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The Deficit–Interest Rate Connection: an empirical assessment of the EU

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Abstract/Resumo:
The progressive deterioration of public finances in most developed countries, during the last two decades, prompted an extensive discussion on the effects of government deficits on the interest rate and, consequently, on employment and economic growth. The empirical literature, largely focused on the US, is far from conclusive. This paper examines this relationship in six core EU countries using non-causality tests, including the recently proposed LA-VAR test. The evidence suggests that, contrary to the conventional economic theory, no causal effect from the deficits to the interest rate can in general be found. On the contrary, the econometric tests highlight the preponderant negative consequences of high interest rates on the government total deficit.

Palavras-chave/Keyword: deficits, interest rates, causality, LA-VAR test, European Union

Classificação JEL/JEL Classification: E43, E62, H62

1. Introduction

The deterioration of public finances in most developed countries, during approximately the last two decades, raised concerns about its potential negative effects on the economy. In particular, it prompted an extensive debate, largely focused on the United States, on the impact of the deficit on the interest rate. This relationship has important consequences for the economy, in several complementary aspects. Directly, because of the effects on the *real* macroeconomic variables such as investment, output and employment, as suggested by the standard macroeconomic theory. More indirectly, because of the central role of the interest rate on the stability of the budget dynamics.

If a government's expanding deficit generates an increase in the interest rate, this would raise the interest expenditures. Unless offset by a larger primary surplus or by monetization, these supplementary interest expenditures will further add to the total deficit and debt in a self-sustained, continuous process. This *snowball effect* could rapidly transform a sustainable fiscal policy into an unsustainable one.

This paper examines the relationship between deficits and the nominal and real interest rates in a group of six European Union members. The next two sections review some of the economic theories which have been proposed to explain the connection between the deficit and the interest rate, and survey the multitude of different empirical approaches to test it. Sections 4 and 5 introduce the data used in the empirical sections, and present the methodology employed in the tests. Section 6 exhibits the results of the non-causality tests on the relationship between the central government deficit and the nominal and real interest rates, while the following section extends the tests to a higher level of government accounts. Sections 8 and 9 examine whether the relationship is explained by domestic factors or primarily by european-wide elements. The last section summarises the main findings and concludes.

2. Theoretical background - competing theories of the interest rate

The connection between deficits and interest rates has been explained by different economic theories, briefly reviewed in this section. The first group of theories, which have dominated the *mainstream* view of the functioning of the economy, intend to explore the mechanisms through which the government deficits are positively transmitted to the interest rate. A second group, in contrast, starting with the Ricardian Equivalence theory, argue that interest rates are determined independently of the fiscal policy actions.

2.1. The positive impact of deficits on the interest rate

The classical monetary theory of interest rates, first presented in 1898 by Wicksell[1], indicates that the interest rate results from the arbitrage between the demand and supply of capital in the *loanable funds market*. This idea can be formalised by the *loanable funds model*, associated with Robertson (1934). It models the interaction between the demand for capital or funds (F), represented graphically by a negatively-sloped curve reflecting the diminishing marginal productivity of capital, and the supply of capital, represented by a positively-sloped curve reflecting the new savings available in the market (Figure 1).

[Figure 1 about here]

The intersection point of the demand and supply schedules indicates what Wicksell denominated the *natural interest rate*, since it is supposed to be determined by real forces of productivity and savings, and to equal the rate of rentability of the productive capital. It is "the same as the rate of interest which would be determined by supply and demand if no use were made of money" (Wicksell, 1936:102).

The natural rate and the market real interest rate are not necessarily equal, at least in the short-term, namely due to the central bank's control over the money supply. However, when the two rates differ, an equalisation mechanism is immediately set in motion. For example, starting from an equilibrium situation (ir_1, F_1), suppose that a fall in the marginal productivity of capital causes a downward shift in the demand schedule and the consequent decline of the natural rate. If, for any reason, the market interest rate does not accompany this fall, there will be an excess supply of funds (F_1-F_2), certain investment projects will

[1] English translation in Wicksell (1936).

have to be abandoned, and income and employment will fall. This causes an upward shift in the supply schedule until the natural and the market interest rates meet again, and equilibrium is restored.

According to this theoretical framework, an increase in the government's total deficit, implying necessarily additional borrowing in the market, will shift the demand curve upwards. To restore the equilibrium in the market, the natural rate of interest must rise. This increase in the interest rate may however be avoided if the private demand for funds declines sufficiently to offset the increase in public demand, if the supply curve moves downward (e.g. if the Ricardian equivalence theorem holds), or if the supply curve is infinitely elastic (e.g. in a small economy with open capital markets). These *special cases* will be presented in the next sub-section.

The classical view was partly challenged by Keynes' *liquidity preference theory*, usually examined within the IS/LM analytical framework. According to this theory, the interest rate is the equilibrium price between the supply of money, or liquidity, supposedly controlled by the monetary authorities, and the demand for money, a function of income and the nominal interest rate. The demand for money depends on the various reasons to detain liquidity, including the so-called *speculative motive*, which is conditional on the demand for alternative financial assets.

Like the classics, Keynes assumes a fixed, exogenous quantity of money. The fundamental difference between the Classical and the Keynesian theories of interest rate determination is that in the former the interest rate is essentially a *real* phenomenon while in the latter it is a monetary phenomenon, determined in the money market and then transmitted to the real sector of the economy. Causality runs in opposite directions in both theories.

In sum, according to the keynesian theory, an expansionary fiscal policy, for example, implies an increase in the demand for money and output, requiring a rise in the interest rate to restore equilibrium in the markets (unless the economy is caught in the *liquidity trap*).

The more recent neoclassical perspective, which may be examined within any of the two theoretical constructions presented above (*neoclassical synthesis*), focuses particularly on the economic *crowding-out* consequences of the deficits. According to the standard neoclassical view, an increase in the deficit, with the consequent additional government borrowing, reduces the total amount of national savings available, requiring an increase in the interest rate to restore equilibrium. The interest increase will change the final composition of output, depending on the degree of economic openness and international capital mobility. In a closed economy, for example, it will crowd-out private investment, since the government competes with private individuals for the available savings.

In a small open economy, with high capital mobility, it will crowd-out net exports. The interest rate increase will attract a capital inflow, causing the domestic currency to appreciate and consequently leading to a trade balance deterioration. At the same time, this inflow of capital forces a fall in the interest rate, limiting at least in part the crowding-out effect on domestic private capital formation. In both cases, whatever the economic characteristics of the country, the expected final result is always a reduction in economic growth.

Finally, another alternative approach claims that the positive effect of the fiscal variables on the interest rate depends, at least in part, on the efficient functioning of the financial markets. The *market discipline hypothesis* maintains that high levels of deficits and debt induce the financial markets to include (or increase) a default risk premium on the interest rate demanded on government bonds. Some authors even claim, in the particular case of the EU, that the financial market is the first place to look for a *natural* restraint on fiscal indiscipline (Bishop *et al.*, 1989).[2]

The empirical evidence on this theory, almost exclusively centred on the United States, provides mixed results. While Goldstein and Woglom (1992) and Bayoumi *et al.* (1995) present results supporting the theory, Eichengreen (1990) and Alesina *et al.* (1992) claim that the risk premium is too small to matter.

Although this theory may help explain the interest rate differentials within a monetary union such as the US

[2] For the opposite view see, for example, Corsetti and Roubini (1992:38), for whom this idea "seems based more on wishful thinking than on an assessment of the incentives faced by the member countries. The market discipline in the form of high interest rates has not prevented members of the EC to continue unsustainable fiscal policies throughout the 1980s".

or the EMU[3], it does not seem able to explain the relation between the fiscal variables and the interest rate in the whole sample considered in this study. The functioning of the market discipline requires the verification of a group of conditions (Lane, 1993), such as the perfect integration of capital markets and the non-monetisation of the debt, hardly met in the whole period analysed here.

2.2. Contrasting views: no fiscal effects on the interest rates

Contrasting markedly with all the above theories, the *Ricardian Equivalence Proposition* (*REP*) claims that no relationship is to be expected between the government deficits and the interest rate. According to this theory, the rational private individuals interpret the present government deficits as an intertemporal reallocation of taxes. They fully anticipate the effects of the current deficits, and consequent debt accumulation, on their future tax liabilities, and therefore increase their savings now in an amount exactly equivalent to the present value of these future tax liabilities. Their optimal consumption plans will not be altered.

In consequence of this behaviour the government deficit, which implies public dissaving, will be completely offset by a compensating increase of private savings, neutralising the impact of the deficit on the interest rate. Coincidentally, Belgium, Italy and the Netherlands, the three most indebted countries in the sample, present an average ratio of private savings to GDP, in the period 1960-96, above the European Union's average[4] and well above any of the three other countries in the sample.

This idea had already been implicitly suggested by some authors. Tobin (1952:117) asks whether "the additional taxes which are necessary to carry the interest charges reduce the value of other components of private wealth?". Bailey (1962:75) admits the possibility that "households regard deficit financing as equivalent to taxation". He later enumerates the conditions necessary for a null net wealth effect: "If all households accurately foresee their future disposable incomes, including the tax implications of current fiscal policy, and if they all plan gifts and bequests to their heirs, taxation and debt finance are equivalent" (Bailey, 1972:651).

But it was Robert Barro who demonstrates this proposition analytically, within the theoretically framework of an overlapping-generations model. Barro (1974:1116) concludes that "fiscal effects involving changes in the relative amounts of tax and debt finance for a given amount of public expenditure would have no effect on aggregate demand, interest rates, and capital formation". The *REP* is a sufficient, although not necessary, condition to explain the lack of relationship between deficits and interest rates.[5]

The main objections to this theory focus on the large set of strong assumptions on which is theoretically grounded. As underlined above by Bailey, it is necessary that the individuals are rational, have perfect foresight, capable of understanding completely the intertemporal budget constraint they face, and there is an operative, altruist, intergenerational transfer mechanism. Furthermore, it is also necessary to assume perfect capital markets and that taxes are lump-sum and nondistortionary.

In spite of all these restrictions and seemingly unrealistic assumptions, some authors followed Evans' (1985:85) advice to "judge the utility of an assumption primarily by its predictive and explanatory power and not by its realism". In fact, the *REP* was supported by several empirical studies during the 1980s, all for the United States, which have found no evidence that private consumption reacted to a deficit-caused increase in disposable income (see, for example, Kormendi, 1983, and Aschauer, 1985).[6]

In the 1990s, it may have been possible to witness in the EU a *Maastricht effect*, somehow similar in its outcome to the *Ricardian Equivalence Proposition*. An individual observing a unfavourable fiscal situation in his country, knowing that the Maastricht's fiscal criteria would have to be met in the medium-term, would expect a tax increase in the near future, and may have increased savings accordingly to account for that

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[3] Goodhart (1996) claims that the default risk will become more significant in the EMU.

[4] Respectively 22.6%, 27.4% and 23.5% of GDP, while the EU(12) average for the same period was 21.2%. The data is from European Commission (1998) and refers to the "Gross saving of the private sector as a percentage of GDP at market prices".

