On Keynesian effects of (apparent) non-Keynesian fiscal policies

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ON KEYNESIAN EFFECTS OF (APPARENT) NON-KEYNESIAN FISCAL POLICIES*

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Central Banks are often accused of being obsessed with inflation. This is untrue. If they are obsessed with anything, it is with fiscal policy.
(Mervyn King, Governor of the Bank of England)

Abstract

The aim of this paper is to evaluate the robustness of the theory that claims restrictive effects of expansionary fiscal policy. It shows that such so-called "non-Keynesian effects" may arise from synchronous and opposite monetary policy interventions. The paper demonstrates this conclusion through a stylized model – supported by an empirical investigation on ECB and FED reaction functions – in which Central Banks consider deficit spending as an element that generates inflation expectations. Econometric analysis also shows that the ECB reacts asymmetrically to deficit spending variations while the FED has a linear reaction to this indicator.

Keywords: Fiscal policy, Monetary policy, Central Banks policy strategies.
JEL classification: E 54, E62, E63

1. The Background

Theoretical settings of fiscal policy have changed dramatically since the early 1990s in comparison with the previous decades. Previously, public deficit was considered strictly a tool for stabilization of aggregate demand and income. Subsequently, such an instrumental role was increasingly criticized. The final outcome of this theoretical reconsideration is a new conventional wisdom that connects counter-intuitive effects to public deficit spending.
This paper evaluates the theoretical robustness of this new orthodoxy that has become a ruling paradigm and a very popular conjecture in mainstream economic thought. New theoretical foundations appear in two mirror approaches, thought of as perfectly equivalent: "Keynesian effects of non-Keynesian fiscal policy", and "non-Keynesian effects of Keynesian fiscal policy".
The former refers to the hypothesis that a fiscal contraction could give rise to positive effects on production and income, a phenomenon now labelled as Keynesian effects of non-Keynesian fiscal policy; the latter, usually thought similar to the former, holds that an increase in public deficit

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spending may create negative quantity effects on production and income, according to a theory of non-Keynesian effects of Keynesian fiscal policy.
Although the two phenomena differ in theoretical terms, irrespective of superficial equivalence, the common starting point of such conventional wisdom is the failure of the "old-fashioned" Keynesian belief in a positive fiscal multiplier.
The struggle against this model is no recent phenomenon. There have been opponents to basic Keynesianism since the first pioneering exposition of a positive fiscal multiplier made by Keynes in the late 1920s through argumentations included in the Treasury View[1]. This disagreement resurfaced in the late 1960s with the Friedman monetarist approach to the natural rate of unemployment approach, and it continued with the "crowding-out" argumentations arriving at Rational Expectations Models and Ricardian equivalence.
It must be stressed that all these positions theorized a low or null fiscal multiplier whereas new positions in the early 1990s assumed negative fiscal multipliers, that is non-Keynesian effects of Keynesian fiscal policies and vice versa.
The germinal work of the new approach was provided by Giavazzi and Pagano in 1990[2], leading to an uninterrupted flow of contributions, with new research by old pioneers, now supported by new scholars.[3] Such contributions have to be analysed very carefully because they constitute a constant benchmark for all subsequent studies on the negative effects of fiscal policy and because new conventional positions of policy-makers, particularly within the Euro Area, refer constantly and explicitly to the Giavazzi and Pagano position.
Our paper offers a different view with respect to the interpretative hypotheses of the non-Keynesian view (hereafter NKV). We shall seek to argue that:

i. *Keynesian effects are produced by a peculiar policy mix (well-known in the 1980s) determined by an essential role played by monetary and exchange rate policies and not by "pure non-Keynesian fiscal policies";*
ii. *Possible success of "intrinsic pure non-Keynesian fiscal policies" depends on very severe and unreal analytical conditions;*
iii. *European policy-makers, namely the European Central Bank and the European Committee, have embraced such a theoretical approach without exploring all its limits.*

In this paper we try to develop this alternative approach using the following structure. Section 2 analyzes the main theoretical foundations of the non-Keynesian view. In section 3, we review the empirical literature of the NKV approach. In section 4 we comment on the framework conditions that usually help NK policies to reach counter-intuitive results. In section 5 a model containing the fiscal policy transmission mechanisms is presented in its structural relations. Through this model we derive the validity condition of NKV outcomes and show the relevance of monetary policy cooperation in order to reach these results. In section 6 we empirically ascertain the consistency of our conjectures, particularly the relevance of the monetary framework. Section 7 concludes the paper.

2. The Tale of a Fiscal Counter-Revolution

During the 1980s the growing budget deficit and very high public debt triggered a profound review of the direct relation between public expenditure and growth. Academics agreed that there was the need to consolidate public finances due to the instability effects of real, monetary and financial markets. The institutional claims coming from the ongoing EMU lent further impetus to this stream of studies.

[1] Peden G.C., 1984
[2] Giavazzi and Pagano, 1990.
[3] Giavazzi et al, 1999, 2000 and 2005.

However, even if economists agreed on the negative effects on growth of increasing fiscal imbalances, at the same time they feared the negative results of fiscal restrictions. Therefore, when they started to observe successful fiscal consolidations – i.e. the contemporary presence of budget deficit reductions and income growth – they concluded that there was no doubt left as to which economic policy to pursue.

The work considered the most important for the subject was that by Giavazzi and Pagano (1990), a very successful econometric analysis in which the authors observed a consumption increase during fiscal restriction. It paved the way to the general conclusion – or, as they call it, to the non-conventional wisdom - that retrenchments can be expansionary. This is what we call the non-Keynesian view.

Following this first publication, Giavazzi and Pagano (1995) extended the results of fiscal consolidations to fiscal expansions[4]. They found that "fiscal policy changes *can* have non-Keynesian effects if they are sufficiently *large* and *persistent*"[5]. These results were further consolidated in Giavazzi et al. (1999), (2000) and (2005), where they estimated the saving function instead of the consumption one.

The theoretical foundations of their empirical results are based on a composition of Modigliani life-cycle theory or Friedman permanent income theory and Ricardian-equivalence theory as in Barro (1974). If consumers a) have rational expectations and b) are not liquidity-constrained, they tend to smooth consumption – or saving - through time, following the expected flow of actualized disposable income. If therefore during fiscal retrenchment we observe an increase in consumption, it is proof that private individuals have revised their permanent income upward and that – the authors state – the cause of this revision is the consolidation of public finances.

On further investigation, progressive consolidation of their non-Keynesian view emerges. In Giavazzi and Pagano (1990) the positive effects on consumption were observable because of "two simultaneous policy shocks: a fall in current disposable income, due to the increase in current taxes, and a wealth effect due to an unanticipated fall in nominal and real interest rates"[6]. They admit that the expansionary effect is not the result of a pure fiscal restriction but of its indirect effect on interest rates. In Giavazzi and Pagano (1995) the observed negative effect on income of fiscal expansions is caused - in their view - by the downward revision of private individuals' permanent income. It is considered certain that the reduction in permanent income is *univocally* determined by expansionary fiscal policy.

The stream of studies has been so successful that they have continued to extend and reinforce their conclusions through testing the saving function. Giavazzi et al. (1999), (2000) and (2005) differ from each other in the width of the sample considered. Using econometric analysis they conclude that:

a) national saving non-linearly increases or decreases when there is fiscal consolidation and contraction, respectively;

b) non-linearity arises since fiscal episodes are not sufficiently large and persistent as predicted by the theory of permanent income;

c) fiscal consolidations are more effective than fiscal expansions;

d) variation in net taxes are more effective than variations in public consumption;

e) finally, the level of public debt is not a good predictor of non-Keynesian effects.

In brief, while at the beginning the core of their NKV was the fiscal and monetary policy mix, through the years, it has become pure fiscal policy. The opposite effect of fiscal interventions is assured by a kind of "super-Barro effect" according to which fiscal contraction or expansion does

[4] Non-Keynesian effects of fiscal restrictions are very often estimated, while the opposite has not found broad consensus in the empirical literature.

[5] Giavazzi Pagano's (1995) abstract. The first but not the second use of italics is ours.

[6] Giavazzi Pagano (1990), p. 14

not have a null outcome, but a more than proportional autonomous negative effect on permanent income[7].
This last position has limits that cannot be easily overcome: non-Keynesian effects of Keynesian policies cannot derive simply from the relation between fiscal stance and saving or consumption[8]. In order to make them occur it must be supposed – beside the hypotheses of rational expectations and no-liquidity constraint - that the fiscal policy intervention: a) is unanticipated, otherwise individuals would have already discounted the disposable income change and b) has positive effects on the real value of private assets or c) is financed through debt because this predicts a further tax movement in order to pay interests on public bonds or d) causes interest rate movements in the same direction. In all these cases the fiscal policy causes the opposite movement of income through the channels of the consolidated theory – in other words through the change in the rate of interest, real or nominal, actual or expected.
The literature which followed this approach investigated empirically the non-Keynesian results of fiscal policies, in particular of fiscal restrictions. The results were found to operate through the general effects on reserve wage and competitiveness (Alesina and Perotti 1995 and 1997), but only if fiscal consolidations were conducted without raising taxes or cutting public investments (Alesina and Perotti 1995, 1997, Alesina and Ardagna 1998). The effects on other components of aggregate demand were also investigated, especially the investment channel[9]. The following factors are considered important: the initial level of debt, the persistency of reduction and the dynamic of interest rates (Blanchard and Perotti 1999, and Ardagna 2004). Unlike the Giavazzi-Pagano-Jappelli contributions this "non-Keynesian literature" relies on the indirect effects of the reduction or expansion of public spending on supply and demand without identifying an autonomous capacity of increasing or reducing permanent income.
It is therefore an empirical re-proposition of an old debate about the crowding-out effects of expansionary fiscal policies.

3. Methodologies of the Fiscal Counter-Revolution

The empirical literature about NK effects of fiscal policy can be divided in three main categories based on different approaches. The first approach is based on simulations of macroeconomic models. The second approach uses cross-section and panel analysis in order to analyze the relationships between fiscal policy and output. These contributions estimate the reaction of consumption interest rates, exchange rates and investments to fiscal policies. The third approach is the VAR one.

