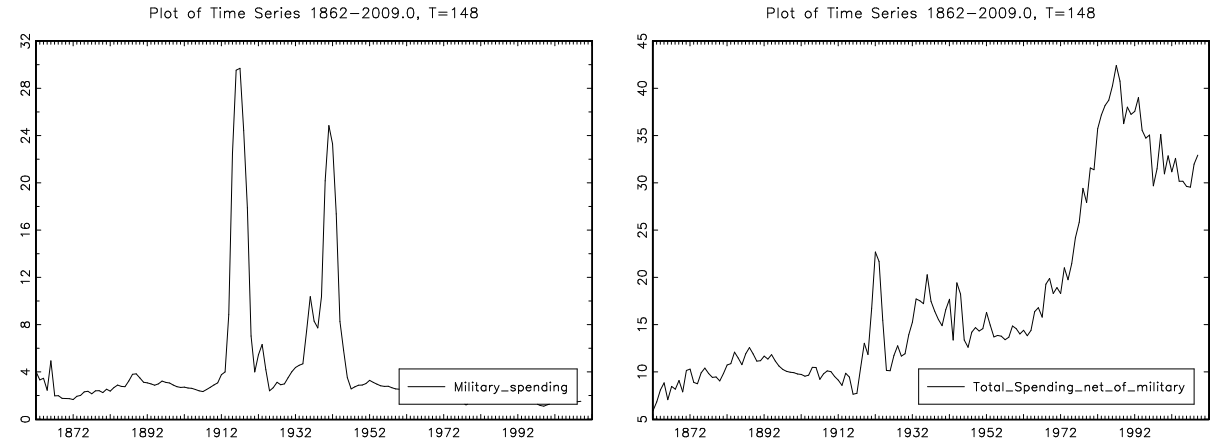
Therefore, we test the hypothesis of unit root for total spending, allowing for a structural break in 1920 (suggested by the automatic procedure) and, alternatively, for a deterministic trend or a simple drift. The graphs below compare the effect of the two alternative deterministic regressors for total spending. The null hypothesis of unit root can be rejected with 10% confidence for the with-interest expenditures when modelling the DGP with a linear trend, whereas when we use a regression equation omitting the trend, we cannot reject the null.

Figure A 17: Lanne et al. (2002) test for total spending, break date 1920; drift (left) and time trend (right)



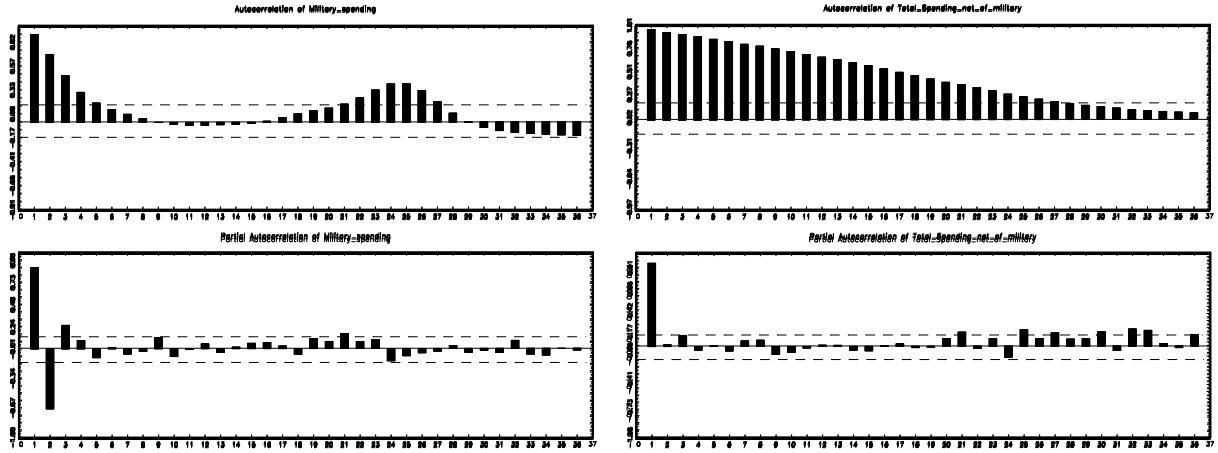
To appreciate the importance of the role played by military spending on total outlays during the war times, we compare, in Figure A19, military spending with total net-of-defence spending, both as a proportion of GDP.

Figure A 18: military spending (left) and total final spending net of military spending (right)



Most importantly, we compare in Figure A20 the correlograms of the two spending measures, which show clearly that they have very different statistical properties: while the military spending displays ACF consistent with a stationary process (ARMA), the remaining total spending exhibits a correlogram characteristic of non-stationary data, with an estimated ρ_1 close to unity and sample autocorrelations that die out slowly. The results of the ADF test confirm this interpretation, clearly rejecting the unit root hypothesis for the former outlay ratio ($\tau_\mu = -3.94, \tau = -2.94$, 1% significance level), whereas it is not possible to reject the null for the total spending net of military outlays ($\tau_\tau = -2.15, \tau_\mu = -0.97, \tau = 0.54$).

Figure A 19: military spending (left) and total final spending net of military spending (right), correlogram



The graphs of the ADF residuals in the two cases are shown in Figures A21 and A22.

Figure A 20: ADF residuals and auto-correlations, total spending net of military outlays (with linear trend)