[5] Conversely, the hypothesis of a positive relation between deficits and interest rate has been used as a way of testing the Ricardian equivalence proposition. However, as shown by Rose and Hakes (1995), rejection of this hypothesis is only a necessary but not a sufficient condition for Ricardian equivalence.

[6] Contrary evidence, also for the US, is reported for example by Feldstein (1982).

tax increase. The final effect is similar to the *REP*, with the increase in private savings compensating at least part of the government dissaving. This case also relaxes some of the strong assumptions of the *REP*, since it requires a smaller time interval before the taxes are expected to be collected.

More recently, another theory has been put forward to explain the possible lack of relationship between government deficits and interest rates. According to some authors (Nunes and Stemitsiotis, 1995, Knot, 1996, among others), this may be due to the growing integration of capital markets, widening the area where governments can obtain finance, and therefore easing the pressure on domestic interest rates. This is particularly conceivable in a small open economy, where an increase in the government's borrowing needs could be met by foreign capital inflows at the world interest rate, without affecting the domestic rate.

This hypothesis has been widely discussed and tested in the literature, since the often quoted paper by Feldstein and Horioka (1980). They revealed the existence of a strong empirical correlation between domestic investment and savings, contrary to the common widespread belief of international financial integration. In spite of the large controversy inspired by this paper, and the huge amount of empirical research in this area, no definitive conclusions have been reached (see, for example, Lemmen, 1996).

Together with the *REP*, these theories illustrate two of the above mentioned exceptions to the functioning of the classical loanable funds model illustrated in Figure 1. While the *REP* implies a downward shift in the supply schedule, due to the increase in private savings, the integration of the capital markets suggest a supply curve infinitely elastic. In both cases, the upward shift in the demand schedule due to a government deficit will not necessarily cause an interest rate increase.

This section has, so far, described several theories suggesting a positive impact of the deficits on the interest rate, followed by other views justifying the inexistence of such relation. In contrast to all these approaches, some post-keynesian authors call the attention for the predominance of the opposite causal relationship, running from interest rates to deficits (see, among others, Smithin, 1994, and Wray, 1997).

As implied above in the loanable funds model, and also in the original IS/LM framework, the relative availability of credit in the market plays a fundamental role in the determination of the interest rate. According to this model, there is an exogenous, fixed, supply of savings and money in the economy, and consequently the level of investment depends on the total pool of savings available at a certain time. The interest rate is an endogenous variable, resulting from the interaction between the demand and supply of savings (or money, for the keynesians) in the market. This view is completely reversed by the post-keynesians, for whom the interest rate is an exogenous variable, determined by the decisions of the central bank and therefore not influenced by the government's deficit. The money supply is the endogenous variable, out of the control of the central bank.

The theoretical framework for this hypothesis is provided by the *horizontalist* approach, as advocated by Kaldor (1982) and Moore (1988), and by the Franco-Italian *circuit school* of Graziani (1990) and LeBourva (1992). In a credit economy, the money supply is a demand-driven variable, consisting basically of commercial bank's deposits. It varies endogenously with the volume of borrowing requested from the banks, which implies that investment decisions can precede savings availability. The central bank, being the lender-of-last-resort, provides the reserves necessary to accommodate the change in the demand for credit, although at the interest rate it chooses.[7]

In sum, according to this theory, the interest rates are set by the central bank's policy decisions and not by the government's fiscal actions. On the contrary, a tight monetary policy for example, leading to an increase in the interest rate, is positively transmitted to the government deficit through two main channels. Directly, and depending on the level of the debt, through the increase in interest expenditures. Indirectly, the higher interest rate slows down the economy and, through the *automatic stabilisers*, reduces tax revenues and increases certain transfers (social transfers, such as unemployment benefits, and possibly also for those sectors of the economy more sensitive to interest rate increases).

3. A review of the empirical literature

[7] This assumption about the functioning of the central bank is confirmed, for example, by Goodhart (1989) and Goodfriend (1993:3), both directly involved in the central bank's operational procedures.

In the empirical literature, this relation between deficits and interest rates is also highly controversial. Numerous tests on the existence of a positive relationship have been performed since the mid 1980s, but the conclusions achieved are almost perfectly divided into a rejection or acceptance of the hypothesis. Extensive lists of papers could be presented, showing opposite results, but will be intentionally avoided here since it is difficult to make meaningful and useful comparisons. On the one hand, most empirical literature in this area has been confined to the United States, which may not necessarily be indicative of the experiences of the countries here analysed. On the other hand, even for the same country, meaningful comparisons are difficult for the well-known reasons of differences in the sample period, econometric estimation methods, model specification, variables involved, among many others.[8]

The variables included in the estimating equation to explain the interest rate, apart from the deficit and/or debt, vary widely according to the authors and the competing economic theory adopted. Some authors simply choose arbitrarily some variables to explain the interest rate movements, and estimate a single-equation regression (Craig, 1994 or Laumas, 1989, for example), or a VAR model (Arora and Dua, 1995, and Miller and Russek, 1996, for example). Most tests however, in the tradition of the 1960s Cowles Foundation structural approach, begin by adopting as reference one of the theoretical models presented above, and then estimate a non-dynamic reduced-form single equation of the interest rate, examining the sign and significance of the coefficient of the deficit or debt variables.

One potential econometric problem with most of these empirical studies is that they do not pay sufficient attention to the analysis of the time series properties of the underlying series, resulting potentially in wrong specification of the models, and spurious results (see, for example, Nunes and Stemitsiotis, 1995, and Cebula, 1997). Other studies acknowledge this fact and first-difference all I(1) variables prior to estimation, loosing potentially important short-term information (this is the case of, for example, Allen and Wohar, 1996 and Cebula, 1998).

One other weakness of most empirical approaches to this question is that they search for correlation without paying attention to issues of causality. However, the correlation between these variables does not necessarily imply that the effect runs exclusively from the fiscal variables to the interest rate. It is necessary to consider the possibility of an inverse causal effect. The level of the interest rate has an important influence on the deficit, mainly through the interest expenditures, and consequently on the accumulation of public debt.

Only a few empirical studies have specifically addressed the question of causality in the relation between the fiscal variables and the interest rate. Using the more standard causality tests, for example, McMillin (1986), Darrat (1989) and Miller and Russek (1996) found no evidence that deficits cause interest rates. In fact, the first two found evidence of the opposite causal effect, that the interest rate Granger-causes the deficit. However, using the more appropriate VECM procedure, Arora and Dua (1995) claim that the government deficits cause the interest rate. All the above studies refer exclusively to US data.

4. Choice of variables and other data issues

There is no consensus on which is the most appropriate measure of the variables used in these studies. A possible procedure is to use alternative concepts and check whether the results are sensitive to the different measures. However, given the number of countries considered, and the time span covered, the alternatives are relatively few if one aims at maintaining the results comparable.

The first question to address is what type of nominal interest rate should be chosen, in terms of maturity, for example. Although most empirical studies have used short-term rates, several arguments may be put forward in favour of the use of a long-term interest rate. The macroeconomic theory suggests that the effects of the deficits on the economy are transmitted through the long-term interest rate, not the short-term rate, because the interest sensitive part of the private investment (such as housing, factories or industrial equipment) depends on the long-term interest rate. Besides, movements in the short-term rates are more volatile and difficult to interpret, since they are highly influenced by transitory factors and by the monetary

[8] Other authors prefer to rely on more informal, graphical or descriptive, analysis. See, for example, Christiansen and Pigott (1997).

authorities (see, for example, Arora and Dua, 1995).[9]

Given the sample period and the countries included, the paper uses the long-term interest rate on government bonds, taken from line 61 of the IMF's *International Financial Statistics* (IFS). This is the most often preferred variable in tests using a long-term interest rate. An alternative, or complement, to using the level of each country's interest rate, is to substitute it by the interest rate differential in relation to some basis country (Germany, the United States, or the average of the group), and study the relationship in relative terms. This procedure will be applied in section 8.

One other important choice to be made is how to estimate the real interest rate. The theoretically most correct procedure is to use the expected real interest rate. The problem is that these expectations are not observable in practice, and the usual alternative procedure is to use some proxy for expectations (forecasts from VAR's, the Hodrick-Prescott filter, rolling moving-averages of past values, and several others). However, there are always some reserves on the quality of these proxies and its effect on the final results of the tests. Furthermore, the main problem in this particular type of tests is that "measurement errors in the proxies for expectations biases the estimated coefficients toward zero, and toward the null hypothesis of Ricardian Equivalence" (Elmendorf and Mankiw, 1998:47). This paper will therefore use the *ex post* real interest rate, computed as the difference between the nominal long-term rate and the *ex post* inflation rate, measured as the growth rate of the consumer price index (line 64 of the IFS).

A third choice to be made concerns the time frequency of the observations. Given the usual problems of stochastic seasonality associated with fiscal variables, the immediate tendency is to use annual data. This choice is supported, in this particular research area, by the suggestions that higher frequencies bias the results towards finding no significant relationship between deficits and interest rates (as pointed out by Hoelscher, 1986). Apart from the problems of seasonality, this phenomenon may be justified by the existence of portfolio adjustment lags, or because the next month's or quarter's deficit (more easily predicted than with annual data) is already influencing the present value of the interest rate.

The sample includes six core members of the EU (Belgium, France, Germany, Italy, Netherlands and United Kingdom), for the period 1950-1996. Finally, all the tests will be performed on two alternative levels of government accounts, the central and the general government. A comparison between them reveals the importance of the social security funds in the analysis, regarded by many authors as the main source of fiscal problems in the medium-term for the developed countries.

With the exception of the series of total surplus of the general government, taken from the OECD Economic Outlook, all the other series are from the IMF's *International Financial Statistics*. The fiscal variables are expressed as ratios to nominal GDP, at market prices. Figures 2 display the joint evolution of the different variables.

[Figure 2 about here]

As suggested by the figures, most variables seem to follow a nonstationary process. For a formal analysis, Table 1 presents the ADF unit root tests for all these variables. Two main alternative methods to choose the lag length are presented in the table: one is based on a information criterion, the Schwarz Bayesian Criteria (SBC), the other is the sequential test procedure first suggested by Perron (1989) which is designated by (P). These are complemented by the sequential test suggested by Perron and Vogelsang (1992), represented by (PV), which allows for the presence of a structural break in the level of the series, in a date endogenously chosen. The hypotheses of a unit root on all the first-differenced series were also tested (results not shown) and clearly rejected in all cases.

The different types of unit root tests present in general coincident results. The very few cases where this does not happen are carefully examined in the empirical applications of the next sections. As shown in Table 1, the nominal interest rate series (and differentials) present in general a nonstationary behaviour, while the real interest rate series are, with a few exceptions, stationary.

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[9] Anyway, Passet (1997) and Christiansen and Pigott (1997) argue that the periods where the long-term rates diverge from the short-term ones, are very rare and ephemeral.