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[7] "Finite horizon models suggest that an increase in net taxes should raise national saving (>0), whereas an increase in government consumption should reduce it. In the benchmark infinite horizon model with lump-sum taxes, taxes have no effect on national saving: this is the Ricardian equivalence proposition. Also, in the infinite horizon model, for a given path of pre-tax income, Y, government consumption does not affect national saving either. […]" But in the regression they find that "the coefficient of *T/Y** is positive and statistically different from zero at the 1 percent level in each regression. [And] the coefficient of *G/Y** is negative and also statistically different from zero at the 1 percent level in both regressions. [Therefore] contrary to the predictions of infinite horizon models with non-distortionary taxes, the fall in private consumption does not fully compensate the increase in government consumption, thereby reducing national saving" Giavazzi et al. (2005) p.15.

[8] This circumstance is recognized by the same authors: "Expansionary fiscal contractions can be explained by the effects of fiscal policy on the market value of wealth and on expectations about future taxes. A fiscal contraction often reduces interest rates, raising the market value of stocks, bonds and real estate, thus stimulating aggregate demand. It can also drastically change people's view of the future and therefore the estimate of their human capital. For instance, in a high-debt country a fiscal correction may prevent a financial crisis, thus improving confidence and increasing consumption and investment" Gavazzi et al. (1998) p.1, (1999) p.2, (2000) p. 2.

[9] Perotti (2004b) "In fact, government investment appears to crowd out private investment, specially in dwelling and in machinery and equipment. "

3.1 Behavioural Equations Estimates

Beginning with Giavazzi and Pagano (1990) a large number of empirical studies has reached the conclusion that contractionary (expansionary) fiscal policies may have positive (negative) effects on households consumption. These studies analyze fiscal consolidation episodes through the effects on behavioural functions. All studies try to isolate the channels through which fiscal contractions may have positive effects on output. This literature has focused mainly on consumption, although there are some studies analyzing the effects of fiscal policy on investments and interest rates.
These studies are based on some strong theoretical assumptions. Most households make inter-temporal optimizations in order to decide their current consumption level, and they have no-liquidity constraints.
The strongest evidence for expansionary fiscal contractions is in Giavazzi and Pagano (1990); the authors find that Denmark in 1983-86 and Ireland in 1987-89 are clear examples of non-Keynesian effects of fiscal policies.
Giavazzi and Pagano (1995) try to extend their previous results and to evaluate whether the coefficients change in different situations. Non-Keynesian effects seem to occur in adjustment periods. The authors find that the effects on private consumption of taxes is 0.05, the coefficient for transfers is -0.07, while the effect of public consumption is -0.02. In normal times the behaviour of consumption seems to be purely Keynesian. Thus, it seems difficult to conclude that such small coefficients in the consumption reaction to fiscal policies could result in expansionary effects of fiscal contractions.
Giavazzi et al (2000) conclude that large fiscal policies have stronger effects[10]. They analyze consumption, estimating a saving behavioural function and making a distinction between bad and good times. The results do not seem to give evidence for non-Keynesian effects of fiscal policies even in bad times.
Hjelm (2002) tries to extend the conclusion drawn for Ireland and Denmark in Giavazzi and Pagano (1990), while Kamps (2001) seeks to do the same for the results in Giavazzi et al. (2000). Kamps (2001) finds no NK effects, except in three cases with country-specific consumption equations. Nevertheless, the author admits that a richer specification is needed in order to make the results less fragile.
Hjelm (2002) analyzes a panel of 19 countries spanning the period 1970-97. Estimation of the share of consumers that are credit constrained shows low levels, ranging from 0.1 to 0.14. Surprisingly, the impact of fiscal policy on consumption is not negative, and sometimes barely positive.
It seems that this kind of analysis has some limits that prevent it from being completely convincing. Since most of these studies focus on some episodes of fiscal contractions, it seems that a sample selection bias may arise. Hemming et al. (2002) suggest that handpicking specific country-cases could provide stronger results with respect to a larger cross-section of countries.
Measurement errors can also occur since most such papers use fiscal deficits as a basis for assessing fiscal policy change, but deficit is just one of the elements determining the effects of a fiscal policy.
A richer specification could have given different results. Other variables could explain the relationship between fiscal policy and economic activity (e.g. inflation, exchange rates, unemployment rates, wealth effect and interest rates).
Another problem, is the absence of a variable (or a set of variables) controlling for the interaction between fiscal and monetary policy. Ahrend et al. (2006) assess how and in what circumstances fiscal consolidations are affected by the choices of monetary policy. Surprisingly, there are not so many papers studying the effects of monetary policy and/or exchange rate variations on a consolidation policy. Fiscal consolidation can be assisted by a shift in monetary stance since a

[10] The same conclusion is reached by Gavazzi and Pagano (1995) and Cour et al (1996).

decrease in the interest rates can compensate the depressive effect of fiscal contraction on the demand. On the other hand, a monetary expansion can reduce interest payments on public debt.
Ahrend et al. (2006) conclude that the reaction of the central bank can be very important in determining the results of a fiscal consolidation. These results seem to have a very strong theoretical implication. Fiscal plans have to be implemented in the central bank projections and the response of the central bank should influence the result of a fiscal policy.

3.2 Macroeconomic Model Simulations

Estimates from simulations of macroeconomic models do not give unique results about fiscal multipliers. Nevertheless, given its technical complexity, this approach permits us to specify some aspects that are not taken into account with other methods. One of these concerns the specification of the reaction in terms of monetary policy. Nevertheless, this literature has some common features, one of them being that most of the analyses show that short-term multipliers are positive.
Richardson (1998) uses the INTERLINK model in order to analyze some short- and long-run macroeconomic aspects. The author investigates the response in terms of output from an increase in public expenditure. The experiment evidences positive multipliers that decrease over time. Moreover, different assumptions about the reactions in terms of monetary policy show different results. Nevertheless, the incidence of different monetary regimes seems to have relevance only in the short run (Dalsgaard et al., 2001 and IMF, 1996).
Further clear evidence is that the range of multipliers estimated is narrower in the long run (McKibbin, 1996 and Bryant et al., 1993). As evidenced in Roeger and in't Velt (2002) and Barrel et al. (2002), the multipliers constantly reduce over time and reach zero in the long run. Hunt and Laxton (2002), and Dalsgaard et al. (2001) find negative long-run multipliers for the same group of countries using INTERLINK and MULTIMOD models.
Many macro model simulations show that in the short run spending changes multipliers are bigger than tax changes. A MULTIMOD model simulation in IMF (1996) shows that for the USA the spending multiplier is 1.1 and the tax multiplier is 0.7.
It seems clear that the specification of the models and their assumptions are crucial in determining different results. Wallis (2003) makes a comparison of the QUEST, NiGEM, MULTIMOD and AWM models, and finds that all short-run multipliers are positive.
The main difference between the models seems to be the specification of the consumption function. In AWM the consumption function is based on present income. In the simulations of the NIGEM model, consumption is not a function of temporary income changes and consumers are completely backward-looking. MULTIMOD models consider liquidity constraints, and these levels change with different specifications of the model.
To conclude, there is evidence that public expenditure cuts reduce output. Nevertheless, estimates of future incomes and how they are used for the forecasts, estimates of consumption, the predictability level of the economy by the agents are all points that are sometimes not stressed and explained in exhaustively.

3.3 VAR Approach Literature

The time series-based empirical literature studying the effects of fiscal policy shocks mainly uses VAR models to represent the economy. The main differences among all these studies concern the VAR specification and shock identification strategies.
Fatas and Mihov (2001 a, b) solve the identification problem using the recursive approach (based on the Cholesky decomposition) introduced by Sims (1980). Fatas and Mihov (2001 a) show that an increase in government expenditure is coupled with an increase in private consumption and

employment. Although the results are in line with the Keynesian theory, the spending multiplier values are small.
Blanchard and Perotti (2002) show that an increase in public expenditure is followed by an increase in output, and that an increase in taxes is followed by a reduction in output. Moreover, the long-run multiplier still remains positive and close to unity.
The Blanchard and Perotti (2002) approach has been widely used: Kuttner and Posen (2002) find a spending multiplier of 2.0 and a tax multiplier of 2.5 for Japan. Perotti (2002) analyzes a sample containing five countries, and finds that impact and peak spending multipliers are always positive, although the peaks are reached in different periods ranging from one quarter (Germany) to 17 (UK and Canada). The evidence for the sign of long-run multipliers is more mixed, depending on the sub-samples considered. Nevertheless, the above article suffers from some statistical weaknesses since some series are non-stationary and the trend correction could have been insufficient to correct it.
Mountford and Uhlig (2002) use a different approach imposing sign restrictions directly on the impulse-response functions. They analyze USA data and they find that shocks to government expenditure are substitutes for private investment rather than private consumption, since the latter is not reduced after an increase in government spending. Moreover, they argue that the fiscal policy reacts to cycles but does not to monetary policy.
Ramey and Shapiro (1998) introduce the fiscal dummy variable approach, also known as the narrative approach, in order to analyze the effects of large military spending in the USA. Their idea is to consider defence spending as a proxy for government expenditure. They conclude that consumption falls after an increase in military spending while the increase in GDP is not statistically significant. On the other hand, other fiscal shocks could have occurred in the same period, polluting the identification of the military expenditure shock.
As already evidenced, all these papers differ in the VAR specification and in the identification of the fiscal shock. It can be argued that the different results of such studies may be due to specification and identification choices. Caldara and Kamps (2006) test whether such differences can explain the different results. All the implemented approaches agree in showing a positive reaction of GDP to a positive government shock. They conclude that, with appropriate VAR specification, the recursive and Blanchard-Perotti identification schemes have only minor differences in their impulse-response functions.
VAR literature shows that there is a positive relationship between government expenditure and output and that the multiplier is not negative even in the long run. The results concerning the relationship between government expenditure and consumption are more controversial. Nevertheless, even in papers where consumption decreases after a positive shock in public expenditure the fiscal multiplier is positive. It must therefore be incorrect to conclude from a negative relationship between consumption and fiscal policy that the latter has negative effects on output.