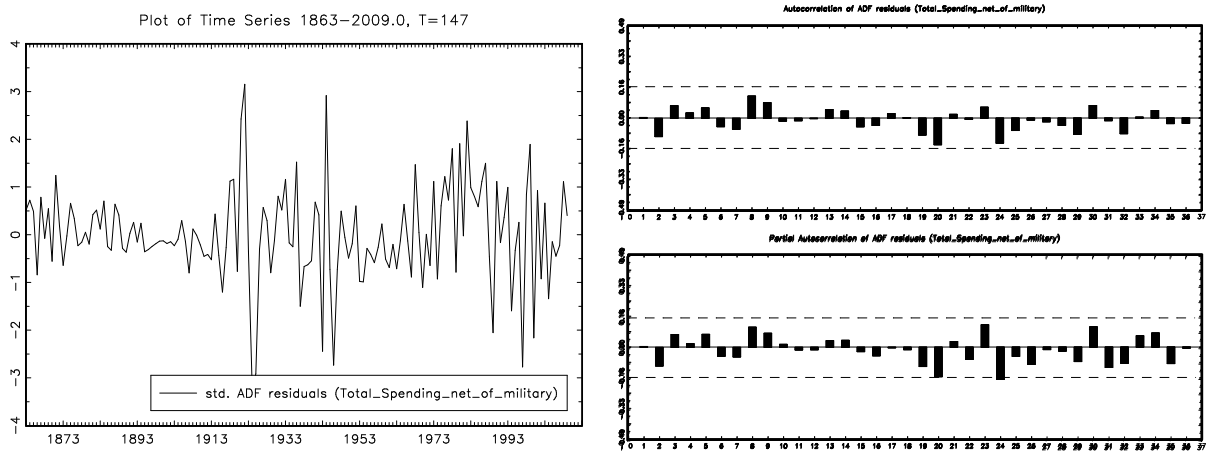
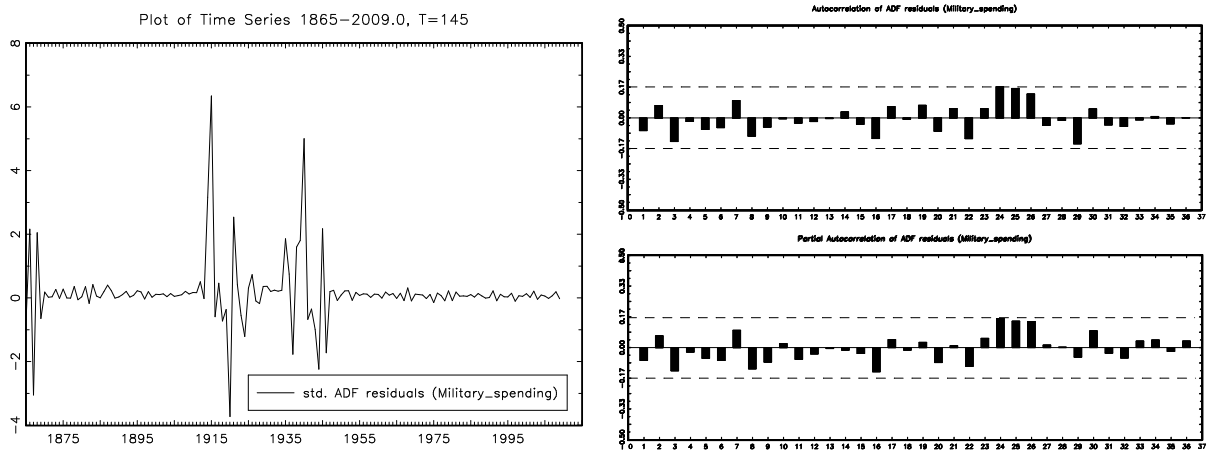


Figure A 21: ADF residuals and auto-correlations, military outlays (no linear trend, no drift)



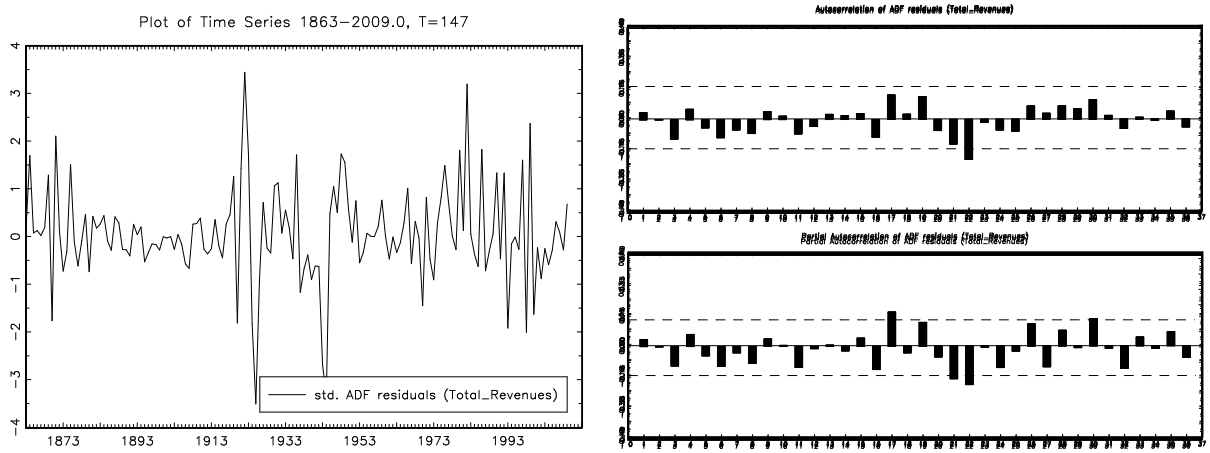
According to the ADF results, total outlays are the sum of stationary plus an I(1) process. Therefore we can trust that they too are driven by a stochastic trend. As a final check, we repeated the unit root test with structural break for total outlays net of military spending: the residuals plotted in graph A21 seem to highlight larger variance after WWI. Also controlling for a structural break in 1924 (endogenously determined), spending net of military outlays are still I(1), with a calculated t statistic equal to -2.23.

Total final revenues

The pattern of total final revenues showed an upward trend for the series, though with several possible break dates. In order to correctly model the deterministic component in the ADF testing procedure, we follow the strategy recommended by Enders (1995), starting from the less restricted model. With regard to the total final revenues, the F statistics calculated to appropriately find the deterministic component, do not reject the null hypothesis of the most restricted model, i.e. neither trend nor constant ($\Phi_2 = 1.78; \Phi_1 = 1.05$).

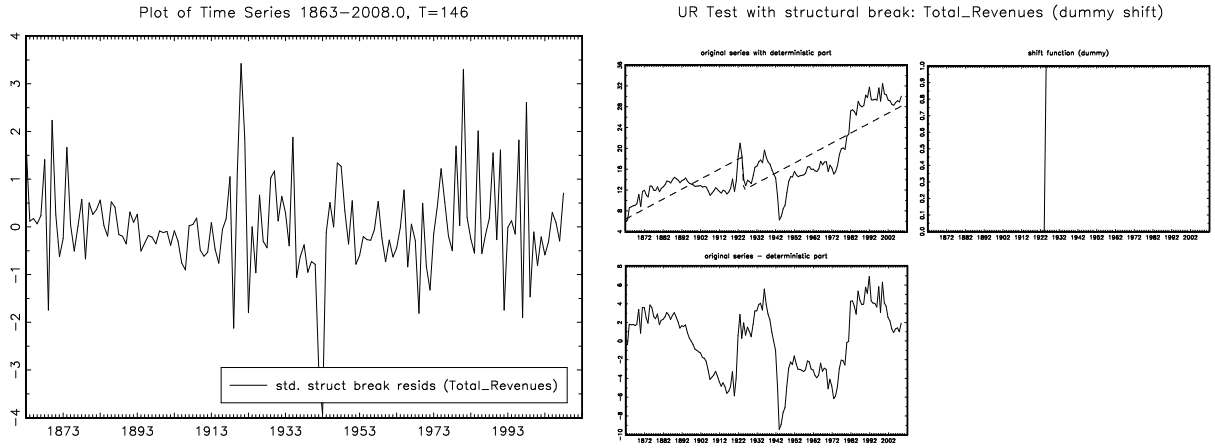
The ADF test cannot reject the null of unit root, and the residual diagnostics, as summarized in Figure A23, do not exhibit either autocorrelation or structural breaks, though there are some spikes in the residuals' plot and some evidence of heteroskedasticity, with larger variance starting from the period post WWI.

Figure A 22: ADF residuals and auto-correlations, total final revenues



Provided that structural breaks can bias the ADF tests toward the non rejection of the unit root hypothesis, we proceed to test for the presence of a stochastic trend following Lanne et al. (2002), controlling for a deterministic trend. The regime shift in 1925 (identified by the automatic procedure) matches quite well the upward jump in the Data Generating Process, and the Lanne et al. (2002) test confirms the revenues series is driven by a stochastic trend.