[Table 1 about here]

Some of the series present an unusual volatile behaviour in the beginning of the sample, easily detected in the figures, as well as a possible structural change in the beginning of the 1970s. To check the sensitivity of the results to these outliers and mid-sample changes, different alternative strategies were implemented. However, to avoid a unreasonable number of tables, only the main test results will be presented in the paper. The innumerable supplementary tests intended to check the sensitivity of the main results will only be referred when significantly contradicting the main conclusions, but are available upon request.

5. Methodology adopted to test the relationship

The empirical studies of the relationship between the fiscal variables and the interest rates, discussed in section 3, above, have been in general based on structural, large-scale, macro-econometric models or, more frequently, on reduced-form equations. The former can be immediately excluded from the present study on the grounds of data availability and small number of degrees of freedom for the sample period and data frequency analysed here. On the other hand, the reduced-form models have the important disadvantage, among others,[10] of assuming exogeneity of all dependent variables to the interest rate. As noted above, the level of the interest rate may influence the level of the deficit, through its direct effects on the interest expenditure or its indirect effects on the primary deficit.

There is therefore an identification problem in most empirical work, since it may be difficult to separate the effects of the deficits from their causes. In fact, at least four distinct outcomes may arise from the empirical analysis of the relationship between deficits and interest rates, with different economic consequences and policy implications. Table 2 systematizes these alternative hypotheses.

[Table 2 about here]

The procedure followed by most empirical studies, exclusively based on correlation analysis, is not able to distinguish between the three first hypothesis outlined above, always concluding in favour of the first one.

Additionally, it is also necessary to acknowledge the possibility of finding a negative relation between deficits and interest rates, leading to three additional hypothesis to consider. In fact, several studies report evidence of a negative relationship. Evans (1985) and Kolluri and Giannaros (1987), for example, claim that increasing deficits are associated with falling interest rates in the US. Evans (1987) and Boothe and Reid (1989) present evidence of a negative relation between debt and interest rates in, respectively, the US and Canada.

The criticisms on the standard econometric procedures led to the introduction of different approaches and econometric methods.[11] One of these was initially suggested by Sims (1980) and it is based on the estimation of a vector autoregressive (VAR) model, where no *a-priori* judgement is made concerning the choice of the dependent variables or the dynamic structure of the model. Theory only influences the modelling strategy by suggesting which variables to include in the VAR.

One advantage of the VAR model, particularly useful for the objectives of this study, is that it allows testing Granger non-causality. In view of the different empirical approaches available, and also considering the data restrictions, this seems the most adequate approach to the study of the relationship between the government's total deficit and the interest rate.

During the last few years, a considerable amount of research has been focused on the issue of causality in

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[10] For instance, the single-equation representations of the interest rate depend on the researcher's subjective pre-choice of the background theoretical model, which indicates the variables to be included in the estimation. Knot (1996) presents a more extensive enumeration of the merits and disadvantages of these models in a study of the relation deficits/interest rates.

[11] Miller and Russek (1996) compare three alternative econometric methods which have evolved as a reaction against the methodology based on the Cowles Commission approach: *Bayesian* (from the pioneer work of E. Leamer), *LSE methodology* (identified with D. Hendry) and *VAR* (C. Sims). Applying these three methodologies to analyse the connection between deficits and interest rates, they conclude that the empirical results are sensitive to the econometric method preferred.

the context of the VAR and of its resticted form, the VECM. The standard Granger non-causality tests in the context of a VAR in levels are applied to the following representation

(1) $$z_t = c + \sum_{i=1}^{p} \lambda_i ir_{t-i} + \sum_{i=1}^{p} \eta_i def_{t-i} + \varepsilon_t ,$$

where *z* is a vector containing *ir* and *def*, respectively the interest rate and the government total deficit, and *c* is a constant term. With stable VAR models, the tests of *block non-causality* are then performed by using a Wald test of the joint significance on the coefficients of all lagged terms.

These tests are correct provided the *true* order of integration of the variables involved is zero. However, if the series are integrated and possibly cointegrated, the tests involve nonstandard asymptotic distributions and also nuisance parameters (as shown by Park and Phillips, 1989). This means that the limiting distribution under the null hypothesis has to be simulated for each particular case, which is certainly very laborious and may be even impossible (see, for example, Dolado and Lütkepohl, 1996)

Therefore, in the presence of integrated variables, the standard procedure was to use a VAR specification in first differences, or a VECM in case of cointegration between the variables. In the latter case, the tests are based on the model

(2) $$\Delta z_t = \Pi z_{t-1} + \sum_{i=1}^{p-1} \lambda_i \Delta ir_{t-i} + \sum_{i=1}^{p-1} \eta_i \Delta def_{t-i} + \varepsilon_t ,$$

where $\Pi=\alpha\beta$ is a square matrix with four elements $\Pi_{i,j}=\alpha_i\beta_j$ (*i,j=ir,def*).

Suppose we are interested in testing, for example, whether interest rates are caused, in the Granger sense, by the government's deficit. The testing procedure consists basically in assessing the joint significance of all the lagged differenced terms of def_t (the coefficients η) and the error correction term (coefficient α_{def}), using a conventional Wald test. The resulting statistic is then compared with the critical values taken from the chi-square distribution (applications of this procedure can be found, for example, in Silvestre, 1997).

This procedure has also been shown not to be entirely correct, since Toda and Phillips (1993) have demonstrated that these tests do not have a chi-square distribution, unless some particular restrictions on the rank of the matrix $\Pi=\alpha\beta$ (the coefficients of the lagged levels endogenous variables) hold. More specifically in the case analysed here, they show that in the presence of cointegration, the Wald test statistic has only an asymptotically valid chi-square distribution if $rank(\beta_{ir})=1$ or $rank(\alpha_{def})=1$. This results from the fact that the VECM involves the nonlinearity $\Pi=\alpha\beta$ (see, for example, Yamada and Toda, 1998). Furthermore, the traditional testing procedure is conditioned by a previous sequence of integration and cointegration tests between the variables, and therefore it may suffer from important pre-test biases (given the low power of these tests in finite samples and its dependence on nuisance parameters).

These findings incentivated the development of several alternative testing procedures. Toda and Phillips (1993), for example, indicate a correct methodology to apply the appropriate tests based on the VECM. However, their procedure is very intricate and difficult to apply in practice, and has not been widely adopted in the empirical literature (see, for example, Toda and Yamamoto, 1995, and Mills, 1998).

An alternative approach was proposed by Toda and Yamamoto (1995) and by Dolado and Lütkepohl (1996), and it became later known as *Lag-Augmented Var Approach*, abbreviated by LA-VAR. These papers examine the question of testing restrictions on the parameters of the VAR when there is uncertainty concerning the correct order of integration and cointegration of the variables. Their idea is to make Wald tests well-behaved by reducing the efficiency of parameter estimators. Since the problems with the traditional tests arise from the singularity of the asymptotic distribution of the least squares estimators of the coefficients of the VAR, the solution was to eliminate the singularity by estimating a VAR model with a order higher than the correct[12] (see, e.g., Dolado and Lütkepohl, 1996).

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[12] The finding of the correct order also involves the possibility of some pre-testing bias. However, this is present in the standard procedure as well.

When there is the suspicion of cointegration between the variables, the procedure is to estimate the VAR model in levels, but increasing it intentionally with one more lag (if the variables involved are, at most, I(1)[13]) than suggested by the usual order selection criteria. The test is then based on the standard Wald statistic of the significance of all lagged terms except the last one (for applications see, for example, Mills, 1998). One necessary condition is that the order of integration of the process is not higher than the true lag length of the model.[14] The introduction of the additional lag, which should be zero under the null hypothesis, is necessary to allow the test to become asymptotically chi-square. This allows the use of the standard Wald tests.

One other advantage of this test is that it does not require a pre-test of integration/cointegration of the series, avoiding possible pre-test biases. This may be particularly useful when there are doubts about the existence of a cointegration relationship between the variables but there are some hypothesis of restrictions on the parameters to be tested. If, for example, the primary intention when applying the VAR model is not to test cointegration but to test the hypothesis of Granger causal relations between the variables, independently of being or not cointegrated, this approach offers a very simple procedure. However, it is important to keep in mind that the model estimated is only a technical device for testing causality, it is not conceived for inference or forecast.

The main problem with this approach is that it has lower power[15], relatively to the Toda and Phillips (1993) approach, and it is also less efficient, due to the overfit of the VAR model, i.e., the presence of the additional, redundant terms. However, this depends on the number of variables and lagged terms in the model, as well as on the true order of integration of the series. The shorter the number of variables included and the longer the lag length, the smaller will be the inefficiency caused by the inclusion of the extra lag(s). In this case, the pre-test biases from the unit root and cointegration tests may be more serious.[16]

Because of these possible problems of loss of power and inefficiency of this approach, Toda and Yamamoto (1995) suggest the use of this procedure as a complement to the conventional analysis. Their suggestion will be followed in this paper. The methodology used in each case depends on the order of integration of the variables involved and whether they are cointegrated or not. With nonstationary but cointegrated variables, the non-causality tests are performed in the context of the VECM. In all other cases, the tests are performed in the VAR, with the nonstationary variables pre-converted into a stationary process by the precise degree of differencing suggested by the ADF tests of Table 1.

6. The relation deficit - interest rate

Table 3 presents the synthesised results of the tests on the causal relationship between the central government's total surplus and the nominal interest rate. This table shows the order of integration of the variables involved in the model, the dummy variables necessary to induce well-behaved residuals, the results of the appropriate non-causality tests, and the lag-order of each model. When there is no unanimous result concerning the order of integration of a variable (as for example the UK's total deficit in the next table), both possibilities are considered, and non-coincident results are reported.

[Table 3 about here]

With the only exception of the United Kingdom, the tests indicate a strong and positive causal relationship running from the nominal interest rate to the total deficit of the central government. This suggests that,

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[13] The general rule is to introduce as many additional lags as the maximum suspected order of integration of the variables involved.

[14] Since the variables involved in the budget constraint are all I(1) at most, this procedure is always valid in the sample analysed in this paper.

[15] In fact, Yamada and Toda (1998) show that generally the LA-VAR test is less powerful than the other two (VECM and FM-VAR), but it is superior to the others in terms of size. They found a trade-off between size and power of the different tests, which must be considered when interpreting the results of empirical applications.

[16] Dolado and Lütkepohl (1996) demonstrate this by using Monte Carlo simulations.

contrary to the *standard* economic theory, it is usually the nominal interest rate that affects the government's deficit and not the contrary. This relation reflects the importance of the interest expenditures on the government's deficit, and depends on the amount of outstanding debt.
Illustrating this is the fact that a long-term equilibrium relationship was only found in Belgium and Italy. These are the only two countries where the value of the debt exceeds the present value of each respective GDP, leaving the deficit highly vulnerable to interest rate changes. In Belgium for example, "a 1 percentage point drop in the average or effective interest rate paid on government debt translates into a decrease in the budget deficit of 1.3 per cent of GDP" (OECD *Economic Surveys*, 1997:43). In Italy, this same point drop in the interest rate, maintained over the 1995-2000 period would by itself "reduce the debt-GDP ratio directly by almost 5 points by the year 2000" (OECD *Economic Surveys*, 1997:66).
The effect of the deficits on the nominal interest rate appears only in the case of Italy, where a bidirectional and positive causal relationship was found between these two variables. It indicates the existence in this country of a self-fulfilling continuous cycle of nominal interest rate increases and budget deterioration, raising concerns about the sustainability of the italian fiscal policies.
The next table examines this relationship but using the long-term *ex post* real interest rate, computed as the difference between the nominal rate on public bonds and the growth rate of the consumer price index. One first observation is that the variables in the model usually present different orders of integration, restricting the choice of non-causality tests available. This can also be considered a prior indication of a possible lack of relationship between the variables.