Apart from the theoretical robustness of contributions, as well as their shortcomings, the NKV context shows the following features:

i) it aims at undermining the positive value of the Keynesian fiscal multiplier;
ii) the Ricardian Equivalence Approach becomes a practical tool to propose radical departures in policy-making: Fiscal retrenchment cannot be further considered as a cause of recession;
iii) the model key variable is private consumption (or saving). Keynesian effects of non-Keynesian fiscal policies are supposed to arise through private consumption variations, whereas in the Keynesian approach the adjustment burden is borne by investment.

iv) *In a single step, the NKV dismisses arguments on Keynesian fiscal policies, even those pertaining to the struggle, in the late 1920s, between Keynes and the so-called "Treasury View"*[11].

The NKV approach has benefited from broad academic and "policy" acceptance, which is hard to understand from a purely theoretical point of view.

There were few doubtful economists: undoubtedly Blinder (2004), Fitoussi (2002, 2004 and 2005), Solow (2005) and Krugmann (2005), partly Wyplosz (2005 and 2006), and not one younger scholar.

The result was a huge effort in econometric technicalities aimed at strengthening the empirical consistency of the NKV approach, without considering its theoretical coherence.

4. The Theoretical Coherence of the Fiscal Counter Revolution: Ceteris are not Always Paribus.

A major shortcoming of the IS-LM approach was neglect of the public budget constraint and, hence, of the interdependence between fiscal and monetary policy; similarly, the NKV fails to consider monetary effects of fiscal stance variations. The Central Bank, following a fiscal shock, can decide three different behaviours: neutral feedback, when the Central Bank determines its instrumental variable and intermediate targets irrespective of fiscal policy; an antagonist approach, when it operates on its instrumental variables aiming at frustrating decisions taken by the fiscal authority); a cooperative stance, when monetary policy cooperates to achieve targets by means of public deficit variations (Allsopp and Vines 2005, Allsopp 2002).

The monetary policy instrument for a central bank is the interest rate (Romer 2000 and 2006). It can be assessed without its intermediate and final targets being defined. The interest rate is determined by the reaction function of the central bank. Thus it follows that:

i. complete evaluation of fiscal policy effects that are assumed by the NKV should also consider the effects determined by interest rate variations decided by the central bank in response to a new fiscal policy setting;

ii. consideration of the effects of interest rate changes would permit a distinction between pure policies (in the sense of policies without any monetary feedback) or policies brought about in the presence of co-operative or antagonistic central bank behaviour;

iii the validity of the NKV (that is, the presence of Keynesian effects with non-Keynesian fiscal policies, or non-Keynesian effects through Keynesian fiscal policies) depends on the assumption of the presence of pure fiscal policies. Otherwise we should start from a monetary and fiscal policy mix.

On analyzing the first NKV paper (Giavazzi and Pagano, 1990), it seems clear that episodes of fiscal policy retrenchments that are considered to have caused non-Keynesian effects are actually policy mix episodes, in which monetary and currency policies have played a crucial role: "…reviewing the key facts about the Danish and Irish experiments, highlighting the importance of the monetary and exchange rate policies that accompanied the fiscal stabilisation"(p.6); "cuts in spending and tax increases were accompanied ….by complementary monetary and exchange rate policies"(p.7); "the removal of controls on capital inflows by Danish authorities was equivalent to a positive demand shock"(p.27);..we also found that part of the expansionary effects of the fiscal contractions analyzed here must be attributed to the concomitant monetary disinflation….it is remarkable that in both our cases of "expansionary contractions" the shift in fiscal and exchange rate policy was preceded by a sizable devaluation"(p.28)[12].

[11] Keynes proposed a program of public works financed by government bonds in the electoral program of Lloyd George. The Treasury, a British institution "more than a ministry" (Peden), disagreed, because it assumed both negative effects due to dis-saving created by the public sector, and inefficiencies in government expenditure.

[12] Italics added.

This approach did not change in subsequent works: fiscal retrenchments are always analysed for their apparent features, as if *ceteris* were *paribus* and not regarding other phenomena, such as central bank reaction on interest and exchange rates.
But if *ceteris* are not *paribus* it is interesting to examine the effects of fiscal policies on monetary policy, hence on "the reaction function of central bank" (hereafter CBRF)[13].
Actually, the cases examined by Giavazzi and Pagano, throughout their contributions, are canonical examples of the interaction between monetary and fiscal policies, where interest and exchange rates are affected by public deficit variations.
The notion that the reaction function of monetary authorities also depends on fiscal policy (Allsopp and Vines, 2000) and that the stance of the latter will be, more or less, enhanced by antagonistic or co-operative monetary policy reaction function (Taylor, 1996), is not new in the literature. The debate on "optimal policy mix", i.e. on the effectiveness of fiscal contractions harmonized with benign monetary policy, goes back to the 1970s and '80s. The debate in the USA on the optimal combination of monetary and fiscal policy in the 1970s and '80s is fundamental to understanding that the theory of economic policy is richer than the debate that originated the NKV (Okun 1972, Carlson 1982, Tobin 1982, Blinder 1985)[14].
Understanding policy interdependence and the reaction of the central bank to public deficit variations involves analysis of the monetary authorities' loss function, that is, the behavioural equation underlying the reduced form equation of the Taylor Rule, since a rigorous Taylor Rule must be derived explicitly from the central bank model of the economy and from the weights attached to the possible deviations from the selected targets. We therefore assume that the reaction function of the central bank becomes a cornerstone to analyse the effects, whether Keynesian or non-Keynesian, of fiscal policies.
The starting point is the awareness that, empirically speaking, fiscal policy results are strictly influenced by monetary policy behaviour. Ahrend et al. (2006) investigate this relationship by considering episodes of fiscal consolidation in 24 OECD countries[15]. The main findings, for our aims, can be summarized as follows:

i. Consolidation is more likely to be successful if, *ceteris paribus*, it is coupled with an easing of monetary policy, especially in the early stage of policy implementation. In addition, it seems more likely to be successful when the monetary policy reacts to a greater extent than that predicted by a Taylor rule;
ii. Consolidation has a higher probability of succeeding when interest rates are falling. The interest rate variable does not affect the fact that a consolidation period is started, but declining nominal and real short-term interest rates are associated with a higher likelihood that the adjustment is pursued, and with greater success. The most convincing explanation for this result is that falling interest rates can encourage the continuation of consolidation, because the interest rate variable is picking up a reaction of monetary authorities.

More generally, monetary authorities seem to adopt asymmetric behaviour in the presence of fiscal stance changes[16].
Fiscal retrenchment is, usually, encouraged by the central bank: in such a case, the non-Keynesian fiscal policy is "helped" by interest and exchange rate policies that give rise to Keynesian effects: "If the central bank continues to follow its previous interest rate policy in the face of decline in the long-run real interest rate, then it will set an interest rate which is too high; this will have the effect of reducing demand in the economy (Taylor, 1995). "To the extent that fiscal plans are expected to be implemented, they can normally be expected to be factored into central banks' macroeconomic

[13] Meyer (2000) explicitly stresses the effects of public surplus on the formulation and conduct of monetary policy.
[14] " To achieve a solid recovery, we need a easier monetary policy combined with a tighter fiscal policy." (Tobin, 1982).
[15] An episode of fiscal consolidation is identified as starting when CAPB increases by 1% of GDP in no more than two years. Short term interest rates are used as a proxy for monetary stance (Ahrend et al., 2006).
[16] Mervyn King, Governor of the Bank of England, is completely aware of the relevance of the fiscal stance on central banker behaviour. See King (2005 and 2007).

projections" (Ahrend et al. 2006)[17]. By contrast, fiscal expansion is feared by monetary authorities: in such a case, exchange rate appreciation and increased interest rates can frustrate fiscal Keynesian policy: "The fiscal authority attempts to lower unemployment by rising the deficit; this is countered as monetary authority raises interest rates to fight inflation; and so forth. At the end of this struggle, because the two parties pursue different objectives, the surplus is the big loser" (Nordhaus, 1996)
The key variable to produce asymmetries in the central bank reaction function, and particularly for the European Central Bank, is given by the central role that inflation and inflation expectations play in determining the monetary authority's setting of interest rates. Fiscal policies consistent with a downgrading of inflation expectations determine a co-operative stance by the Central Bank, whereas an increase in public deficit perceived as inconsistent with the stability of inflation expectations is worrying and potentially combated by monetary authorities. Building on this evaluation we will present, in the next section, a simplified model of income determination, taking into account NKV assumptions of "super-Barro effects" of public retrenchment in the consumption function, the role of monetary policy decisions on interest and exchange rates, variables which are affected by a peculiar reaction function, and are asymmetrically influenced by the supposed consequences of public deficit movements on inflation expectations (Surico, 2003).

5. Modelling the Role of "Ceteris not Paribus"

We may now present a simple model of income determination, shifting from theoretical evaluations under the NKV, augmented with some inclusions we consider crucial: changes in fiscal stance proceed necessarily with interest rate variations produced, through its reaction function, by effects that monetary authorities think public deficit will cause on market inflation expectations.
Our model is therefore built on the basis of some key assumptions: the NKV theory of the relationship between fiscal policy and permanent income and consumption; the supposed effect of public deficit on inflation expectations; the existence of a monetary policy reaction function in which inflation expectation alterations play a role.
We show intentionally a simple exercise of comparative statics, aimed at stressing the main structural equations of the model, coming back "to the Neolithic Age of Structural Models" (Nordhaus, 1996)[18].

$$Y = C + I + D_1 + D_2 + NX \qquad (4.1)$$

$$C = \theta c_0 Y + (1-\theta) c_1 Y_P \qquad (4.2)$$

$$I = -\alpha R \qquad (4.3)$$

$$Y_P = B - \gamma D_2 \qquad (4.4)$$

$$NX = n_0 E - n_1 Y \qquad (4.5)$$

$$R = \beta \pi^e + \delta Y \qquad (4.6)$$

$$\pi^e = \nu A + D_1^n + D_2^n \qquad (4.7)$$

$$E = -\xi R \qquad (4.8)$$

Equilibrium income is represented in equation (4.1); the only exception with respect to manual treatment is given by the splitting of the public deficit into two different components: D_1, a

[17] Similar conclusions are reached by Bibow (2004).
[18] Dynamic complication (and/or functions smoothing) should not modify the main results.