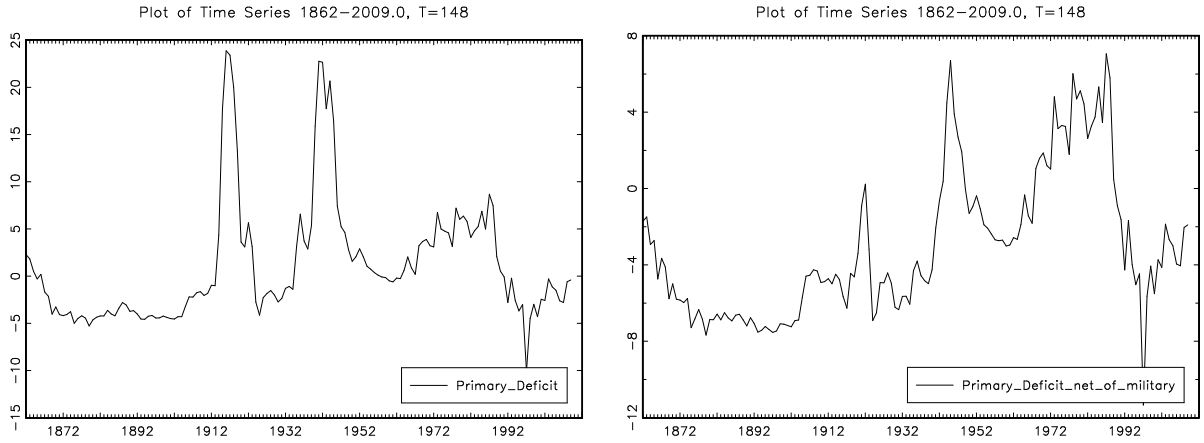
Figure A 23: Lanne et al (2002) test for Revenues/GDP, plot of the residuals and structural break (1925)



Net-of-interest deficit

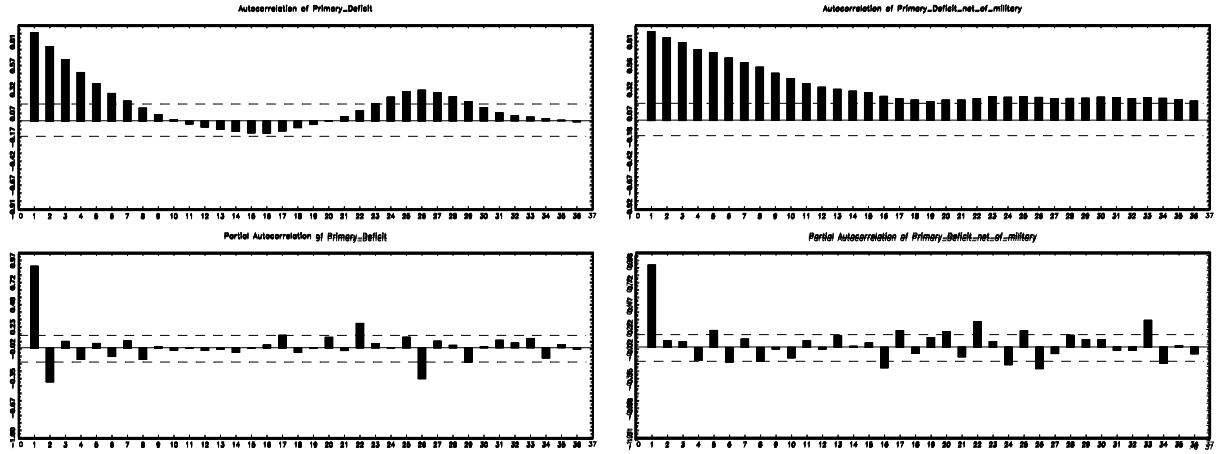
The pattern of primary deficit, with and net of military spending, as displayed in Figure A24, suggests that the large spikes occurring during the world wars might influence the results of the unit root tests. In addition, the deterministic component to be included in the test regression should be carefully selected and it could be different when comparing the two measures of the primary deficit. Actually, while accounting for the total spending suggests the occurrence of a structural break in primary deficit in 1915, but no evidence of a deterministic trend, when looking at the deficit net of military spending there is no longer evidence of a regime-shift in 1915, though there is a large spike in 1997, and some evidence of a broken trend in the data generating process.

Figure A 24: primary deficit (left) and primary deficit net-of-military spending (right)



The two correlograms are displayed in Figure A25, supporting the idea that the two indexes of the fiscal stance might display quite different statistical properties. With regard to the primary deficit the graph in Figure A25-left suggests an autoregressive but stationary process, plausibly with a moving average component. Conversely, the ACF of the net-of-military outlays deficit display far more persistence, casting doubts on the stationarity of the data generating process. Therefore, we will separately run unit root tests for the two deficit measures.

Figure A 25: correlogram of the primary deficit, total (left) and net-of-military spending (right)



In order to correctly model the deterministic component in the ADF testing procedure, we follow the strategy recommended by Enders (1995), starting from the less restricted model. With regard to the total primary deficit, the F statistics calculated to appropriately find the deterministic component, do not reject the null hypothesis of the most restricted model, i.e. neither trend nor constant ($\Phi_2 = 0.37; \Phi_3 = 0.38$).

The ADF tests displayed reject the null of unit root, and the residual diagnostics, as summarized in Figure A26, do not exhibit either autocorrelation or structural breaks, though there is some evidence of larger volatility during the wars. Given the spikes observed during the war periods, 1915-47, and given that tests showed this period was clearly crucial for spending, as a further check we perform a unit root test with structural break for the net-of-interest deficit variable, using as break dates those identified for the public outlays.