[Table 4 about here]

When considering the real interest rate, the only two significant effects found, at the usual levels of significance, suggest a negative relation. In Germany the real rate has a negative effect on the level of the total deficit. The inverse effect, from the deficit to the real interest rate, appears in Italy (and the Netherlands, but it is a very weak effect) but also seems to be negative[17], as can be more informally confirmed in Figure 2, for example.
The negative impact of the deficit on the real interest rate in Italy may be a consequence of a monetisation policy during this period. If the government reacts for example to a deterioration of the deficit by increasing the seigniorage revenues, the monetary easing will probably reduce the nominal interest rate and/or increase the inflation rate, and therefore the real interest rate tends to decrease.
The lack of empirical evidence on the effect of the deficits on the real interest rate, contrary to what the *standard* economic theory would suggest, has been documented in several empirical papers[18] and justified by several arguments. Evans (1985), for example, explains it by the Ricardian Equivalence Proposition, while Passet (1997) claims that the level of the real interest rate is dictated by the central bank's reaction function.

7. General government fiscal variables and the interest rate

This section will examine whether the results obtained above are affected by using a different, higher level of the government accounts. The general government accounts includes the central, local and regional governments, and the social security funds. The relative contribution of these elements to each country's fiscal position varies widely across the sample.
The results of the unit root tests on the fiscal variables can be found in Table 1. For Belgium and Italy, for whom there is now a very slightly shorter sample available, the unit root tests (not shown) were repeated for the interest rate variables. Table 5 presents the results of the non-causality tests.

[Table 5 about here]

[17] The correlation coefficient between the two variables is -0.04.
[18] See, for example, Boothe and Reid (1989) and Smithin (1994) for Canada, Evans (1985) and Kolluri and Giannaros (1987) for the United States.

With the exception of Italy and the Netherlands, for all the other countries considered the tests of non-causality suggest a strong and positive causal effect running from the nominal interest rate to the general government total deficit.[19] The inverse effect also appears, but only in the cases of Belgium and Italy, the two most indebted countries in the group under analysis.[20]

The sporadic differences in results when using central or general government data highlight particularly the importance of the social security funds. In Belgium, for example, there is now a causal effect from the deficits to the nominal interest rate which did not appear with the central government's data. In fact, Belgium is the only country where on average for the entire period considered here, the deficits of the general government have been higher than those of the central government.

This may justify the evidence of a self-sustained cycle of deficits and interest rate increases in Belgium, which previously have only appeared in Italy, with central government data. Using precisely the general government data, the OECD (1992:29) alert that in Belgium "the snowball effect - i.e. the self-sustaining increase in the debt/GNP ratio as a result of interest payments - which had been arrested in 1989, resumed".

All the tests performed so far do not reveal whether the relations found between the fiscal variables and the interest rates are the result of domestic fundamentals in each country, or if there are common external influences concealing or emphasising the influence of these fundamentals. The next two sections will try to distinguish these effects, by analysing the interest rate differentials, which remove the external influences, and then the aggregate variables, which focus exclusively on those external determinants.

8. The interest rate differentials: fiscal discipline through the financial markets

By examining the interest rate differential to some average or third country interest rate, and comparing the results with those obtained with the domestic interest rate, it is possible to observe the extent to which external factors constrain the effects of internal influences on the domestic rate. Those external influences are typically proxied, for the EU countries, by German (Craig, 1994, and Knot, 1998) or US interest rates (Ibrahim and Kumah, 1996).

One interesting possibility, analysed by several authors, is the hypothesis that financial markets may discipline national government's fiscal policy. Interest rates on public bonds of less disciplined governments would increase relatively to the others.[21] This situation can be more easily depicted by dividing the causes of an interest rate differential, with perfect capital mobility, into

(3) $$i - i^* = \Delta er^e + ferp + drp\,,$$

where the left-hand side is the difference between the domestic and the foreign long-term interest rates on government bonds with identical maturity, liquidity and tax treatment, Δer^e is the depreciation expectation, *ferp* represents the foreign exchange risk premium, and *drp* is the default risk premium.

Equation (3) allows a better understanding of the way interest differentials react to the fiscal position of a government under different exchange rate systems and how things will change in the particular case of the European Union, with EMU. The exchange-rate-related determinants of the interest rate (the first two elements on the right-hand side) depend on the exchange rate system adopted and will disappear within a monetary union. The default risk premium will remain, with perfect capital mobility, as the only determinant of the interest rate differentials. Some authors even claim that the disappearance of the other two factors may not lead necessarily to a narrowing of the interest rate differentials because the default risk premium may increase in a monetary union. This premium will be larger the more credible is the no-bailout rule of the Maastricht Treaty, prohibiting the European Central Bank from buying public debt directly from the

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[19] In fact, in Italy "the central government is the chief beneficiary of lower interest rates" (OECD *Economic Surveys*, 1996:41).

[20] The tests were also performed with the real rate, but the results do not reveal any important relationship and therefore are not shown here.

[21] Besides this effect on interest rate differentials, financial markets may also discipline governments through the *depreciation threat* (Heinemann, 1998).

issuer.[22]

The interest rate used in this sub-section is the difference between the domestic rate and the U.S. (until 1971) or the German (after 1972) rates, and is represented by i^d. The choice of these two reference countries in these two particular time periods is motivated by their anchor functions in, respectively, the Bretton Woods fixed exchange rate system and the European Monetary System.

The only significant result of the tests (Table 6) suggests a bidirectional positive relationship between the italian total deficit and the nominal interest rate deviation from the U.S. and German rates.[23] It suggests that an increase in the italian's government deficit will cause its nominal interest rate to increase relatively to the foreign rate which, in turn, will further deteriorate the fiscal balance. Italy seems to be the only country where domestic fiscal determinants play an important role in defining the nominal interest rate.

[Table 6 about here]

One other interesting result from these tests is that while using the domestic individual interest rates it was found that they have a strong positive impact on the deficit, with interest rate differentials that causal effect is only statistically significant (at the usual levels) in the case of Italy. This suggests that for all other countries this effect is primarily driven either by external factors or by similar movements in the domestic interest rates. The next section examines this hypothesis.

Using a smaller sample and monthly data (1987.01-1993.12) for a similar group of countries, Craig (1994) found that only in Belgium did the deficit affect the interest rate differential with Germany. He uses general government data from the OECD, which confirms the importance of the social security funds and the regional authorities in this country, as previously found in section 7. Ibraim and Kumah (1996), using the short-term interest rate differential with the US rate, also conclude that variations in the differential in Germany and the United Kingdom, among other countries, are explained more by monetary than by fiscal innovations. Knot (1998) reports mixed conclusions, with the long-run interest differentials being usually affected by the deficits and the short-term differentials not affected.

The results in this section do not support the existence of market discipline. With the exception of Italy, there is no evidence suggesting that investors differentiate between different fiscal positions by including significantly different risk premia on the interest rates of bonds placed by the governments.

9. European-wide effects

As noticed from the observation of Figure 2, the interest rates in the European Union have followed a similar general pattern across countries, both in nominal and real terms. The nominal interest rate exhibits a double peak, with significant increases in the aftermath of both oil crisis, and a third less pronounced peak in the beginning of the nineties, probably due to the impact of the German unification process. The real interest rate has fallen suddenly and almost simultaneously in all EU countries in the mid-1970s, reaching in general negative values, recovering in the early 1980s to stabilise in the last decade at levels above those prior to the 1970s.

Christiansen and Pigott (1997) found evidence of an increase in the covariation of long-term interest rates among some EU countries in the 1990s, implying that the interest rates became possibly less subject to the influence of domestic determinants. Using panel data techniques, Gagnon and Unferth (1995) found an high correlation of *ex post* real interest rates across OECD countries for the period 1977-93. Lemmen (1996) found evidence of financial market's integration among the countries participating in the EMS.

These common trends in the evolution of the interest rates and also, to a certain extent, of the fiscal variables, suggest the importance of analysing the common factors in the relationship between these variables. Several authors[24] have suggested that, in a market with high capital mobility, it is the aggregate

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[22] Art. 21 of the Protocol on the European System of Central Banks.

[23] The results of the same test but with the real interest rate differentials do not reveal any statistically significant positive relationship, and therefore will also not be presented here.

[24] See, for example, King (1995:172) and Nunes and Stemitsiotis (1995:426).

fiscal variables which influence interest rates. The growing integration of world financial markets allows governments to finance their deficits through external borrowing, possibly spreading the effects of deficits and reducing its domestic consequences.

While in the previous section the intention was to examine exclusively the influence of internal factors acting through the risk premia, removing all the external influences, this section is concerned only with those common elements in the determination of the interest rates. Disregarding the different fiscal evolution of the individual countries, the tests concentrate on the explanation of its average development.

One other potential advantage of studying the aggregate relationship is the stability of the model. In the literature on aggregate money demand functions in the European Union, it has been argued that an aggregate money demand function is more stable than its individual country counterparts (see, for example, Knot, 1996 and Cassard *et al.*, 1997).

This section will examine the relationship between the aggregate total deficit of the six countries under analysis, and the average interest rate (Figure 3). The fiscal variables of each country were first converted into dollars using the average market exchange rate (line *af* of the IFS), aggregated, and then divided by the aggregate GDP (computed in the same way). The average interest rate was weighted by the proportion of each country's GDP on the total of the six countries for each year.[25]

[Figure 3 about here]

The results of the unit root tests on the series of the aggregated variables are shown on the first columns of Table 7. With the exception of the real interest rate, the aggregated series seem to possess a unit root.

[Table 7 about here]

The tests above suggest, in broad terms, that the aggregate deficit of the six european countries is affected by both the nominal and the real interest rates, while the opposite relation, suggested in the theoretical literature, was not found. This confirms the general results of the individual tests with the nominal rate. It also extends the same conclusions for the case of the real rate, for which the individual tests were not powerful enough to indicate any statistically significant result.

Using a reduced-form equation derived from an IS/LM model, Knot (1996) also found evidence of a positive relationship between the aggregate deficit and the nominal interest rate, in a group of five EU countries. However, he interprets it as evidence that the deficits affect the nominal interest rate, not the opposite. In contrast, Evans (1987) did not find any relationship between the aggregate deficit and the real interest rate of six OECD countries.