transitory component that is not considered a component of fiscal stance and D_2, perceived as a permanent value of fiscal stance. The consumption function, in equation (4.2), embodies alternative scenarios: a traditional Keynesian element, $c_0 Y$, whereby consumption depends on current income and NKV, $c_1 Y_P$, whereby consumption depends on permanent income. The value of θ reflects the social behaviour with reference to private consumption: if $\theta = 1$, a strict Keynesian approach holds; with $\theta = 0$, consumption depends totally on permanent income and, therefore, a NKV scenario rules; if $0 \prec \theta \prec 1$, then private consumers decide, in the very short run, both on disposable and permanent income. Investment depends, as in equation (4.3), on the interest rate, while equation (4.4) considers the flow of permanent income given by usual factors of "life-cycle" hypothesis, B, and the "super-Barro" component derived from the expected permanent reduction in fiscal stance, D_2. The wealth variation is a condition determined through a subjective parameter, γ. Net exports depends, as in equation (4.5), from exchange rate and disposable income[19]. Equations (4.6)-(4.7)-(4.8) have to be analyzed together: both components of the public deficit, D_1 and D_2, affect, in addition to an exogenous element A, inflation expectations, π^e, according to eq. (4.7). The general form of the influence of D_1 and D_2 is included through a generic exponent value, n, that, in the case of odd values allows us to suppose a non-linear influence of the public deficit on inflation expectations. Inflation expectations, along with a proxy of the output gap, impact on the interest rate, through the central bank reaction function[20](hereafter CBRF), that, in the very short run, is the key variable for influencing the exchange rate, as we assume in eq. (4.8). Assumption of a non-linear relationship between deficit and inflation expectations and, thus, between the deficit and CBRF will prove crucial in discussing the NKV.

Resolving for eq.(4.1), the equilibrium value of income is:

$$Y = \frac{1}{k}\left(1 - \beta\alpha D_1^{n-1} - n_0 \xi D_1^{n-1}\right) D_1 + \frac{1}{k}\left[1 - \beta\alpha D_2^{n-1} - n_0 \xi D_2^{n-1} + c_1 \gamma\left(\vartheta - 1\right)\right] D_2 + \\ + \frac{1}{k}\left[B c_1 \left(1 - \vartheta\right)\right] - \frac{1}{k}\left[A \beta \nu \left(\alpha + \xi n_0\right)\right] \qquad (4.9)$$

where $\frac{1}{k}$ is the usual multiplier of autonomous aggregate demand:

$$\frac{1}{\mathrm{k}} = \frac{1}{1 - \vartheta c_0 + n_1 + \delta(\alpha + n_0 \xi)} \qquad (4.10)$$

Let us consider k deeply.

The first three components, $1 - \vartheta c_0 + n_1$, also appear in the Keynesian version of the model, keeping in mind the meaning of ϑ. A new different role is played by the CBRF, included in $\delta(\alpha + n_0 \xi)$: if income rises there is a balancing effect of the interest rate reaction function of the central bank on investment expenditure ($\alpha\delta$) and through the exchange rate ($n_0 \xi \delta$). From an analytical point of view the term $(\alpha + n_0 \xi)\delta$ could be thought of as a "negative accelerator" of the Central Bank.

As an initial step, we can discuss the effects of fiscal policy with assumptions of the NKV and without the working of the CBRF. It means the assumption of a fixed interest rate is: $R = \bar{R}$.

Now the equilibrium income is:

[19] It would be necessary, from a strictly theoretical point of view, to include the flow of permanent income, Y_P, as an independent variable affecting NX, in addition to Y. But results are likely to remain unchanged.

[20] Appendix I derives a Central Bank Reaction Function (CBRF) consistent with a structural Loss Function of the monetary authority.

$$Y = \frac{1}{1 - \vartheta c_0 + n_1}\left[(1 - \vartheta)c_1(B - \gamma D_2) - (\alpha + n_0\xi)R + D_1 + D_2\right] \qquad (4.11)$$

Further, if all public deficit is judged as long-lasting and consumption depends completely on permanent income, that is if:

$D_1 = 0 ; \vartheta = 0$

the equilibrium value of income is:

$$Y = \frac{1}{1 + n_1}\left[c_1 B + (1 - c_1\gamma)D_2 - (\alpha + n_0\xi)R\right] \qquad (4.12)$$

From eq.(4.12) counter-intuitive non-Keynesian effects will result if the following inequality holds:

$$\frac{dY}{dD_2} = \frac{1 - c_1\gamma}{1 + n_1} < 0 \qquad (4.13)$$

that is, if:

$$\gamma > \frac{1}{c_1} \qquad (4.14)$$

We recall that γ is a parameter that links permanent public deficit to permanent income. If $c_1 = 1$, inequality holds if $\gamma > 1$, that is if a permanent income variation involves belief of a *greater* permanent income variation. If $c_1 < 1$, inequality becomes much more doubtful.

Recalling that the equilibrium income is:

$$Y = \frac{1}{k}\left(1 - \beta\alpha D_1^{n-1} - n_0\xi D_1^{n-1}\right)D_1 + \frac{1}{k}\left[1 - \beta\alpha D_2^{n-1} - n_0\xi D_2^{n-1} + c_1\gamma\left(\vartheta - 1\right)\right]D_2 + \\ + \frac{1}{k}\left[Bc_1\left(1 - \vartheta\right)\right] - \frac{1}{k}\left[A\beta\nu\left(\alpha + \xi n_0\right)\right] \qquad (4.15)$$

A detailed list of fiscal multipliers with different relevant assumptions on parameter values is included in Appendix II. Now, deriving eq.(4.15) for D_1 and D_2, we obtain the total effect on income of public deficit, D_1 and D_2:

$$\frac{dY}{dD_1} + \frac{dY}{dD_2} = \frac{1 - n\beta(\alpha + n_0\xi)D_1^{n-1}}{k} + \frac{1 - n\beta(\alpha + n_0\xi)D_2^{n-1}}{k} + \frac{c_1\gamma(\theta - 1)}{k} \qquad (4.16)$$

If consumption is totally dependent on permanent income, that is if $\vartheta = 0$, the total effect is equal to:

$$\frac{dY}{dD_1} + \frac{dY}{dD_2} = \frac{1 - n\beta(\alpha + n_0\xi)D_1^{n-1}}{k'} + \frac{1 - n\beta(\alpha + n_0\xi)D_2^{n-1}}{k'} - \frac{c_1\gamma}{k'} \qquad (4.17)$$

where:

$$\frac{1}{k'} = \frac{1}{1 + n_1 + \alpha\delta + n_0\xi\delta} \qquad (4.18)$$

is a smaller multiplier than that of eq.(4.10), due to the absence of c_0.

If we assume a simple linear relation between public deficit and inflation expectations, with the exponent of D_1^n and D_2^n equal to unity, the effect of deficit spending on income becomes

$$\frac{dY}{dD_1} + \frac{dY}{dD_2} = \frac{1 - \beta(\alpha + n_0\xi)}{k} + \frac{1 - \beta(\alpha + n_0\xi)}{k} + \frac{c_1\gamma(\theta - 1)}{k} \qquad (4.19)$$

Hence:

$$\frac{dY}{dD_1} + \frac{dY}{dD_2} < 0 \qquad (4.20)$$

if

$$\left\{2\left[1 - \beta(\alpha + n_0\xi)\right] - (1 - \theta)c_1\gamma\right\} \prec 0$$

or if

$$\left|2\right| \prec \left|2\beta(\alpha + n_0\xi) + (1 - \theta)c_1\gamma\right| \qquad (4.21)$$

Finally, inequality (4.21) holds greater is the value of the CBRF on monetary market, β, and on exchange market, ξ, the non-Keynesian component of consumption, $c_1(1 - \vartheta)$, the "super-Ricardian" effect, γ.

If we relax the previous assumption of linearity between public deficit and inflation expectations, and we suppose non-linearity and asymmetry in the effects of the public deficit on inflation expectations, public deficit will switch in cubic functions, D_1^3 and D_2^3.

Now:

$$\frac{dY}{dD_1} + \frac{dY}{dD_2} = \frac{1 - 3\beta(\alpha + n_0\xi)D_1^2}{k} + \frac{1 - 3\beta(\alpha + n_0\xi)D_2^2}{k} + \frac{c_1\gamma(\theta - 1)}{k} \qquad (4.22)$$

Recalling the key role of CBRF, and with:

$$\beta(\alpha + n_0\xi) = RF$$

$$\frac{dY}{dD_1} + \frac{dY}{dD_2} < 0 \qquad (4.23)$$

if

$$1 - 3\beta(RF)D_1^2 + 1 - 3\beta(RF)D_2^2 - (1 - \theta)c_1\gamma < 0$$

or if:

$$\left|2\right| \prec \left|2\left[(3\beta(RF)(D_1^2 + D_2^2)\right]\right| + \left|(1 - \theta)c_1\gamma\right| \qquad (4.24)$$

Asymmetrical effects of public deficit on inflation expectations increase the probability of fiscal consolidation success, but it is worth mentioning that in such a case non-linearity increases the

probability of inequality as fiscal retrenchment is helped by an easing of monetary policy which increases investment and net export. However, this is not a case of pure fiscal policy.

6. An Empirical Analysis

In this section we explore the existence of a relationship between interest rate setting and a set of explanatory variables like inflation expectations, deficits, output gap, and other macroeconomic factors that could affect monetary policy decisions. Our approach to modelling inflation expectations and monetary policy follows the idea, introduced by Ball (2000), of the so-called "nearly rational" approach. It assumes that, in forming expectations (of any variable), economic agents optimally use all information in the past values of such a variable. That is, we assume that expectations are based on optimal univariate forecasts. This "near rational" approach to expectations can explain why inflation appears so sluggish in the past two decades.
First, we consider the basic relationship between interest rate setting and inflation expectations with a standard OLS methodology. Second, we use a Kalman filter approach in order to observe how the coefficients of each variable of the model have changed over time. Finally we shift our analysis to the study of linear-nonlinear relationships of an augmented Taylor rule where we test the assumptions made in the theoretical model of non-linear reactions of the Central Bank to deficit. Using monetary policy reaction functions, this section examines whether monetary policy responds to deficit in two central banks, namely, the ECB and FED.