Figure A 26: ADF residuals and auto-correlations, primary deficit

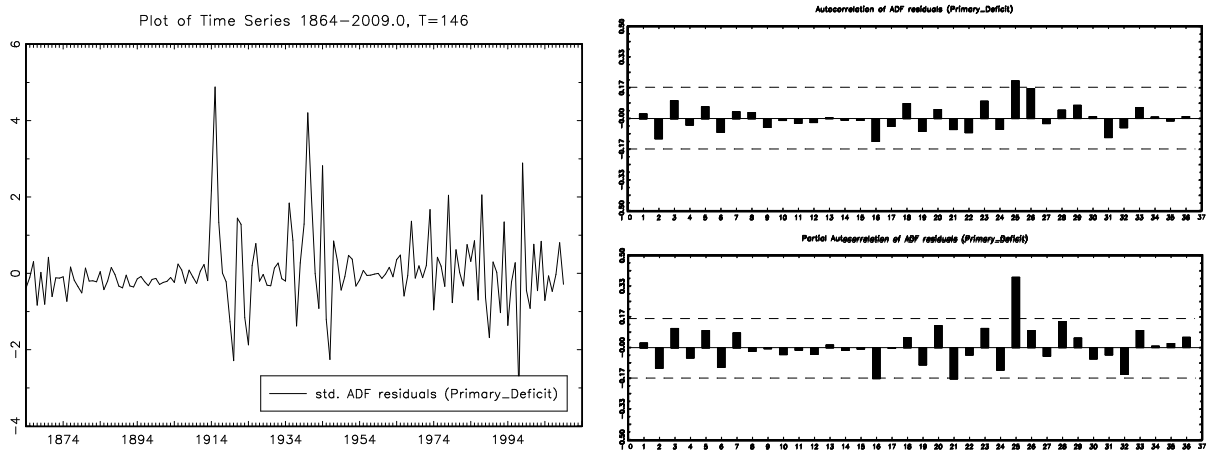
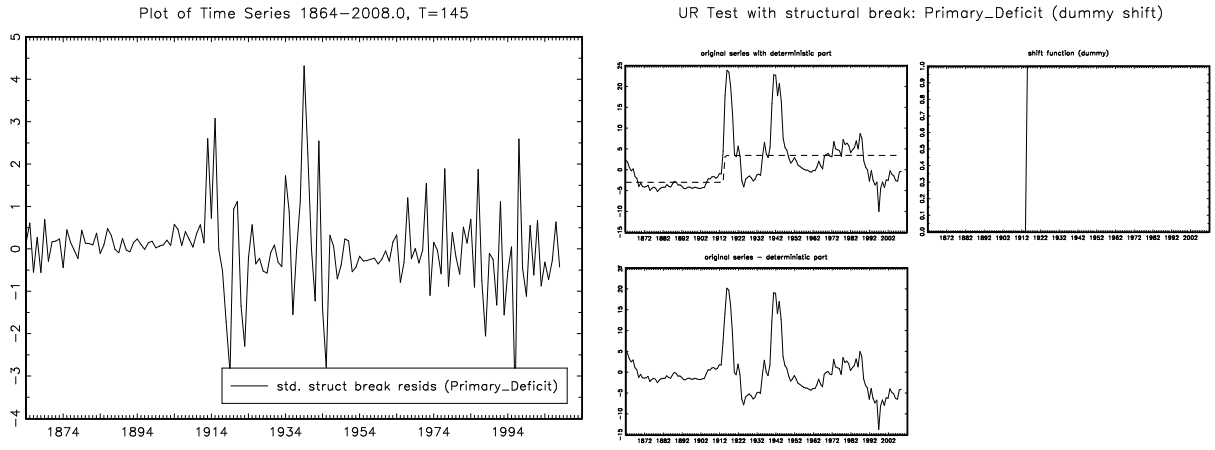


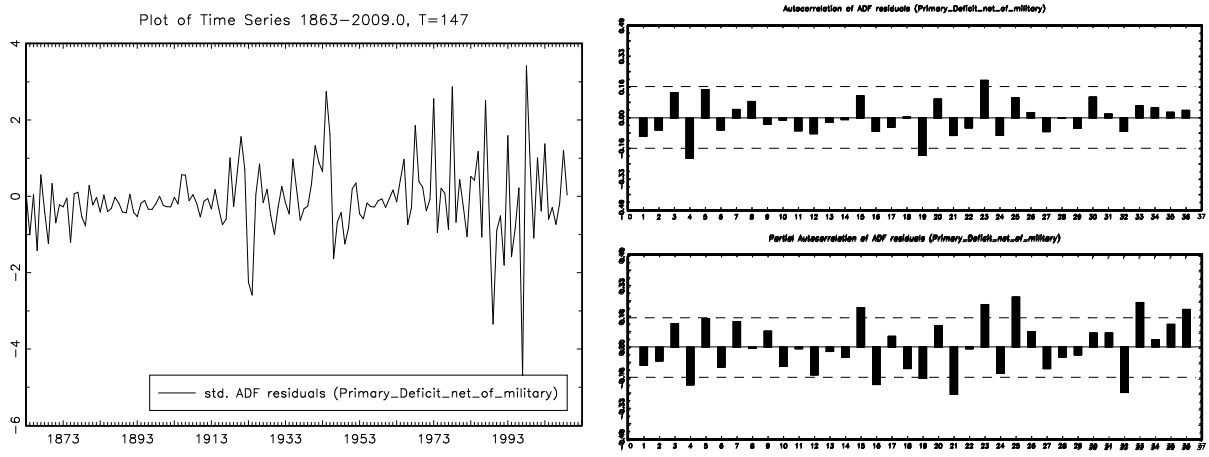
Figure A 27: Unit root test with structural break (1915). Residual and deterministic component, primary deficit



The regime shift in 1915 (identified by the automatic procedure and consistent with the evidence available for military spending), matches well the upward jump in the Data Generating Process, and the Lanne et al. (2002) test confirms the stationarity of the primary deficit series. However, doubts still linger on the reliability of the test results since there is evidence of larger volatility in the residuals during the wars, not yet removed by the structural break.

To this end, we repeat the ADF tests for the net-of-military primary deficit. As found for the total primary deficit, the *F statistics* calculated to appropriately find the deterministic component do not reject the null hypothesis of the most restricted model, i.e. neither trend nor constant both when running the ADF test with zero lagged differences ($\Phi_{1,0} = 0.8; \Phi_{2,0} = \Phi_{3,0} = 1.8$) and when including, according to the AIC and the Final Prediction error criteria, seven lagged differences ($\Phi_{1,7} = 1.24, \Phi_{2,7} = 2.2, \Phi_{3,7} = 2.01$). The corresponding t statistics are -1.92 and -1.77, suggesting that the primary deficit net of military spending is driven by a stochastic trend.

Figure A 28: ADF residuals and auto-correlations, primary deficit net of military spending (restricted model, zero lags)

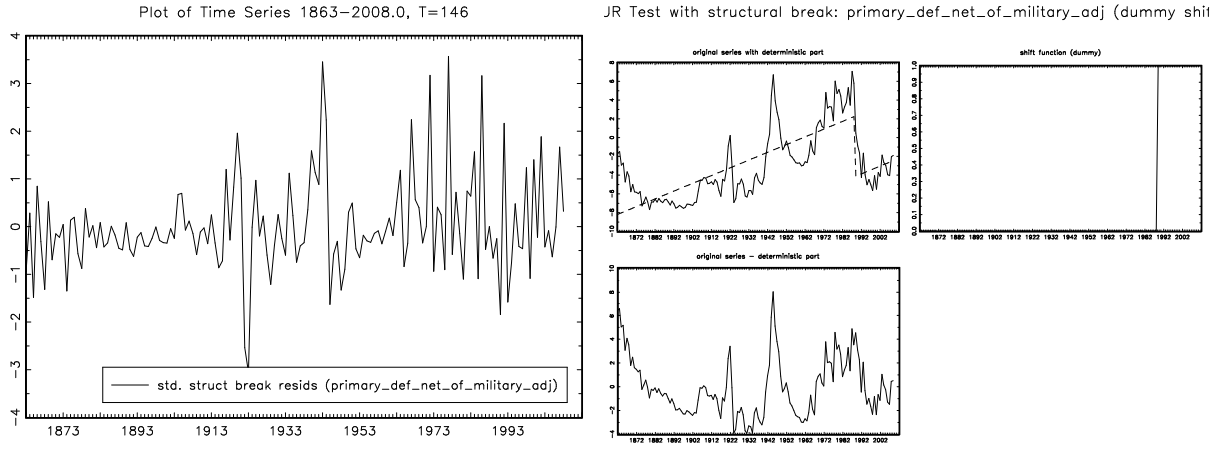


Though the ADF test does not reject the null of unit root, there is a clear outlier in the standardized residuals of the ADF regression (Figure A28), corresponding to 1997, which is clearly associated to the strong effort implemented by Italian government to comply with the EMU requirements. The presence of structural breaks can affect the reliability of the Dickey Fuller test which is, in such a situation, biased toward non-rejection.