10. Summary of the main results and policy implications

The relationship between the fiscal variables and the long-term interest rate on public bonds was tested in this paper using fundamentally Granger non-causality tests. The *standard* tests in the context of the VAR in levels with stationary variables, or in first differences with nonstationary and non-cointegrated variables, or the VECM with nonstationary but cointegrated variables. These were complemented by the more recent, but less powerful, approach to non-causality testing in the context of a LA-VAR model.

In order to check the robustness of the results, some of them contradicting the conventional macroeconomic theory, several additional tests were performed. One of the main concerns was to account for the possibility of structural breaks influencing the results of the tests. On the one hand, the sample was truncated either by removing the first, more volatile, observations or by using only the second part of the total sample, due to the major macroeconomic events coinciding in the beginning of the 1970s. On the other hand, with the full sample, exogenous variables or intervention dummy were introduced in the model

[25] All the tests were also performed with simple averages of the ratio of the total surplus to GDP and the nominal and real interest rate, without affecting any conclusion. Nunes and Stemitsiotis (1995) used as weights of the aggregated interest rates the share of the country in SDR composition, while the fiscal variables were weighted by the country's share in total GDP.

to explain the breaks and whiten the residuals.

The tests were performed primarily with central government variables, but also in a broader level of the government accounts, the general government. A comparison of the results highlights the importance of the regional governments and the social security funds on each country's fiscal position. Finally, the previous two sections examined the relative importance of domestic and external factors in explaining the relation between the variables. In order to remove the effect of common factors affecting this relationship, interest rate differentials (in terms of the US rate until 1971 and the German rate afterwards) were tested against the fiscal variables in section 8. In the following section, the variables were aggregated, to evaluate the effects on a european-wide scale.

Several interesting conclusions may be extracted from all the above tests. In the first place, it was found that in general terms and with the exception of Italy, there is no evidence showing that government deficits have a positive impact on the nominal interest rates. On the contrary, the empirical evidence strongly suggests that, for example, an increase in the nominal interest rate Granger-causes an increase in the deficit.

The interest rate affects the government's budget constraint through basically two channels. Directly, because an higher interest rate increases the interest payments on public bonds. Indirectly, because higher interest rates may reduce economic growth, increasing the public transfers to the private sector, and reducing tax revenues. These effects are also due to the inertia of the primary surplus, which is very difficult, for economic, political and even institutional reasons, to adjust with sufficient haste and flexibility.

Italy, with central, and Belgium, with general government data, are the only countries where a bidirectional relationship was found between the deficit and the nominal interest rate, suggesting the existence of a vicious, self-sustained cycle between these variables. Both countries share a history of high deficits and debt since the early 1970s, well above any of the other countries in the sample.

Considering the real interest rate, the tests show in general no evidence that it is positively affected by deficits in any country. This relation either does not appear in the results, or is negative, or only the opposite negative effect was found. This conclusion is also usually supported using central or general government data, interest rate differentials or domestic rates, and aggregate variables.

Several authors suggest that the most adequate explanation for this lack of empirical evidence of the effects of the deficits on the interest rate is the Ricardian Equivalence Proposition. However, other theoretical explanations have also been advanced in the literature, reviewed in sub-section 2.2, such as the integration of the financial markets or the proposition that the interest rate is fundamentally a monetary and not a fiscal phenomenon.

From all these conclusions, several policy implications may be inferred. The first general inference from the tests is that in general, apart from the mentioned case of Italy, there seems to be no reason to fear the *crowding out* effects of deficits caused by their pressure on the interest rate. Therefore, a policy of fiscal consolidation, especially in a situation of economic recession, would further deteriorate the economic conditions (see, for example Tobin, 1993) without reducing by itself the interest rate.

One other meaningful policy implication from this paper's findings concerns the actions of the monetary authorities. If the central bank maintains a very tight monetary policy, with high interest rates, to confront inflationary pressures, this will put a burden on the government's budget accounts. The consequences are harder for those countries with a large stock of public debt accumulated. The considerable amount of interest payments on this debt will demand rising primary surpluses or seigniorage revenues in order to keep the global deficit at low levels.

This compensation for a growing interest burden is certainly more difficult in a monetary union. On the first place, the member states no longer control their seigniorage revenues. Secondly, the primary surplus, usually slow to react, is even more constrained in a monetary union, due to the tax harmonisation policies and the tendency for the uniformisation of some spending categories, notably wages and social transfers.

References

ALESINA, A., DE BROECK, M., PRATI, A. and TABELLINI, G. (1992) Default Risk on Government Debt in OECD Countries, *Economic Policy*, 427-463.

ALLEN, S. and WOHAR, M. (1996) The Differing Effects of Pre- and Post-1981 Federal Budget Deficits on Tax-Adjusted Real Interest Rates, *Applied Economics*, 28, 45-53.

ARORA, H. and DUA, P. (1995) Long-Run Equilibrium Between Budget Deficits and Long-Term Interest Rates, *International Advances in Economic Research*, 1(1), 23-31.

ASCHAUER, D. (1985) Fiscal Policy and Aggregate Demand, *The American Economic Review*, 75, 117-128.

BAILEY, M. (1962) *National Income and the Price Level: A Study in Macrotheory*, McGraw-Hill.

BAILEY, M. (1972) The Optimal Full-Employment Surplus, *Journal of Political Economy*, July/August, 649-661.

BARRO, R. (1974) Are Government Bonds Net Wealth?, *Journal of Political Economy*, 82(6), 1095-1117.

BAYOUMI, T., GOLDSTEIN, M. and WOGLOM, G. (1995) Do Credit Markets Discipline Sovereign Borrowers? Evidence from US States, *CEPR*, Discussion Paper 1088.

BISHOP, G., DAMRAU, D. and MILLER, M. (1989) 1992 and Beyond: Market Discipline CAN Work in the EC Monetary Union, *Salomon Brothers*.

BOOTHE, P. and REID, B. (1989) Asset Returns and Government Budgets in a Small Open Economy: Empirical Evidence for Canada, *Journal of Monetary Economics*, 23(1), 65-77.

CASSARD, M., LANE, T., and MASSON, P. (1997) Core ERM Money Demand and Effects on Inflation, *The Manchester School*, 65(1), 1-24.

CEBULA, R. (1997) A Note on the Impact of the United States Federal Budget Deficit on the Intermediate-Term Interest Rate, 1960-94, *Applied Economics Letters*, 4, 711-714.

CEBULA, R. (1998) An Empirical Analysis of the Impact of Federal Budget Deficits on Long-Term Nominal Interest Rate Yields, 1973.2-1995.4, Using Alternative Expected Inflation Measures, *Review of Financial Economics*, 7(1), 55-64.

CHRISTIANSEN, H. and PIGOTT, C. (1997) Long-Term Interest Rates in Globalised Markets, *Economics Department Working Papers*, 175, OECD.

CORSETTI, G. and ROUBINI, N (1992) Tax-smoothing Discretion Versus Balanced Budget Rules in the Presence of Politically Motivated Fiscal Deficits: the Design of Optimal Fiscal Rules for Europe after 1992, *CEPR*, Discussion Paper no. 682.

CRAIG, R. (1994) Who Will Join EMU? Impact of the Maastricht Convergence Criteria on Economic Policy Choice and Performance, *International Finance Discussion Papers*, Board of Governors of the Federal Reserve System, 480.

DARRAT, A. (1989) Fiscal Deficits and Long-Term Interest Rates: Further Evidence from Annual Data, *Southern Economic Journal*, 56(2), 363-374.

DOLADO, J. and LÜTKEPOHL, H. (1996) Making Wald Tests Work for Cointegrated VAR Systems, *Econometric Reviews*, 15(4), 369-386.

EICHENGREEN, B. (1990) One Money for Europe? Lessons from the US Currency Union, *Economic Policy*, 5, 10, 118-187.

ELMENDORF, D. and MANKIW, N. (1998) Government Debt, *Finance and Economics Discussion Series*, Federal Resserve Board.

EUROPEAN COMMISSION (1998) Broad economic policy guidelines *European Economy 66*.

EVANS, P. (1985) Do Large Deficits Produce High Interest Rates?, *The American Economic Review*, 75, 68-87.

EVANS, P. (1987) Do Budget Deficits Raise Nominal Interest Rates? Evidence from Six Countries, *Journal of*

Monetary Economics, 20, 281-300.

FELDSTEIN, M. (1982) Government Deficits and Aggregate Demand, *Journal of Monetary Economics*, 1-20.

FELDSTEIN, M. and HORIOKA, C. (1980) Domestic Saving and International Capital Flows, *The Economic Journal*, 90, 314-329.

GAGNON, J. and UNFERTH, M. (1995) Is There a World Real Interest Rate?, *Journal of International Money and Finance*, 14(6), 845-855.

GOLDSTEIN, M. and WOGLOM, G. (1992) Market-Based Fiscal Discipline in Monetary Unions: Evidence from the US Municipal Bond Market, in M. Canzoneri, V. Grilli and P. Masson (eds.), *Establishing a Central Bank: Issues in Europe and Lessons from the US*, Cambridge University Press, 228-260.

GOODFRIEND, M. (1993) Interest Rate Policy and the Inflation Scare Problem: 1979-1992, *Federal Reserve Bank of Richmond Economic Quarterly*, 79(1), 1-24.

GOODHART, C. (1989) Monetary Base, in *The New Palgrave: Money*, E. Milgate and P. Newman (eds.), MacMillan, 206-211.

GOODHART, C. (1996) The Transition to EMU, *Scottish Journal of Political Economy*.

GRAZIANI, A. (1990) The Theory of the Monetary Circuit, *Economies et Sociétés: Monnaie et Production*, 7(6), 7-36.

HEINEMANN, F. (1998) EMU and Fiscal Discipline: The End of the Depreciation Threat, *Zentrum für Europäische Wirtschaftsforschung GmbH Discussion Paper*, 98-30.

HOELSCHER, G. (1986) New Evidence on Deficits and Interest Rates, *Journal of Money, Credit, and Banking*, 18(1), 1-17.

IBRAHIM, S. and KUMAH, F. (1996) Comovements in Budget Deficits, Money, Interest Rates, Exchange Rates and the Current Account Balance: Some Empirical Evidence, *Applied Economics*, 28, 117-130.

KALDOR, N. (1982) The Scourge of Monetarism, *Oxford University Press*.

KING, M. (1995) Commentary: Monetary Policy Implications of Greater Fiscal Discipline, in *Budget Deficits and Debt: Issues and Options*, Federal Reserve Bank of Kansas City, 171-183.

KNOT, K. (1996) *Fiscal Policy and Interest Rates in the European Union*, Edward Elgar Publishing Limited.

KNOT, K. (1998) The Fundamental Determinants of Interest Rate Differentials in the ERM, *Applied Economics*, 30, 165-176.

KOLLURI, B. and GIANNAROS, D. (1987) Budget Deficits and Short-Term Real Interest Rates Forecasting, *Journal of Macroeconomics*, 9 (1), 109-125.

KORMENDI, R. (1983) Government Debt, Government Spending, and Private Sector Behavior, *The American Economic Review*, 73, 994-1010.