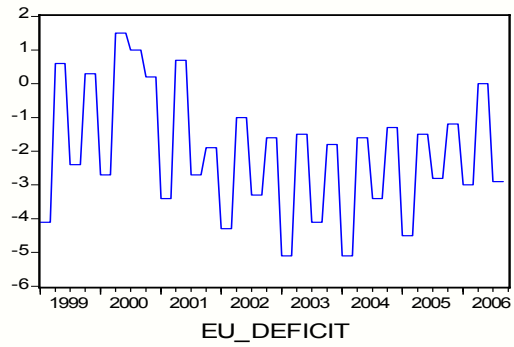
6.1 Data Analysis

The choice of the 1999-2006 sample for the ECB and FED, using monthly observations, was essentially based on the need to analyse the behaviour of both monetary authorities after the launch of the Euro currency. We describe, in appendix III, the variables that will be used in our empirical analysis.

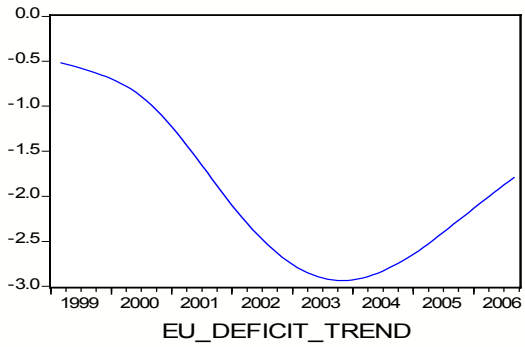
6.2 Preliminary Evidence

The first step in the analysis requires us to test the relationship between a CBRF to inflation expectations. The assumption underlying this relationship is using HCS (Harmonised Consumer Survey) and MSCI (Michigan Consumer Sentiment Index) variables as indicators of inflation expectations. We postulate that they are positively correlated with the interest rate set by central banks. We think there is a strong influence of inflation expectations on interest rate setting. Therefore, inflation expectations dynamic is crucial in determining monetary authority co-operative behaviour in the case of fiscal consolidation. We use, for the ECB and FED, respectively, the Repurchase Rate and the Federal Funds Rate.
Figures 1 and 2 present the patterns of the most representative economic variables and their trends in order to explain the different behaviours of the two Central Banks. The figures give preliminary evidence that there is a relationship between the interest rate and inflation expectations. Moreover, they show that there seems to be a relationship between deficit and inflation expectations for the ECB, while for the FED such a relationship does not seem to exist. Thus, this raw data analysis suggests the need for in-depth investigation of the relationship between the interest rate and inflation expectations and its determinants.

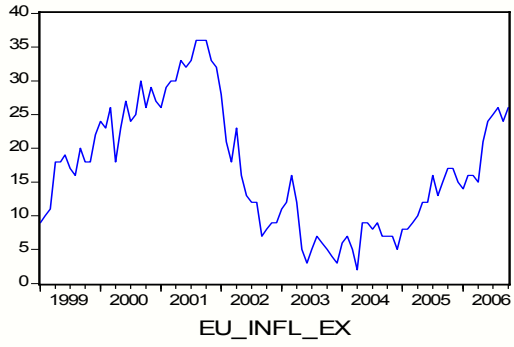
Figure 1 EU Macroeconomic Variables and their Trends