However, there is also evidence of heteroskedasticity, with larger variance starting from the period post WWI; this heteroskedasticity could also be a signal of misspecification of the deterministic component, since the graph of the deficit series net of interest and military outlays clearly shows an upward pattern. Therefore, we proceed to model a unit root test accounting for possible structural break. Since the Lanne et al (2002) test procedure allows us to control for a single break date, we modify the deficit series substituting the outlier recorded in 1997 (-11.35%) with the average between deficits occurring in 1996 and 1998, amounting to -5.06%.

After this adjustment, the endogenously determined break date is 1989. Unlike the previous ADF test, we also model a deterministic trend to account for the observed increasing volatility in the residuals. The value of the calculated statistic is -2.65, thereby confirming that the adjusted primary deficit is I(1). This would imply that the net-of-interest deficit is the sum of two components: military spending (no unit root) and net-of-military-spending deficit, which is I(1). Therefore, we can be confident that the primary deficit is driven by a stochastic trend.

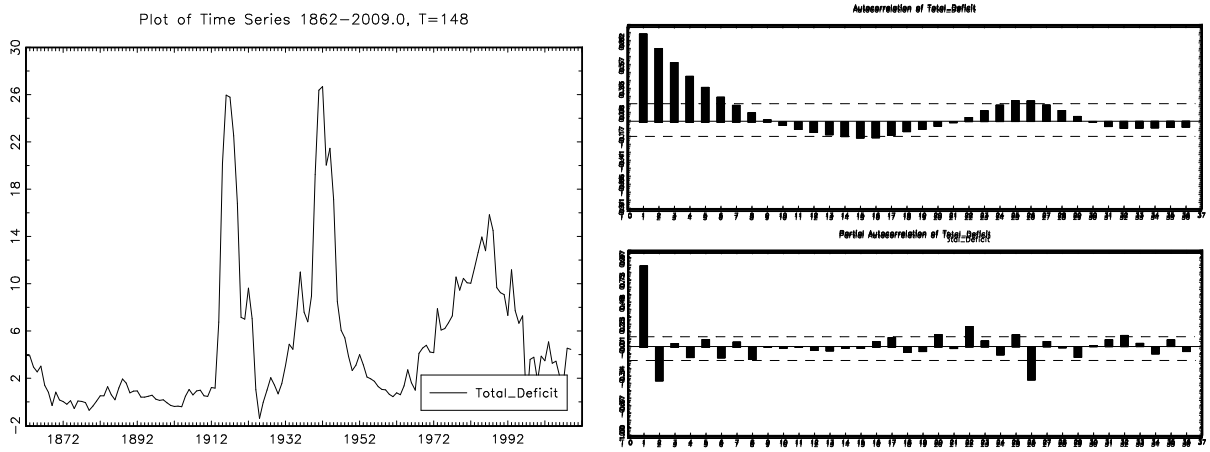
Figure A 29: Unit root test with structural break (1989). Residual and deterministic component, primary deficit net of military spending adjusted for 1997



With-interest deficit

The pattern of total deficit, as well as its correlogram, is displayed in Figure A30, providing evidence of an autoregressive but stationary process, plausibly with a moving average component.

Figure A 30: total deficit (left) and auto-correlations (right)



The ADF test rejects the null of unit root, and the residual diagnostics, as summarized in Figure A31, do not exhibit either autocorrelation or structural breaks, though there is some evidence of larger volatility during the wars. Given the spikes observed during the war periods, 1915-47, and given that tests showed this period was clearly crucial for spending, as a further check we perform a unit root test with structural break for the with-interest deficit variable, using as break date those identified for the public outlays. The regime shift in 1915 (identified by the automatic procedure and consistent with the evidence available for military spending) matches well the upward jump in the Data Generating Process, and the Lanne et al. (2002) test confirms the stationarity of the deficit series.

Figure A 31: ADF residuals and auto-correlations, total deficit

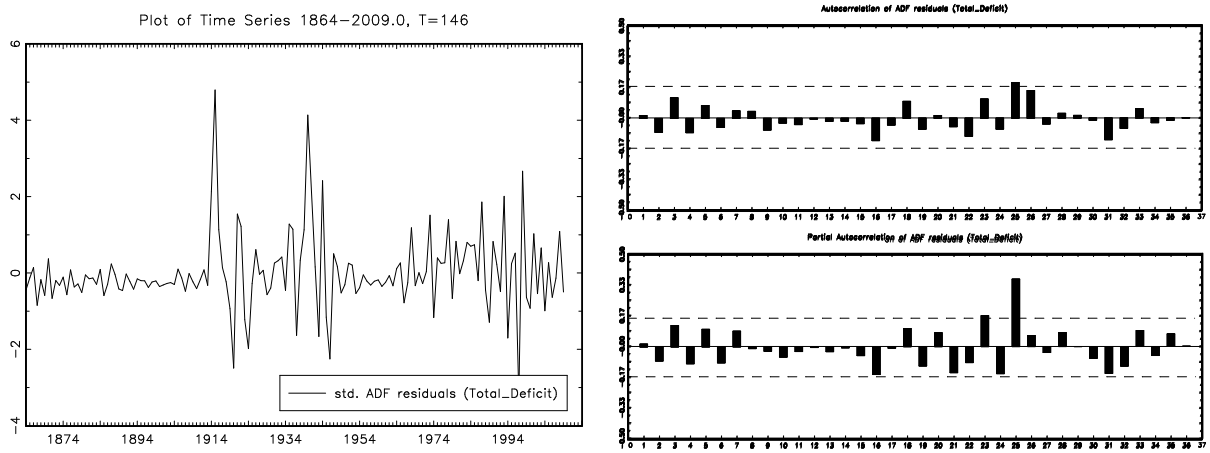
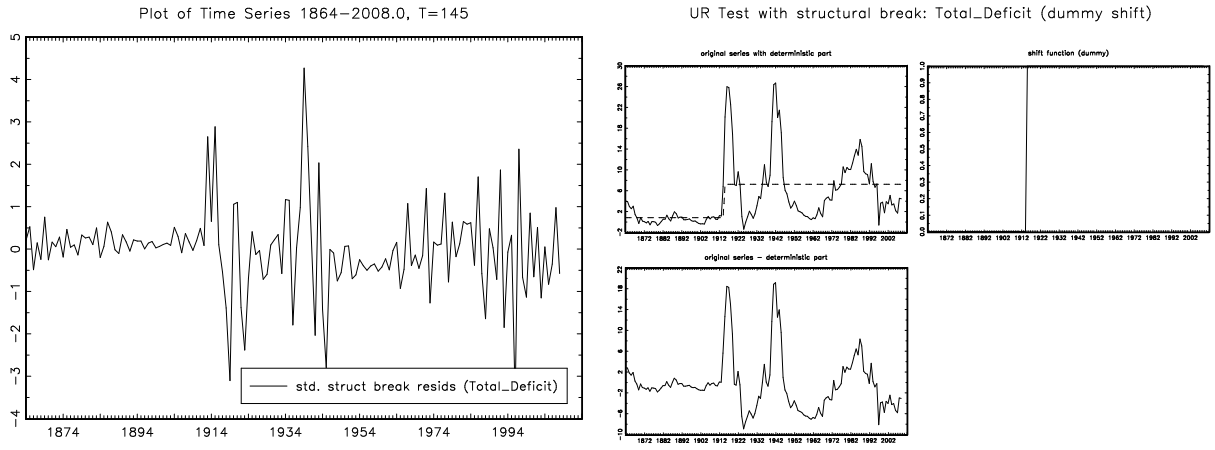