LANE, T. (1993) Market Discipline, *IMF Staff Papers*, 40, 1, International Monetary Fund, 53-88.

LAUMAS, G. (1989) Anticipated Federal Budget Deficits, Monetary Policy and the Rate of Interest, *Southern Economic Journal*, 56(2), 375-382.

Le BOURVA, J. (1992) Money Creation and Credit Multipliers, *Review of Political Economy*, 4(4), 447-466.

LEMMEN, J. (1996) Financial Integration in the European Union: Measurement and Determination, *Centre for Economic Research*, Tilburg University.

McMILLIN, W. (1986) Federal Deficits and Short-Term Interest Rates, *Journal of Macroeconomics*, 8, 403-422.

MILLER, S. and RUSSEK, F. (1996) Do Federal Deficits Affect Interest Rates? Evidence from Three Econometric Methods, *Journal of Macroeconomics*, 18(3), 403-428.

MILLS, T. (1998) Recent Developments in Modelling Nonstationary Vector Autoregressions, *Journal of Economic Surveys*, 12(3), 279-312.

MOORE, B. (1988) *Horizontalists and Verticalists: The Macroeconomics of Credit Money*, Cambridge University Press.

NUNES, J. and STEMITSIOTIS, L. (1995) Budget Deficit and Interest Rates: Is There a Link? International Evidence, *Oxford Bulletin of Economics and Statistics*, 57(4), 425-449.

OECD (1992) *OECD Economic Surveys*, Organisation for Economic Co-Operation and Development, several issues.

OECD Economic Surveys (several issues) Organisation for Economic Co-operation and Development.

PARK, J. and PHILLIPS, P. (1989) Statistical Inference in Regressions with Integrated Processes II, *Econometric Theory*, 5, 95-131.

PASSET, O. (1997) Le Rôle des Déficits Publics dans la Formation des Taux d'Interêt, *Revue de l'OFCE*, 62, 29-74.

PERRON, P. (1989) The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis, *Econometrica*, 57(6), 1361-1401.

PERRON, P. and VOGELSANG, T. (1992) Nonstationarity and Level Shifts With an Application to Purchasing Power Parity, *Journal of Business and Economic Statistics*, 10(3), 301-320.

ROBERTSON, D. (1934) Industrial fluctuations and the natural rate of interest, *The Economic Journal*, 44, 650-656.

ROSE, D. and HAKES, D. (1995) Deficits and Interest Rates as Evidence of Ricardian Equivalence, *Eastern Economic Journal*, 21(1), 57-66.

SILVESTRE, A. (1997) The Causal Relationship between Taxes and Expenditures in Portugal: Cointegration and Error-Correction Models, *Estudos de Economia*, 18(1), 29-46.

SIMS, C. (1980) Macroeconomics and Reality, *Econometrica*, 48, 1-48.

SMITHIN, J. (1994) Cause and Effect in the Relationship between Budget Deficits and the Rate of Interest, *Economies et Sociétés*, MP 9, 151-169.

TOBIN, J. (1952) Asset Holdings and Spending Decisions, *The American Economic Review*, 42, 109-123.

TOBIN, J. (1993) Thinking Straight About Fiscal Stimulus and Deficit Reduction, *Challenge*, March-April, 15-18.

TODA, H. and PHILLIPS, P. (1993) The Spurious Effect of Unit Roots on Vector Autoregressions - An Analytical Study, *Journal of Econometrics*, 59, 229-255.

TODA, H. and YAMAMOTO, T. (1995) Statistical Inference in Vector Autoregressions with Possibly Integrated Processes, *Journal of Econometrics*, 66, 225-250.

WICKSELL, K. (1936) *Interest and Prices: A Study of the Causes Regulating the Value of Money*, MacMillan and Co..

WRAY, L. (1997) Deficits, Inflation and Monetary Policy, *Journal of Post Keynesian Economics*, 19(4), 543-571.

YAMADA, H. and TODA, H. (1998) Inference in Possibly Integrated Vector Autoregressive Models: Some Finite Sample Evidence, *Journal of Econometrics*, 86, 55-95.

Figures and Tables:

Figure 1: Demand and supply of savings

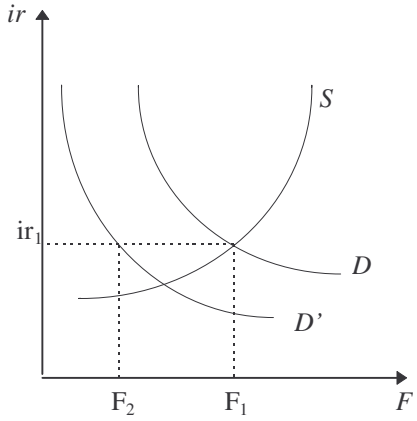
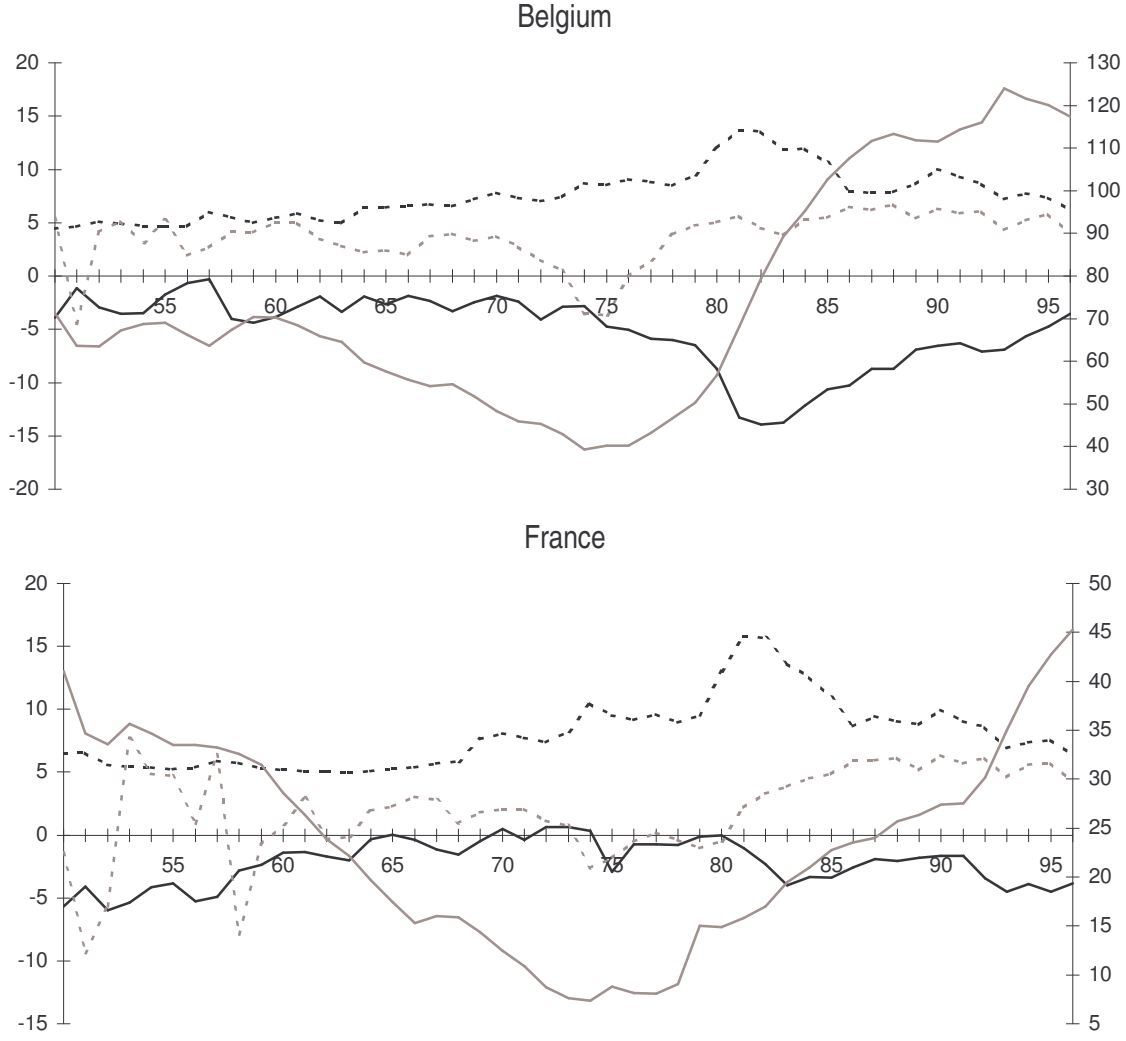