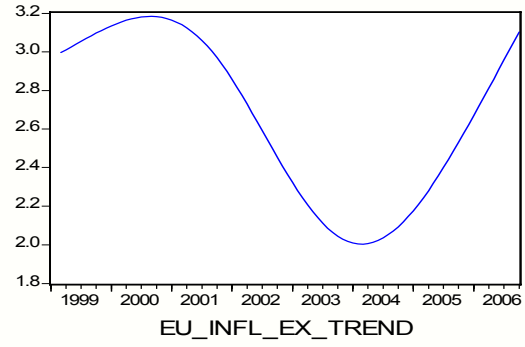
EU_DEFICIT



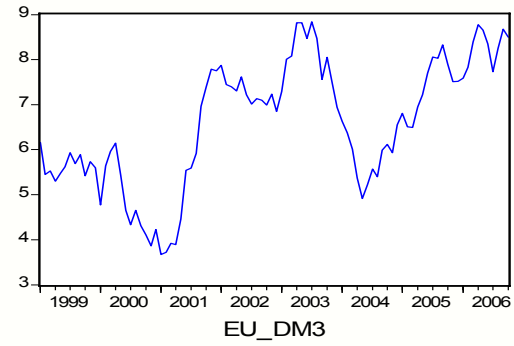
EU_DEFICIT_TREND



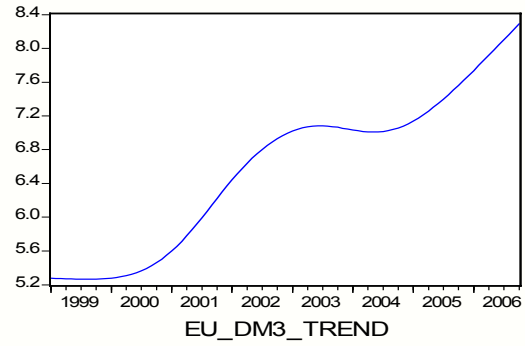
EU_INFL_EX



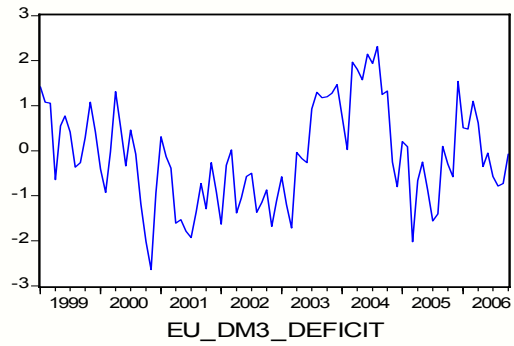
EU_INFL_EX_TREND



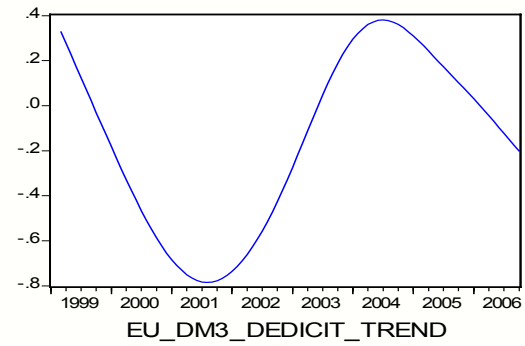
EU_DM3



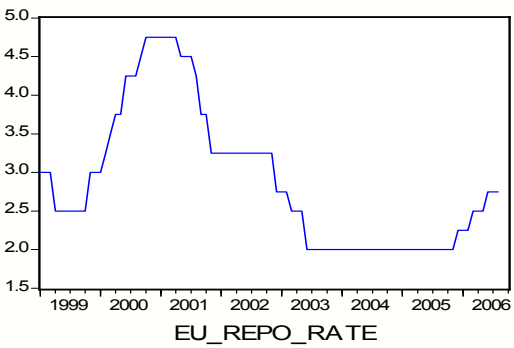
EU_DM3_TREND



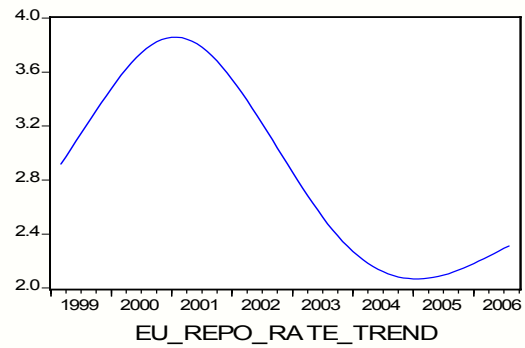
EU_DM3_DEFICIT



EU_DM3_DEDICIT_TREND

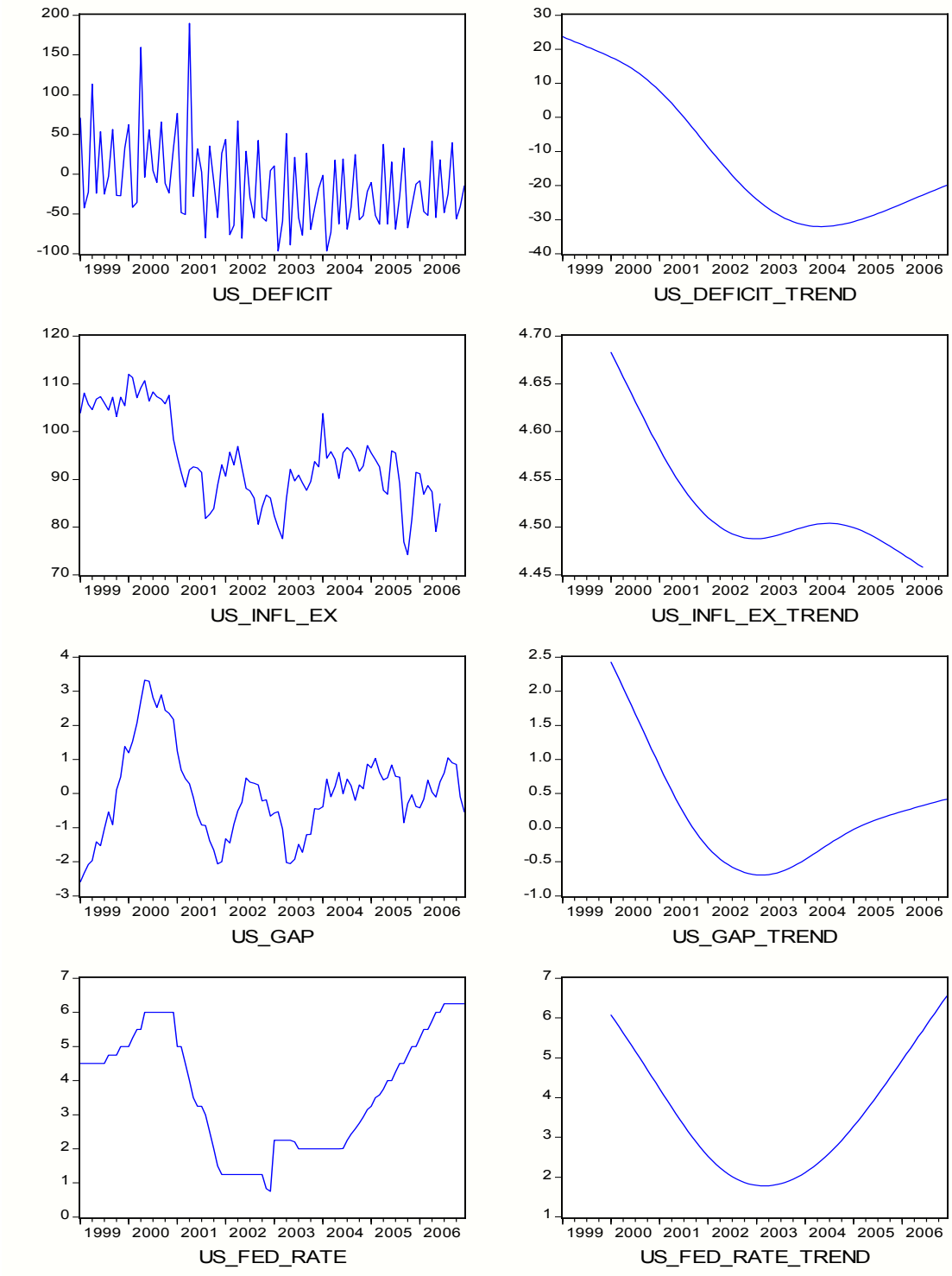


EU_REPO_RATE



EU_REPO_RATE_TREND

Figure 2 US Macroeconomic Variables and their Trends



Therefore, we start our empirical analysis applying an OLS estimation with several lags of the dependent variable. However, it is well established that, due to the correlation of the lagged dependent variable to the transformed error term, standard fixed effects estimators of models with lagged dependent variables result in biased and inconsistent estimates unless the number of time periods is large (see Ridder & Wansbeek 1990, and Kiviet 1993). In this model, T = 92, hence the bias is negligible.

We assume that the central bank cooperative attitude will depend on inflation expectation dynamics in the following way:

$$R_t = \alpha + \sum_{i=1}^{n} \beta_{j,i} \pi^e_{t-n} + \varepsilon_t \qquad (6.2.1a)$$

or

$$R_t = \alpha + \sum_{i=1}^{n} \beta_{j,i} \left(\pi^e - \pi\right)_{t-n} + \varepsilon_t \qquad (6.2.1b)$$

The results of the estimations of equations (6.2.1a) and (6.2.1b) for ECB and FED are presented in tables 1 and 2. The best measure is given by the relation between overnight rate and inflation gap, a quarter lagged.

Tab. 1 EUROPEAN CENTRAL BANK INTEREST RATE REACTION TO INFLATION EXPECTATIONS

	REPURCHASE RATE		**OVERNIGHT RATE**	
		R_squared		**R_squared**
π^e_t	0.078 (11.939)	0.618	0.077 (12.293)	0.61
π^e_{t-1}	0.079 (12.208)	0.629	0.078 (11.59)	0.61
$\left(\pi^e - \pi\right)_t$	1.103 (7.715)	0.403	1.092 (7.473)	0.383
$\left(\pi^e - \pi\right)_{t-4}$	1.347 (8.549)	0.601	1.347 (10.825)	0.577
Source: ECB and European Commission				

Tab. 2 FED INTEREST RATE REACTION TO INFLATION EXPECTATIONS

	FED DISCOUNT RATE		**FED FUND RATE**	
		R_squared		**R_squared**
π^e_t	0.078 (4.554)	0.20	0.11 (6.492)	0.30
π^e_{t-1}	0.081 (4.509)	0.20	0.118 (6.545)	0.32
$\left(\pi^e - \pi\right)_t$	2.53 (7.164)	0.30	1.782 (4.396)	0.11
$\left(\pi^e - \pi\right)_{t-4}$	2.49 (6.808)	0.25	1.826 (4.541)	0.11
Source: FED and University of Michigan				

6.3 Kalman Filter Methodology

We then proceed to identify the coefficient of inflation expectations in eq. (6.2.1a) and (6.2.1b) in a more sophisticated way. In order to recover the parameter dynamics over time, we estimate eq.

(6.2.1) employing the Kalman filter algorithm. Our second step concerns the selection of the best lagged variables using time-varying coefficients methodology. Generally, the choice of explanatory variables depends on their statistical significance in the model.
The Kalman Filter is a popular method which can be used to estimate unobserved variables, provided they appear as explanatory variables in a model that can be written in a "state space form". Hence, the system must be written in a state space form with a measurement equation in a matrix format:

$$y_t = Z.X_t + \gamma_t \text{ with } \gamma_t \sim N(0, H) \qquad (6.3.1a)$$

where y_t is the value of the output gap, while X_t is a matrix of dimension *(Txk)* which includes all the explanatory variables plus a constant; the state vector *Z*, a (*kx1*) vector that contains all the slope coefficients, which are now varying through time and γ_t represents residuals with variance/covariance matrix H. The transition equation in a matrix format:

$$Z_t = T.Z_{t-1} + v_t \qquad (6.3.1b)$$

where *vt ~ N (0,Q),* and T is a vector of parameters. Such a model may be estimated by means of a Kalman filter.
In principle, with this method all the model parameters may be estimated. In practice, there might be a trade-off between the number of parameters being estimated and the convergence of the likelihood function. More specifically, a key variable to the estimation of such models is the relative smoothness of the unobserved variable, which is governed by the relative size of the error variances in (6.3.1a) and (6.3.1b). The higher the ratio of the variance of the transition to the measurement equation residuals, referred to as the "signal-to-noise ratio" (Q/H), the more explanatory power is given to the unobserved variable, and the better the fit of the measurement equation. In the limit, for very large values of Q, the unobserved variable may soak up all the residual variation in the measurement equation. Alternatively if Q is zero, then it will be estimated as a constant.
In practice, most studies fix the signal-to-noise ratio so that the estimated unobserved variable is relatively smooth, with fluctuations which are judged to be reasonable from one period to another, which Gordon (1997) qualifies as "the [unobserved variable] can move around as much as it likes, subject to the qualification that sharp quarter-to-quarter zigzags are ruled out"[21].
Time-Varying Methodology allows us to recover an unobservable factor that could affect the repo rate.
We then apply a time-varying parameter model as follows:

$$R_{it} = \alpha_{it} + b_{1it}\pi_{it-1} + b_{2it}\pi_{it-2} + ... + b_{n,it-n}\pi_{it-n} + \gamma_{it} \qquad (6.3.2)$$

where *i* is the country, γ_{it} is an independent white noise and the coefficients are assumed to be random walks. This can be written in state space form where the observation equation is given by (3) above and the state equations are given by:

$$\begin{bmatrix} \alpha_t \\ b_{1it} \\ b_{2it} \\ \dots \\ b_{nit} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \alpha_{t-1},\dots\alpha_{t-n} \\ b_{1t-1},\dots b_{1t-n} \\ b_{2t-1},\dots b_{2t-n} \\ \dots., \quad \dots.. \\ b_{nt-1},\dots b_{nt-n} \end{bmatrix} + \begin{bmatrix} v_{it} \\ v_{1it} \\ v_{2it} \\ \dots \\ v_{nit} \end{bmatrix} \qquad (6.3.3)$$

21 See Bank of England (1998) for a survey. Some exceptions are Apel and Jansson (1998, 1999) for Sweden, Kichian (1999) for Canada. These are country-specific studies, using quite sophisticated models.

The model in equations (6.3.2) and (6.3.3) was initially estimated by maximum likelihood and the estimated variances are presented in table 3. Since we consider the time variation in parameters very important and its implication in defining a more reliable monetary policy, we need to test five hypotheses regarding the constancies of all or part of the parameters in eq. (6.3.3). Accordingly, we test five hypotheses:

1. $H_0^1 : \sigma_\nu^2 = \sigma_{\nu 1}^2 = \sigma_{\nu 2}^2 = \sigma_{\nu 3}^2 = 0$ which implies that all parameters in eq. 3 are constant;
2. $H_0^2 : \sigma_\nu^2 = 0$ which implies a constant intercept but time variation in the persistence parameters;
3. $H_0^3 : \sigma_{\nu 1}^2 = 0$ which implies a time-varying intercept but a constant inflation expectations parameter with one lag.
4. $H_0^4 : \sigma_{\nu 2}^2 = 0$ which implies a time-varying intercept but a constant inflation expectations parameter with two lags.
5. $H_0^5 : \sigma_{\nu m}^2 = 0$ which implies a time-varying intercept but a constant inflation expectations parameter with "n" lags.

In order to test these hypotheses, we estimate the restricted versions of the model.
The maximum number of lags used is n=5; the hypotheses in 1), 2), 3), 4) and 5) can be tested using the likelihood ratio test (LR test). These test statistics follow a χ^2 distribution with R degrees of freedom under the null hypothesis[22]. The results from these five tests are given in table 4.

Table 4 Variance of the parameters from Kalman filter of equations (3) and (4).

Variance	USA	EUM
σ^2_{ν}	3.958×10^{-7}	6.875×10^{-6}
$\sigma^2_{\nu 1}$	3.857×10^{-6}	4.269×10^{-7}
$\sigma^2_{\nu 2}$	3.098×10^{-6}	7.546×10^{-6}
$\sigma^2_{\nu 3}$	8.153×10^{-6}	6.172×10^{-7}
$\sigma^2_{\nu 4}$	4.589×10^{-7}	5.771×10^{-7}
σ^2_{μ}	3.547×10^{-5}	5.334×10^{-6}

[22] A likelihood ratio test is calculated as the ratio of the likelihood of the sample data at the hypothesised value of β to the maximum of the likelihood function (i.e. evaluated at the MLE). Hence we calculate (for H_0: $\beta = \beta_0$ vs $\neq 0$)

LR = $\lambda = L(\beta_0)/L(\beta_{ML})$ with $\lambda < 1$. If it is near to 1 we accept H_0, if not we reject it. We now need the distribution of λ. In some simple problems this can be worked out, but usually not. Fortunately it can be shown that -2 *ln* $\lambda \sim \chi^2$ in large samples, with *q* degrees of freedom where *q* is the number of restrictions in H_0. Now, large values of the test statistic (minus twice the log-likelihood ratio) reject H_0.