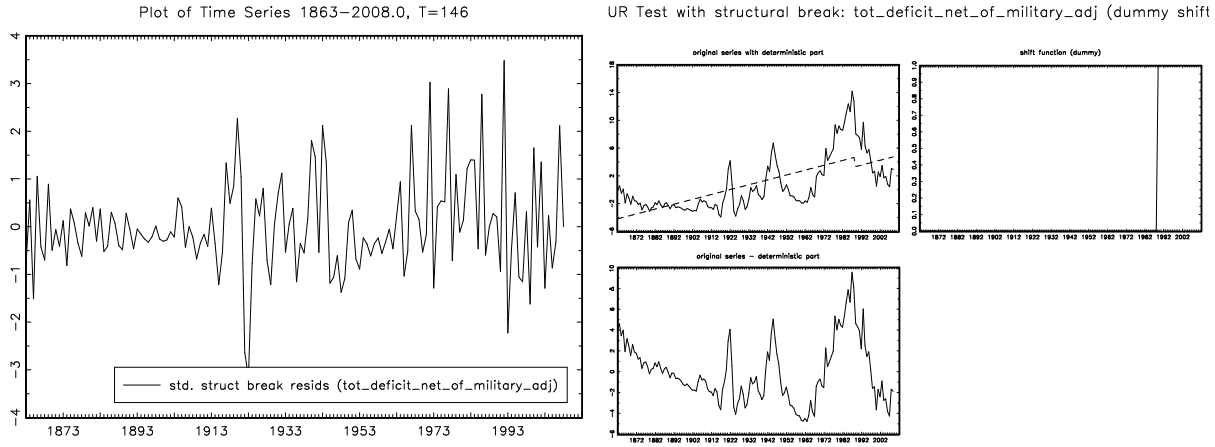
Figure A 32: Unit root test with structural break (1915). Residual and deterministic component, total deficit



However, doubts still linger on the reliability of the test results since there is evidence of larger volatility in the residuals during the wars, not yet removed by the structural break. To this end, we replicate the analysis already performed for the primary deficit by removing the military expenditures, and we repeat the ADF tests for the net-of-military total deficit. The t statistics calculated with the ADF test are -1.49 when accounting for a non-zero mean and -2.16 when adding a deterministic trend (four lagged terms), suggesting that the deficit net of the military spending is driven by a stochastic trend.
However, also in this case there is an outlier for the year 1997. Hence we proceed to model a unit root test, accounting for possible structural breaks. Since the Lanne et al. (2002) test procedure allows a single break date to be controlled for, we modify the total deficit series substituting the outlier recorded in 1997 (-1.94%) with the average between deficits occurring in 1996 and 1998, amounting to 4.11%.

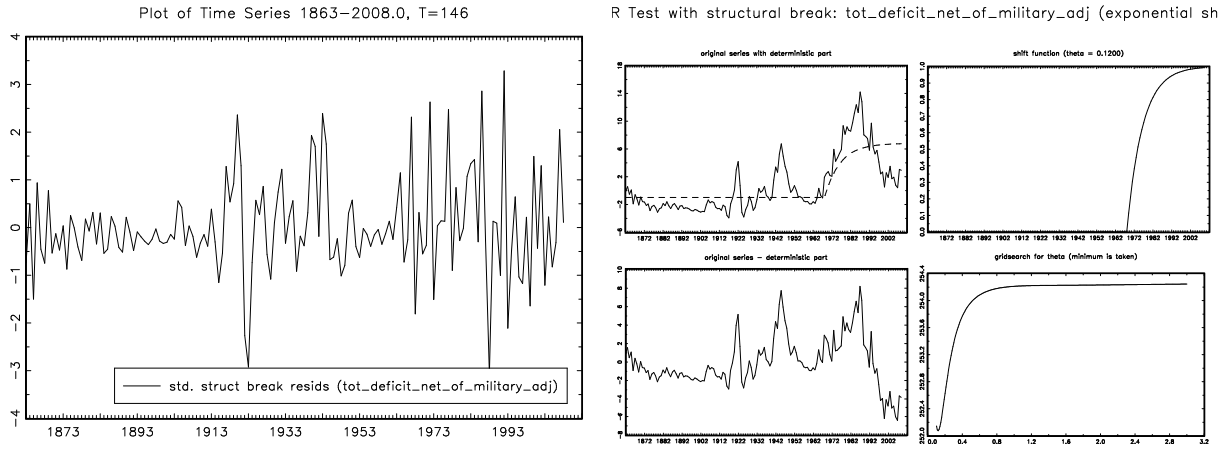
After this adjustment, the endogenously determined break date is 1989, and the t statistic would be -2.39, which does not allow us to reject the null of unit root. Unlike the primary deficit, the 1989 date does not capture the break in the with-interest-deficit, as shown in Figure A33.

Figure A 33: Unit root test with structural break (1989). Residual and deterministic components, total deficit net of military spending (adjusted)



Hence we decided to repeat the test by imposing 1969 as a break date, with a test statistic amounting to -3.38, which allows us to reject the null with 5% significance. Hence it may be stated that total deficit is stationary.

Figure A 34: Unit root test with structural break (1969). Residual and deterministic component, total deficit net of military spending



A5 VECM ANALYSIS

The presence of a unit root in the series for the debt and the primary deficit does not permit to examine a policy reaction function of the type suggested by Bohn (1998, 2005), i.e. a contemporaneous single-equation regression, since the presence of unit roots could generate spurious regression.

First of all it is necessary to check for the existence of a cointegrating relationship. The results of the Johansen trace test are displayed in Table A6, showing that there is evidence of a cointegrating relationship, once controlling for a structural break in 1915 and the dummies described in the main text.