Figure 2: Debt, total surplus, nominal and real interest rates



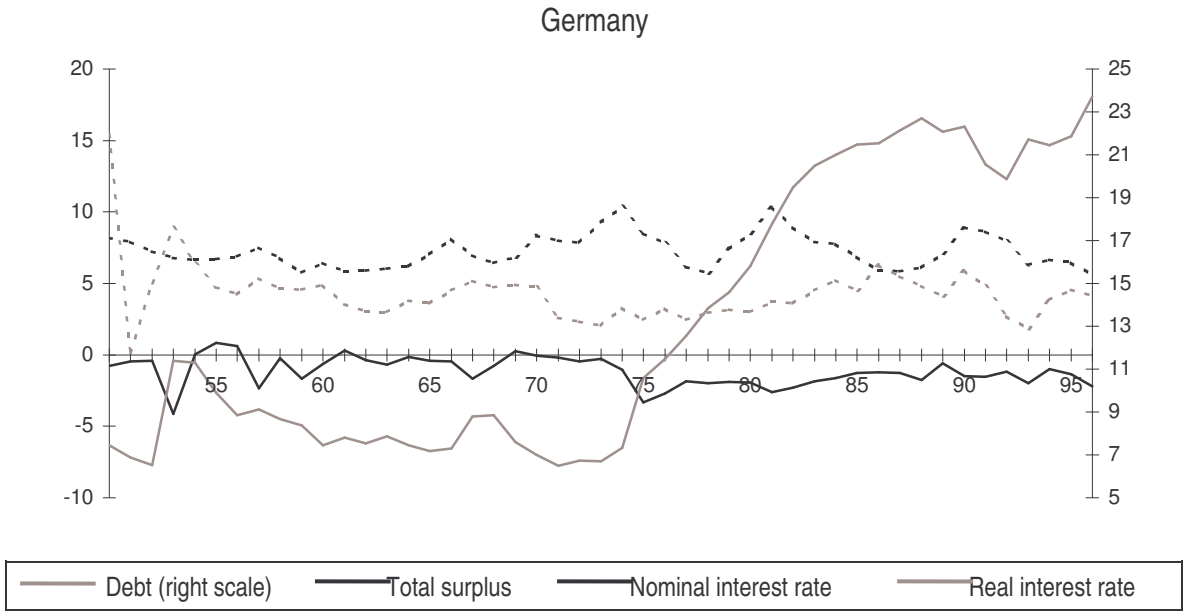
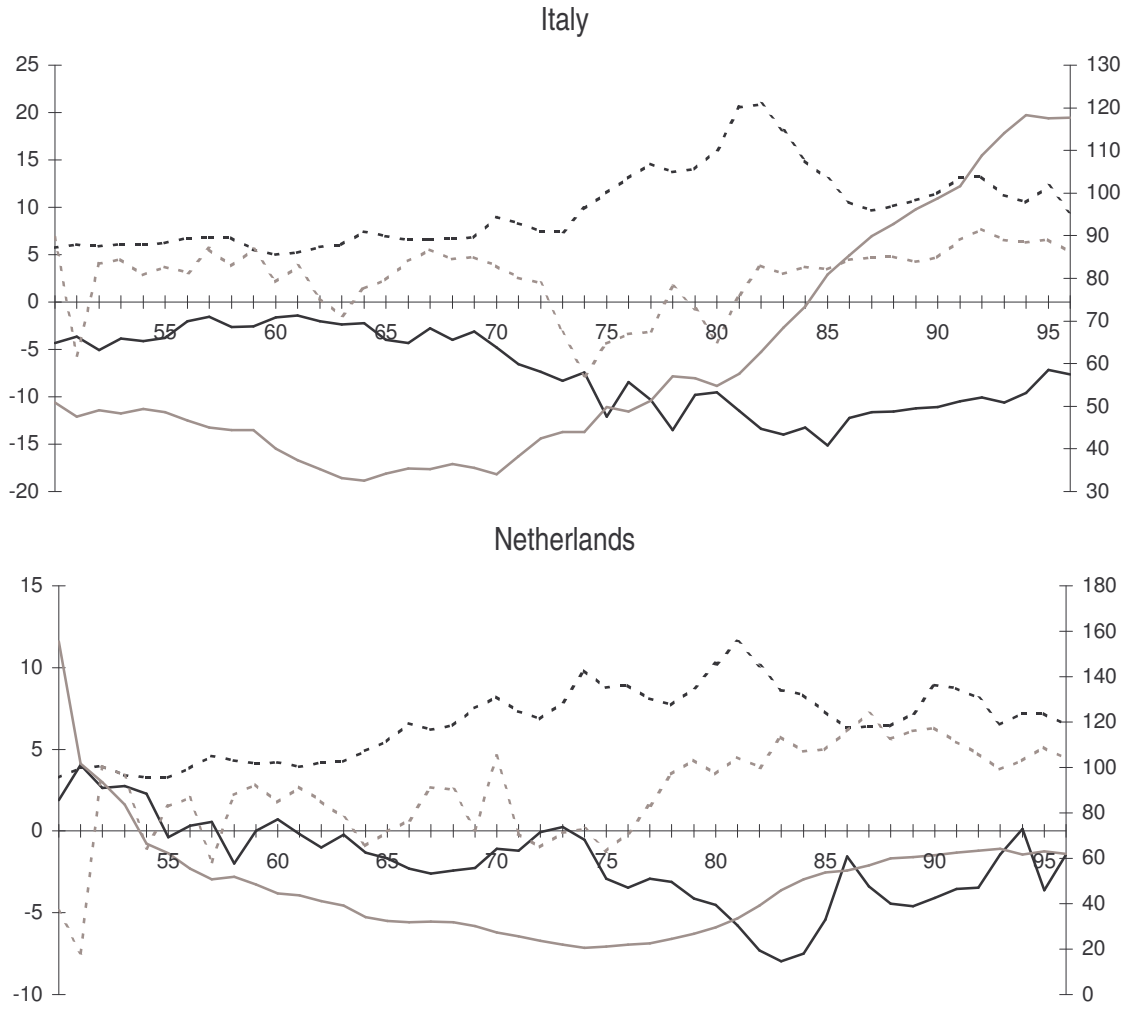


Figure 2: Debt, total surplus, nominal and real interest rates (cont.)



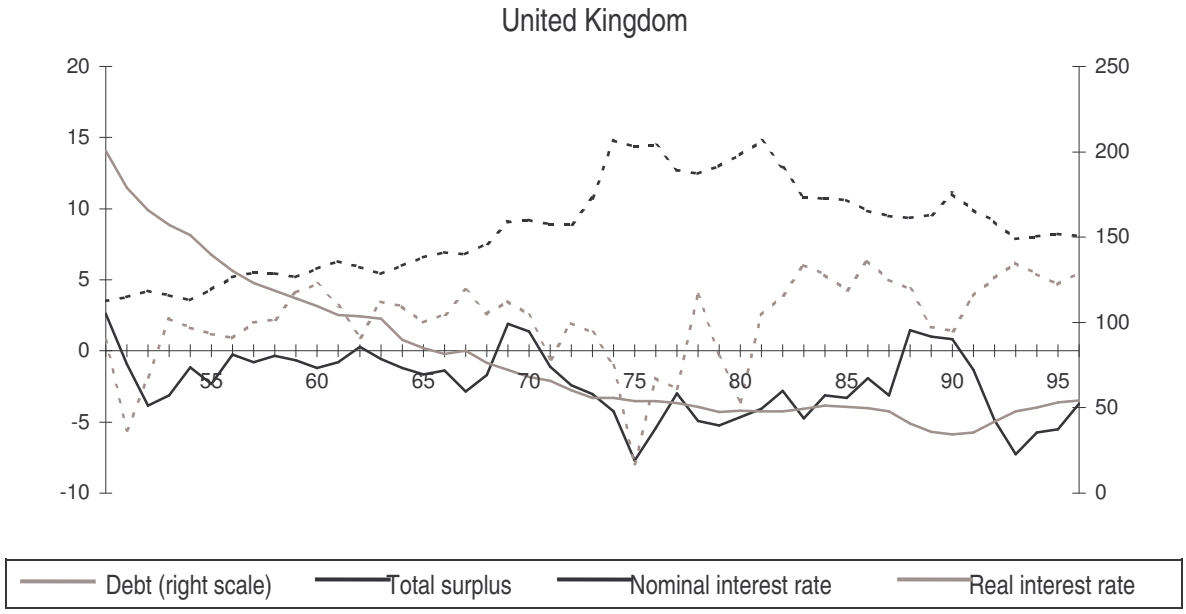


Figure 3: Central government's aggregate total surplus, nominal and real interest rates

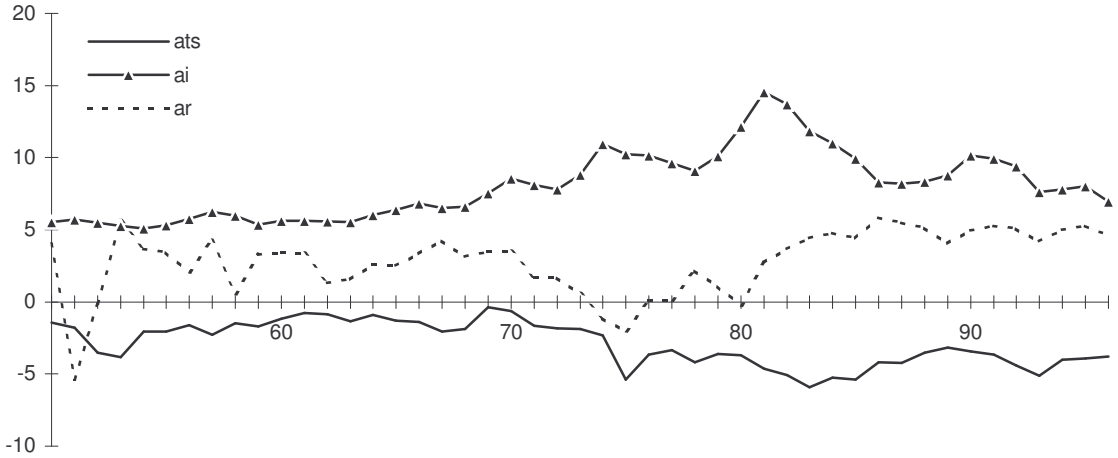


Table 1: Augmented Dickey-Fuller unit root tests

Test	Belgium	France	Germany	Italy	Netherlands	U. Kingdom
			nominal interest rate			
SBC	-1.9455 (1)	-1.8120 (1)	-3.9241** (1)	-1.9858 (1)	-1.7894 (0)	-1.7918 (1)
P	-1.9455 (1)	-1.8120 (1)	-3.9241** (1)	-1.9858 (1)	-1.9104 (1)	-1.7918 (1)
PV[1]	-2.6257 (1) [1973]	-2.8157 (1) [1972]	-4.8756** (1) [1969]	-3.5011 (1) [1974]	-3.6528 (1) [1965]	-2.6589 (1) [1968]
			real interest rate			
SBC	-3.5953** (0)	-3.9163** (0)	-2.8377* (2)	-3.3588** (0)	-1.1490 (2)	-3.3107** (0)
P	-3.5953** (0)	-3.9163** (0)	-2.8377* (2)	-3.3588** (0)	-1.1490 (2)	-3.3107** (0)
PV[1]	-5.6063*** (3) [1977]	-6.3197*** (2) [1981]	-2.9262 (2) [1982]	-3.1103 (3) [1981]	-3.6517 (2) [1977]	-4.8036** (0) [1981]
			total surplus (central government)			
SBC	-1.3384 (0)	-2.4347 (0)	-4.7637** (0)	-1.3984 (0)	-2.1618 (0)	-3.2308** (0)
P	-1.3384 (0)	-2.4347 (0)	-4.7637** (0)	-1.1295 (1)	-2.1618 (0)	-3.2308** (0)
PV[1]	-2.6773 (1) [1976]	-3.0665 (0) [1957]	-6.7379*** (0) [1974]	-3.7043 (0) [1971]	-3.0290 (0) [1974]	-4.1230 (1) [1971]
			total surplus (general government)			
SBC	-1.5385 (0)	-1.8753 (0)	-1.9929 (0)	-1.4768 (0)	-4.8338*** (0)	-2.8556* (1)
P	-1.5385 (0)	-1.8753 (0)	-1.5518 (1)	-1.4768 (0)	-4.3153*** (2)	-2.8556* (1)
PV[1]	-2.5956 (0) [1975]	-3.3544 (0) [1980]	-4.2607 (0) [1964]	-4.1780 (0) [1971]	-5.2498*** (2) [1977]	-4.6731 (1) [1972]
			nominal interest rate differential			
SBC	-2.0210 (0)	-1.9448 (0)	-1.9202 (0)	-2.4484 (1)	-3.5907** (1)	-1.7799 (0)
P	-2.0210 (0)	-1.9448 (0)	-1.9202 (0)	-2.4484 (1)	-3.5907** (1)	-2.1809 (1)
PV[1]	-2.7490 (0) [1976]	-2.5605 (0) [1976]	-3.4576 (0) [1974]	-4.1671 (1) [1975]	-4.6661** (2) [1983]	-3.2190 (1) [1973]
			real interest rate differential			
SBC	-2.7556* (0)	-4.8955** (0)	-4.5573*** (0)	-2.5873 (0)	-5.7084** (0)	-3.6119** (0)
P	-3.8255** (3)	-1.9606 (3)	-2.9145* (2)	-2.5873 (0)	-5.7084** (0)	-3.6119** (0)
PV[1]	-5.2451*** (3) [1961]	-5.5180*** (0) [1984]	-4.8547** (1) [1980]	-3.0298 (3) [1971]	-6.1340*** (1) [1977]	-4.8937** (0) [1970]

The number of lags (in parenthesis) is chosen by the Schwarz Bayesian Criterion (SBC) or the procedure suggested by Perron (P) of starting from a maximum lag length (3) and removing the last lagged term if not significant at the 10% level (in both cases, ensuring no serial correlation or heteroscedasticity in the residuals). If statistically significant, a trend is included in the model. (PV) indicates the sequential structural break test of Perron and Vogelsang (1992), additive outlier model with a break in the level (date of the break in square brackets). The asterisks *, ** and *** indicate that the null hypothesis of a unit root was rejected at the, respectively, 10%, 5% and 1% level of significance. Sample period [1950-96].