Tab. 4 Likelihood Ratio Test (LR test)

		USA	EUM
$H_0^1 : \sigma_\nu^2 = \sigma_{\nu 1}^2 = \sigma_{\nu 2}^2 = \sigma_{\nu 3}^2 = 0$	$\chi_{LR}^2(4)$ ♦	524.65**	451.77**
$H_0^2 : \sigma_\nu^2 = 0$	$\chi_{LR}^2(1)$	623.69**	479.54**
$H_0^3 : \sigma_{\nu 1}^2 = 0$	$\chi_{LR}^2(1)$	598.71**	396.98**
$H_0^4 : \sigma_{\nu 2}^2 = 0$	$\chi_{LR}^2(1)$	608.26**	413.36**
$H_0^5 : \sigma_{\nu 3}^2 = 0$	$\chi_{LR}^2(1)$	588.45**	389.58**
$H_0^6 : \sigma_{\nu 4}^2 = 0$	$\chi_{LR}^2(1)$	651.94**	405.86**
Sample		1999:01/2006:10	1999:01/2006:10

♦ $\chi_{LR}^2(R)$ **are the test statistics from the likelihood ratio tests of whether the variances in the equations for the parameters of the model are zero. ** significant at the 1% level;**

First, it can be noted that $H_0^1 : \sigma_\nu^2 = \sigma_{\nu 1}^2 = \sigma_{\nu 2}^2 = \sigma_{\nu 3}^2 = 0$ is forcefully rejected for all countries and we conclude that some kinds of time-variation in coefficients seem to be important. The tests also confirm that the constant intercepts for all countries are time-varying. Rejecting $H_0^3 : 0$, $H_0^4 : 0$, $H_0^5 : 0$ and $H_0^6 : 0$ it connotes that π_{t-1}^e, π_{t-2}^e, π_{t-3}^e and π_{t-4}^e are not constant.

In conclusion, null hypotheses are rejected for both countries and for all tests. Based on the above results, we conclude that the unrestricted models in equations (6.3.2) and (6.3.3) are preferred and we do not need to impose any restriction on them.

Once we have estimated the dynamic coefficients of the unrestricted model in eq. (6.3.3), we see the contribution of each inflation expectation (*n)* at time *t* in our interest rate setting as presented in table 5 and in figures 8-9 .

In equation (6.3.2), the coefficient 'b', estimated using the Kalman Filter approach against interest rates (EU Repurchase rate and US FED Fund rate), permits us to evaluate the evolution of ECB and FED responsiveness to inflation expectations. The empirical results are summarized in table 5.

Tab. 5 The Kalman Transition Equation 1999-2006

ECB	Constant	INFLEX (-4)
Coefficient	-0.215	1.0971**
z-Statistict	*(-0.4562)*	*(5.212)*
FED	Constant	INFLEX (-1)
Coefficient	-4.981**	0.7128**
z-Statistic	*(-4.863)*	*(4.304)*

* significant at the 0.05 level; ** significant at the 0.01 level

The maximum likelihood estimates show that the parameters of the time-varying coefficients "b" are positive, as predicted by the model, and highly significant for both countries. Figure 3 shows the behaviour of the coefficient 'b_t', for the sample, February 1999 to December 2006.
More precisely, as suggested by the analysis, evolution of ECB and FED responsiveness to inflation expectations reflects the behaviour postulated in the theoretical model and shown in figure 4. Observing ECB behaviour, it increased steadily at the beginning of the sample and remained high till the end of 2004 when it inverted the trend, implying a tight monetary policy (high interest rate responses to high inflation expectations). The Federal Reserve increased the value of its instrumental variable till the end of 2001 when it noticeably inverted its trend, implying more "output-oriented" monetary policy (low interest rate responses to high inflation expectations).

Fig. 3 Kalman Filter's Coefficients and Trends

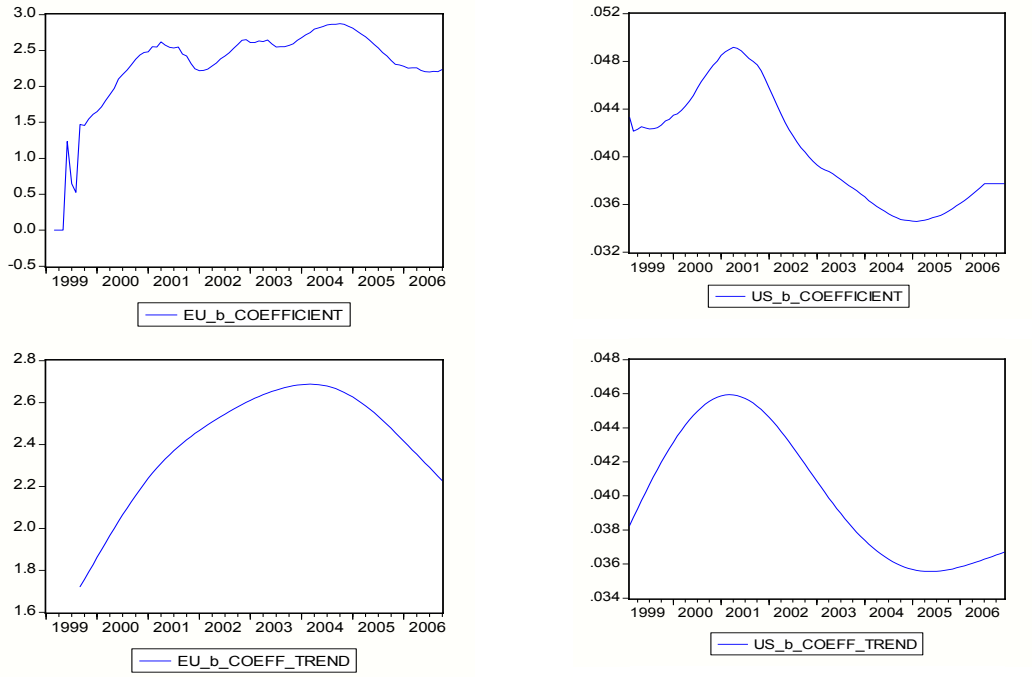


Fig. 4 EURO RED PARR and US Deficit and "b" Trends

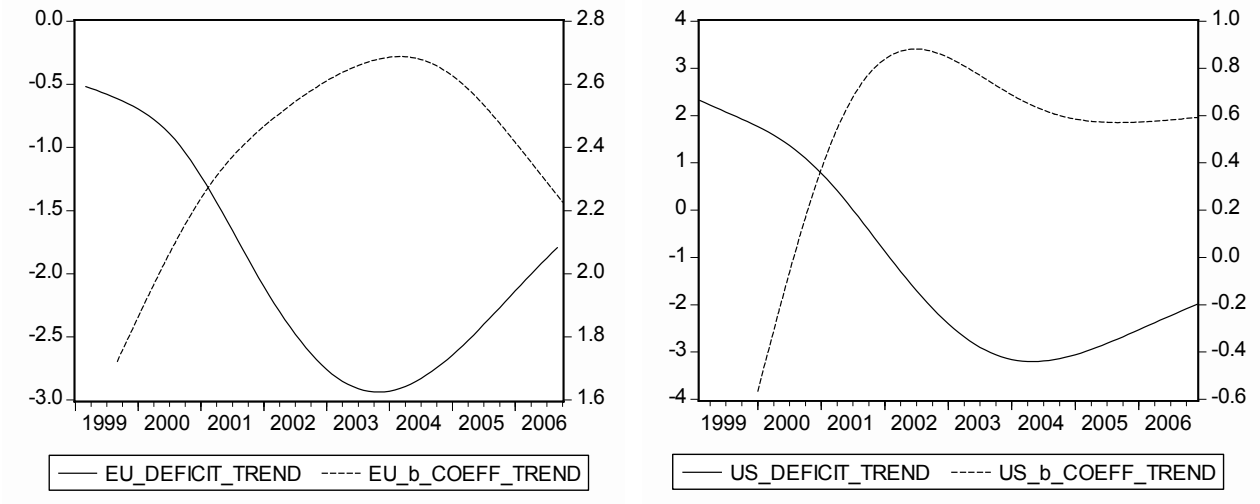


Figure 4 suggests that our model intuition of a non-linear relationship between inflation expectations and deficit could be indirectly confirmed by Kalman Filter analysis. Thus, it seems that a non-linear test for this relation and its analysis is needed.

Non-linear Analysis

The Smooth Transition Regression Model

In order to explain and analyze the non-linear policy behaviour of a central bank, a non-linear time series model is required. In this work we apply the smooth transition regression (STR) model. Despite the Markov-switching model, this method allows the regression coefficients to change smoothly from one regime to another. Moreover, in the STR model, the switching from one regime to another is endogenous, and gives opportunity for an economic explanation of the non-linear behaviour.

The STR model is defined as follows

$$r_t = \phi' z_t + \theta' z_t G(\gamma, c, s_t) + u_t \qquad (6.4.1)$$

and

$$G(\gamma, c, s_t) = (1 + \exp\{-\gamma(s_t - c)\})^{-1} \qquad (6.4.2)$$

Zt is a vector of explanatory variables. *G(γ,c,st)* is the transition function. *G(γ,c,st)* ∈ [0;1], and it is continuous in the threshold/transition variable *st* . *st* is not necessarily contained in *Zt*. *c* is the threshold around which the regimes are defined. *γ* is the slope parameter that determines the smoothness of the transition between regimes.
It is possible to assume that non-linearities in the Taylor rule equation can be described adequately by a Logistic or an Exponential Smooth Transition model (LSTR and ESTR respectively)[23].
However, in this paper we define *G(γ,c,st)* as a first-order logistic function so that the STR model becomes a logistic smooth transition model (LSTR).
Defining *st* as the deficit (*dt*), the LSTR specification implies that the coefficient on deficit would take different values depending on whether the deficit is below or above the threshold value "*c"*. This would mean that whenever the deficit is beyond a particular level, the reaction of the monetary authority becomes more aggressive, leading to a larger response of interest rates when the deficit increases. On the other hand, when the deficit is below the threshold "*c"*, the monetary authority reaction is milder.
In the case of the ESTR model, the coefficient changes depending on whether the deficit is close or far away from the threshold "*c"*, regardless of whether this difference is positive or negative. In this case the reaction of the monetary authority would be equally aggressive for negative or positive deviations from the threshold.
Given the above two specifications, we decide to apply LSTR methodology because it fits well with the idea that a reasonable asymmetric reaction of central bank should take into account the sign of the deviation from the threshold value. Hence, the more the deficit is above the threshold, the stronger the central bank reaction should be. On the contrary, the further below the threshold the deficit is, the less aggressive the monetary authority reaction should be.