Table A 7 Johansen Trace Test for debt and primary deficit (%GDP)

rank	LR test	p-value	90%	95%	99%
0	39.02	0.0001	22.64	24.70	28.88
1	3.45	0.8202	10.94	12.75	16.63

unrestricted dummies: D[1915] D[1916] D[1917] D[1918], d19 d25 d32 d40 d44 blip97 , Restricted dummies: Shift[1915], intercept included
included lags (levels): 4 (consistent with Hannan-Quinn; AIC and FPE suggest five lags, and Schwarz two)

We briefly describe the main diagnostic tests for the VEC model (primary deficit and public debt, both as a share of GDP), for which we also plot the complete Impulse Responses. Further elaborations are available upon request.

The order selection criteria suggest using three lags. Hence the model is based on a sample period going from 1867 to 2009 (143 observations). We use a two-stage estimation procedure: in the first stage the cointegration matrix has to be estimated by the S2S method explained in Lutkepohl (2004). Once an identified form of the estimated cointegration matrix is available, it can be used in the second stage of the estimation procedure. In the second stage, structural and subset restrictions as well as exogenous variables can be accounted for.

There is one exogenous variable, the growth rate of the real GDP, which plays a strategic role in the dynamics of the debt-to-GDP ratio, while the deterministic variables are:

- one mean-shift dummy describing a regime shift starting in 1915. This dummy is restricted to lying in the cointegration space. Its difference should be included as an unrestricted permanent impulse dummy in the VAR equations, current and lagged, i.e. 1915 and 1916,
- several impulse dummies (describing a permanent intervention/shock) for the observations: 1919, 1925, 1932, 1940, 1944). A shift in the levels of a variable becomes an impulse dummy in the differenced variable,
- a further impulse dummy, not linked to the break in the data though accounting for an outlier for the deficit equation in the VECM, is added for the 1997 observation.
- constant.

Residual analysis: diagnostic tests

Table A 8: residual autocorrelation tests for VEC Model

Test	ARCH_LM$_5$ (u_1)	ARCH_LM$_{16}$ (u_1)	ARCH_LM$_5$ (u_2)	ARCH_LM$_{16}$ (u_2)	LM$_5$	LM $_{16}$
Test statistic	10.4	17.0	25.2	32.44	38.8	88.99
p-value	0.06	0.38	0.0001	0.008	0.007	0.02

Table A 9: residual non-normality tests for VEC Model

Test	Doornik Hansen(1994)			Lutkepohl (1993)		
	joint	skewness	kurtosis	joint	skewness	kurtosis
Test statistic	62.4	20.9	41.5	71.0	24.0	46.9
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

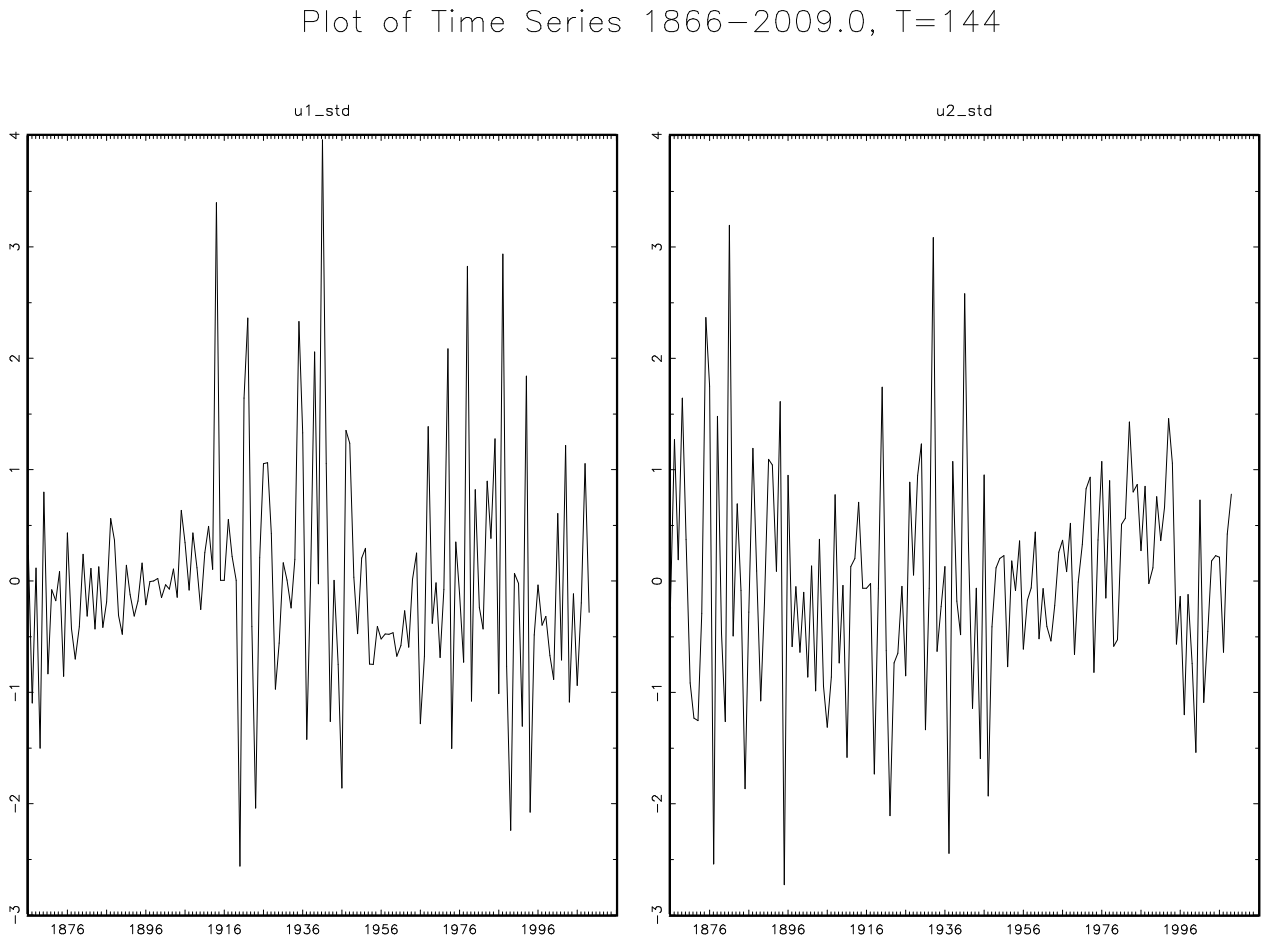
Table A 8: residual non-normality tests for VEC Model (follows)

Test	Jarque Bera			
	u_1		u_2	
Test statistic	64.2	Sk:0.98	6.47	Sk:0.18
p-value	0.0000	K:5.61	0.04	K:3.97

Table A 10: correlation of VEC residuals

	Primary Deficit/ GDP	**Public Debt / GDP**
Primary Deficit/ GDP	1.000000e+00	7.029762e -02
Public Debt / GDP	7.029762e-02	1.000000e+00

Figure A 35: VEC residuals



The estimated cointegration relation reads as follows (t statistics in brackets):

$$Def = \underset{0.97}{2.55} - \underset{-2.32}{0.058}\, Debt + \underset{2.12}{3.39}\, shift1915$$

and the plot of the cointegration vector is displayed in Figure A34, which reproduces, as expected, the pattern of total deficit.