Table 2: Possible outcomes of the non-causality tests

	Hypothesis	Theoretical background	Main consequences	Policy implications
I	def → ir	Classical, monetarist view Keynes liquidity preference theory Neoclassical synthesis Markte discipline hypothesis	crowding-out of private investment and net exports, slower economic growth	need for fiscal restraint
II	ir → def	Post-keynesian *horizontalists*	tight monetary policies contribute to deteriorate the fiscal situation	monetary authorities must assume responsabi-lity for fiscal problems
III*	def → ir ir → def		self-sustained cycle of deficit and interest rate increases	possible need for coordi-nation of fiscal and monetary policies
IV	no effect	Ricardian equivalence proposition Financial markets integration	it is indifferent to finance expenditures by taxes or debt	other variables are more relevant in the determi-nation of interest rates and deficits

* If this is the true hypothesis, the studies which consider the deficit as an exogenous variable would be affected by problems of simultaneous-equation bias, producing biased and inconsistent estimates.

Table 3: Central government total surplus and nominal interest rate

		B	F	G	I	N	UK
Order of integration:							
ts		I(1)	I(1)	I(0)	I(1)	I(1)	I(0)/I(1)
i		I(1)	I(1)	I(0)	I(1)	I(1)	I(1)
Dummies[1]		1980,81	1980,81	1953,81	1981		1974
Non-causality tests:							
VECM[2]	i → ts	30.8727***	n.c.	---	15.0226***	n.c.	n.c.
		[.000]			[.001]		
	ts → i	0.3913			23.8820***		
		[.532]			[.000]		
	order	1			2		
VAR[3]	i → ts	---	6.8067***	6.9819**	---	6.5272**	0.0018
			[.009]	[.030]		[.011]	[.966]
	ts → i		1.2195	0.1540		0.4619	0.7863
			[.269]	[.926]		[.497]	[.375]
	order		1	2		1	1
LA-VAR	i → ts	7.4381***	5.4712**	---	13.6119***	6.6420***	0.1205
		[.006]	[.019]		[.001]	[.010]	[.728][4]
	ts → i	0.5485	1.4015		17.3561***	0.0803	0.2931
		[.459]	[.236]		[.000]	[.777][4]	[.588][4]
	order	2	2		3	2	2

[1]Intervention dummies are included in the model whenever necessary to solve problems of serial correlation, heteroscedasticity or normality of the residuals. [2]Johansen cointegration test based on a model with a restricted intercept and no trend (*n.c.* indicates not cointegrated). [3]First-differencing the I(1) variables. [4]Based on Newey-West adjusted S.E.'s Bartlett weights, truncation lag= 3. The asterisks *, ** and *** indicate that the null hypothesis of non-causality was rejected at the, respectively, 10%, 5% and 1% level of significance. In square brackets are the p-values of the statistics. Sample period: 1950-96.

Table 4: Central government total surplus and real interest rate

		B	F	G	I	N	UK
Order of integration:							
ts		I(1)	I(1)	I(0)	I(1)	I(1)	I(0)/I(1)
r		I(0)	I(0)	I(1)	I(0)/I(1)	I(1)	I(0)
Dummies[1]		1952,58,	1953,58	1953	1973,1974		1975
Non-causality tests:		74,81					
VECM[2]		---	---	---	n.c.	n.c.	---
VAR[3]	r → ts	0.0023	.34301	15.4740***	1.3696	0.9376	0.1585
		[.962]	[.558]	[.000]	[.504]	[.626]	[.691]
	ts → r	0.1868	0.0005	1.5006	6.4674**	0.5708	0.4254
		[.666]	[.982]	[.472]	[.039]	[.752]	[.514]
	order	1	1	2	2	2	1
LA-VAR	r → ts	0.6582	.73109	8.5477**	4.6628	0.2913	.01634
		[.417]	[.393]	[.014]	[.198]	[.962]	[.898]
	ts → r	0.2167	1.0653	0.1938	9.9546**	6.6442*	0.2800
		[.642][4]	[.302]	[.908]	[.019]	[.084]	[.597]
	order	2	2	3	4	4	2

[1]Intervention dummies are included in the model whenever necessary to solve problems of serial correlation, heteroscedasticity or normality of the residuals. [2]Johansen cointegration test based on a model with a restricted intercept and no trend (*n.c.* indicates not cointegrated). [3]First-differencing the I(1) variables. [4]Based on Newey-West adjusted S.E.'s Bartlett weights, truncation lag= 3. The asterisks *, ** and *** indicate that the null hypothesis of non-causality was rejected at the, respectively, 10%, 5% and 1% level of significance. In square brackets are the p-values of the statistics. Sample period: 1950-96.

Table 5: General government total surplus and nominal interest rate

		B	F	G	I	N	UK
Order of integration:							
ts^{GG}		I(1)	I(1)	I(1)	I(1)	I(0)	I(1)
i		I(1)	I(1)	I(0)	I(1)	I(1)	I(1)
Dummies[1]			1980,81	1953	1975,81		1974
Non-causality tests:							
VECM[2]	i → ts^{GG}	28.1646***	n.c.	---	2.4395	---	n.c.
		[.000]			[.295]		
	ts^{GG} → i	10.6584***			22.7983***		
		[.005][4]			[.000]		
	order	2			2		
VAR[3]	i → ts^{GG}	---	6.1966**	8.8960**	---	0.1420	7.7556**
			[.013]	[.012]		[.706]	[.021]
	ts^{GG} → i		0.9598	0.3187		0.2690	0.6320
			[.327]	[.853]		[.604]	[.729]
	order		1	2		1	2
LA-VAR	i → ts^{GG}	33.7656***	2.5721	14.1894***	2.2503	0.3345	6.3609**
		[.000][4]	[.109]	[.001]	[.325]	[.563][4]	[.042]
	ts^{GG} → i	11.1499***	0.0021	0.3698	5.2889*	0.0350	1.7363
		[.004]	[.964]	[.831]	[.071]	[.852][4]	[.420][4]
	order	3	2	3	3	2	3

[11]Intervention dummies are included in the model whenever necessary to solve problems of serial correlation, heteroscedasticity or normality of the residuals. [2]Johansen cointegration test based on a model with a restricted intercept and no trend (*n.c.* indicates not cointegrated). [3]First-differencing the I(1) variables. [4]Based on Newey-West adjusted S.E.'s Bartlett weights, truncation lag= 3. The asterisks *, ** and *** indicate that the null hypothesis of non-causality was rejected at the, respectively, 10%, 5% and 1% level of significance. In square brackets are the p-values of the statistics. Sample period: 1950-96(except since 1953 for Belgium and 1951 for Italy).

Table 6: Central government total surplus and nominal interest rate differential

		B	F	G	I	N	UK
Order of integration:							
ts		I(1)	I(1)	I(0)	I(1)	I(1)	I(0)/I(1)
i^d		I(1)	I(1)	I(1)	I(1)	I(0)	I(1)
dummies[1]		1981		1953,75		1972	1974
Non-causality tests:							
VECM[2]		n.c.	n.c.	---	n.c.	---	---
VAR[3]	$i^d \rightarrow$ ts	2.1525	2.6998*	0.0727	6.6669***	2.6167	0.1204
		[.142]	[.100]	[.787]	[.010]	[.270]	[.729]
	ts $\rightarrow i^d$	0.3503	0.6595	0.3929	4.5664**	5.6770*	0.4473
		[.554]	[.417]	[.531]	[.033]	[.059]	[.504]
	order	1	1	1	1	2	1
LA-VAR	$i^d \rightarrow$ ts	3.0088*	2.0017	1.3893	3.7642	2.3085	0.4107
		[.083]	[.157]	[.239]	[.152]	[.129]	[.522]
	ts $\rightarrow i^d$	0.8555	0.9089	1.9419	4.1419	0.6052	2.2719
		[.355]	[.340]	[.163]	[.126]	[.437]	[.132][4]
	order	2	2	2	3	2	2

[1]Intervention dummies are included in the model whenever necessary to solve problems of serial correlation, heteroscedasticity or normality of the residuals. [2]Johansen cointegration test based on a model with a restricted intercept and no trend (*n.c.* indicates not cointegrated). [3]First-differencing the I(1) variables. [4]Based on Newey-West adjusted S.E.'s Bartlett weights, truncation lag= 3. The asterisks *, ** and *** indicate that the null hypothesis of non-causality was rejected at the, respectively, 10%, 5% and 1% level of significance. In square brackets are the p-values of the statistics. Sample period: 1950-96.

Table 7: Central government aggregated total surplus and interest rates

ADF unit root tests[1]				non-causality tests				
	SBC	P	PV	dummies[2]		VECM[3]	VAR[4]	LA-VAR
i^a	-2.0041	-1.5861	-3.0515	1975	$i^a \rightarrow ts^a$	20.2340***	15.6045***	29.3904***
	(1)	(2)	(1)	1981		[.000]	[.000]	[.000]
			[1969]		$ts^a \rightarrow i^a$	1.4912	0.0801	2.6586
ts^a	-2.0250	-2.0250	-3.6225			[.684]	[.961]	[.447]
	(0)	(0)	(0)		order	(3)	(2)	(4)
			[1974]					
r^a	-3.6698**	-3.6698**	-5.2380***	1975	$r^a \rightarrow ts^a$	---	9.2017***	6.3064**
	(0)	(0)	(0)				[.002]	[.012]
			[1981]		$ts^a \rightarrow r^a$		0.2936	2.1197
							[.588][5]	[.145][5]
					order		(1)	(2)

[1]See notes in table 1. [2]Intervention dummies are included in the model whenever necessary to solve problems of serial correlation, heteroscedasticity or normality of the residuals. [3]Johansen cointegration test based on a model with a restricted intercept and no trend. [4]First-differencing the I(1) variables. [5]Based on Newey-West adjusted S.E.'s Bartlett weights, truncation lag= 3. The asterisks *, ** and *** indicate that the null hypothesis of non-stationarity/non-causality was rejected at the, respectively, 10%, 5% and 1% level of significance. In square brackets are the p-values of the statistics. Sample period: 1950-96.