Figure A 36: the cointegration vector

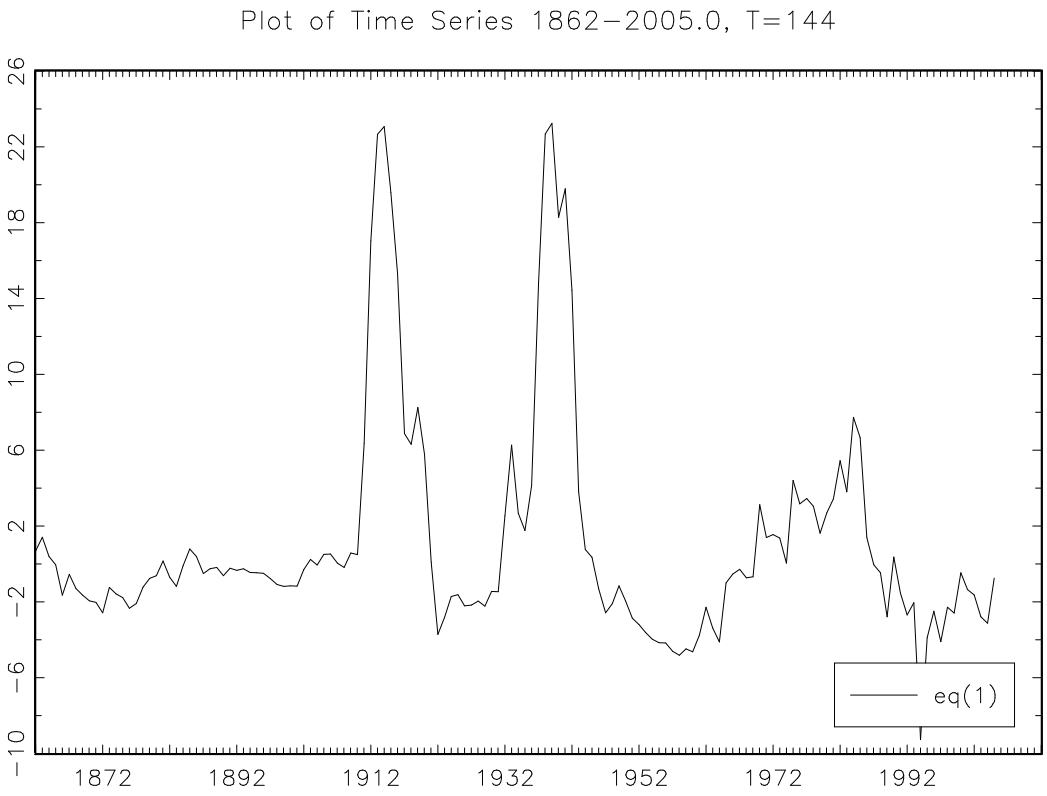
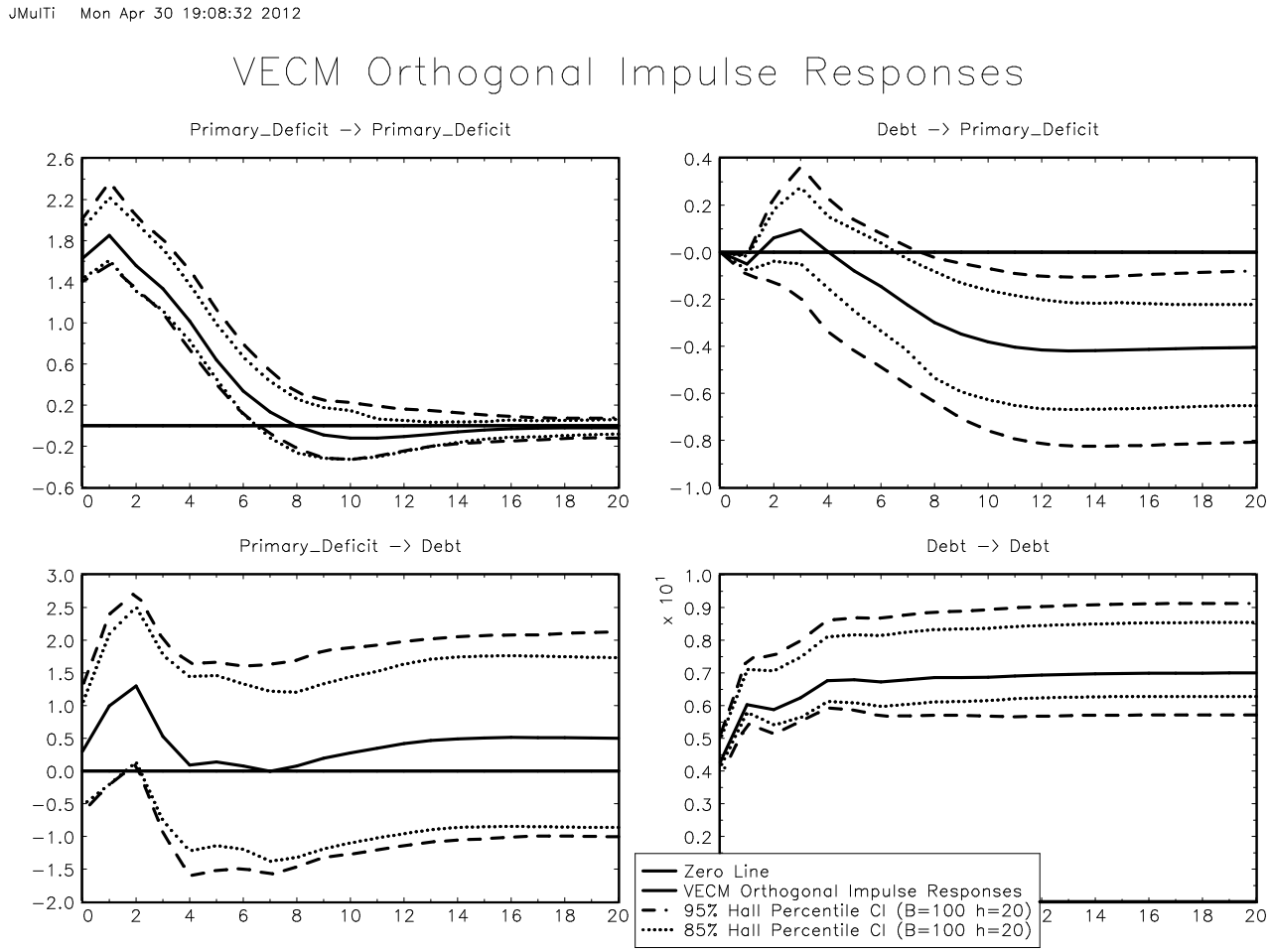


Figure A37 displays the impulse responses of the above-described VEC model. In the first row we read the impact of a shock on the deficit-to-GDP ratio, whereas in the second row the impact on the debt-to-GDP ratio is shown. Over the first column the shock is one S.D. impulse in the deficit to GDP ratio, whereas in second column the shock is one S.D. impulse in the debt-to-GDP ratio.

Figure A 37: the impulse response function



Solid line: VECM orthogonal Impulse Response; Dashed (dotted) line: 85% (95%) Hall Percentile Confidence Interval

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