[23] See Granger and Terasvirta, 1993.

Equations (6.4.1) and (6.4.2) can be rewritten as a linear regression model with time-varying coefficients. Hence, rewriting equation (6.4.1) as

$$r_t = \delta' z_t + u_t \qquad (6.4.3)$$

where

$$\delta_j = \phi_j + \theta_j G(\gamma, c, s_t) \qquad (6.4.4)$$

then $\delta_j \in \left[\phi_j, \phi_j + \theta_j\right]$ and it changes monotonically with the deficit. When $\gamma = 0$ the logistic function is equal to 0.5 and the model is linear. When $\gamma \to \infty$ the LSTR approaches a threshold model with two regimes.

Linearity Test

In order to test for linearity we should test the hypothesis that $\gamma = 0$ in the non-linear model. Unfortunately, our model is not defined under the null. This problem can be avoided by approximating the transition function with a third-order Taylor-series expansion around the null hypothesis $\gamma = 0$, see Tarasvirta (1998). After the approximation, using the deficit as the threshold variable, the following auxiliary regression is obtained

$$r_t = \alpha_{00} + \alpha_{01} d_t + \alpha_{02} y_t + \sum_{j=1}^{3} (\alpha_{j1} d_t + \alpha_{j2} y_t) d_t^j + u_t^* \qquad (6.4.5)$$

Hence, the linearity test can be carried out with

$$Ho: \alpha_{11} = \alpha_{12} = \alpha_{21} = \alpha_{22} = \alpha_{31} = \alpha_{32} = 0$$

The results of the linearity test on equations for the FED and ECB are reported in table 5.

Tab. 5 P-VALUES FOR THE LINEARITY TEST.

	ECB	FED
H0: Linearity Model	0.0260	0.1151

Hence, an important result that can be drawn from this preliminary linearity test is that a linear model could be used to describe the FED behaviour, while a non-linear model should be the most appropriate one for the ECB in the observed period (1999-2006).

The LSTR Model Estimation

The LSTR model has been used to estimate the Taylor rule, as specified in the previous sections. In order to do so, the deficit is chosen as the threshold variable. Thus, the LSTR model takes the following form

$$r_t = \phi_0 + \phi_1 d_t + \phi_2 y_t + (\theta_0 + \theta_1 d_t + \theta_2 y_t) G(\gamma, c, d_t) + u_t \qquad (6.4.6)$$

and

$$G(\gamma, c, d_t) = (1 + \exp\{-\gamma(d_t - c)\})^{-1} \qquad (6.4.7)$$

where *rt* is the interest rate, *dt* is the deficit and *yt* is the output gap.
Table 6 shows that the γ parameter of the FED is close to zero, evidencing a very smooth transition. The deficit threshold for a reaction is estimated to be 4.76895. These conclusions are consistent with the results found in the linearity test (Table 5). In table 7 we calculate several levels of G corresponding to different levels of deficit. The calculated FED response shows that the reaction is extremely smooth since it ranges from 2.6 to 2.7.

Tab. 6 LSTR MODEL FOR THE FEDERAL RESERVE

PARAMETER	ϕ_0	ϕ_2	θ_1	Γ	C
Estimate	6.0524	5.09716	4.3359	0.01019	4.76895
Standard error	7.8015	0.82455	0.05213	0.00481	2.73345
P-Value	0.44	0.000	0.000	0.037	0.084
Sample period 1999-2006 R^2 0.52 Error Variance^(1/2) = 1.17352					

Table 7 THE FEDERAL RESERVE'S RESPONSE TO DEFICIT

DEFICIT	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2
G(γ,c,dt)	0.499315	0.49957	0.499824	0.500079	0.500334	0.500589	0.500843	0.501098
Fed response	2.164979	2.166084	2.167188	2.168293	2.169398	2.170502	2.171607	2.172711
The Federal Reserve's response: 4.3359*G								

Tab. 8 LSTR MODEL FOR THE EUROPEAN CENTRAL BANK.

PARAMETER	ϕ_0	ϕ_2	θ_1	Γ	C
Estimate	2.29556	0.77323	2.40118	15.2458	3.60975
Standard error	0.2955	0.19855	0.19853	0.11575	1.04585
P-value	0.002	0.001	0.001	0.000	0.005
Sample period 1999-2006 R^2 0.67 Error Variance^(1/2)= 1.18688					

Tab. 9 THE EUROPEAN CENTRAL BANK'S RESPONSE TO DEFICIT

DEFICIT	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0
G(γ,c,dt)	0.008816	0.039248	0.157994	0.462907	0.798337	0.947872	0.988169	0.9974
ECB response	0.021168	0.094242	0.379373	1.111522	1.916951	2.276011	2.372771	2.394937
The European Central Bank's response: 2.40118 *G								

Tables 8 and 9 illustrate the results for the ECB using the same method. The γ parameter is higher, thus the transition for the European Central Bank is less smooth around the threshold value. It is worth noting that a) the threshold for the reaction is 3.60975; b) the ECB reaction threshold is very close to that fixed by the stability pact (3.00); c) these results are consistent with those of the linearity test output above (table 5) since the reaction of the ECB shows an asymmetric response. Moreover, we can conclude that the ECB reaction is more asymmetric than the FED one; and d) the ECB reaction increases sharply when the deficit is above the threshold value.

7. Conclusions

NKV success in mainstream economics can be initially ascribed to the climate of progressive criticism which, in the early 1990s, regarded expansionary fiscal policies as a means to achieve full employment. Such criticism based its rationale on the wave of immense disbelief in Keynesian tools, as testified by the crowding-out debate, the trigger of financial instability due to growing stocks of public debts and the Ricardian equivalence approach to policy making.
Complete scepticism of NKV for fine-tuning target of public deficit is the last addendum to a decade of attacks on Keynesian effects of "pure fiscal policies".
The intent to build an alternative standpoint was considered so appealing as to make its advocates blind to the true causes of the success of some isolated experience of expansionary fiscal retrenchments: success was due to a policy mix that Keynesian experience, particularly in the United States in the early 1980s, had already examined, arguing the advantages of a mix of restrictive fiscal policies and easing monetary policies. Therefore, NKV success is much more the result of "consolidated results" of co-operative economic policies than an "unconventional wisdom".
The intent of our paper was to analytically prove that increase (decrease) in consumption and decrease (increase) in inflation expectations cannot result from pure fiscal retrenchments (expansions): in other words, to refute the existence of a "super-Barro" effect and underline the crucial role of a monetary stance in accompanying fiscal policy. It seems, in our opinion, too weak a manifesto for a revolution in theory and policy-making. Nothing new has happened except an over-statement of the "Barro Effect" on consumption.
The European Central bank, much more than the Federal Reserve, was immediately willing to accept the NKV theoretical background (De Grauwe, 2002), because it seemed good theoretical underpinning for fiscal retrenchments and public sector shrinking. The label attached to these agreement is the most evident belief in "Keynesian effects of non-Keynesian fiscal policies". This could help understand why the NKV, despite its unequivocal limits, became the new conventional wisdom in Europe. It would be wise today not only to see their shortcomings but also recall that "new" policies come from far away and that their outcomes depend on many surrounding, exogenous conditions.

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APPENDIX I

CBRF is micro-founded through the CB LOSS FUNCTION

Money market equilibrium can be expressed in the following form:

$$m = ky - hR + \pi$$

where m is the demand for bank reserves - (M_3) expressed in terms of growth rate – which is a positive function of income growth ky and inflation π and a negative function of the rate of interest hR.

The loss function of the Central Bank is obviously linked to the growth rate of money:

$$L = L(m)$$

or

$$L = L(y, R, \pi)$$

Writing the loss-function in an explicit and very simple form we have:

$$\sum L_i = \frac{1}{2}\left(ky_i + \pi_i - hR_i\right)^2$$

The Central Bank looks for the rate of interest - the instrument – which minimizes the loss-function or the m rate of growth. Because m depends on y and π, it is a maximization problem subject to the constraint:

$$sub\begin{cases} y_i = -\rho(R - \pi^e{}_i) \\ \pi_i = \sigma y_i + \pi^e{}_i \end{cases}$$

where the first equation is an IS curve and the second is a supply curve AS.

Substituting the IS constraint in AS, we have:

$$\pi_i = -\sigma\rho R + (1 + \sigma\rho)\pi^e{}_i$$

Considering - for the sake of simplicity - just one period of time and substituting the constraint in the loss-function we have the following Taylor rule:

$$R = \frac{1 + \sigma\rho}{\sigma\rho + h}\pi^e{}_t + \frac{k}{\sigma\rho + h}y_t$$

which is the monetary policy rule curve (MP curve) allowing aggregate demand to be found. In turn, the aggregate demand curve combined with the AS curve determines the equilibrium income.

Finally, indicating:

$$\beta = \frac{1 + \sigma\rho}{\sigma\rho + h}$$

and

$$\partial = \frac{k}{\sigma\rho + h}$$

the Taylor rule then becomes :

$$R = \beta\pi^e{}_t + \delta y_t$$

Appendix II

Taxonomy of deficit increase effects

	$\Delta Y/\Delta D_1$	$\Delta Y/\Delta D_2$
No restrictive assumptions	$\frac{1-n\beta(\alpha+n_0\xi)D_1^{n-1}}{1-\vartheta c_0+n_1+\delta(\alpha+n_0\xi)}$	$\frac{1-n\beta(\alpha+n_0\xi)D_2^{n-1}}{1-\vartheta c_0+n_1+\delta(\alpha+n_0\xi)}+\frac{c_1\gamma(\theta-1)}{1-\vartheta c_0+n_1+\delta(\alpha+n_0\xi)}$
NX =0	$\frac{1-n\beta\alpha D_1^{n-1}}{1-\vartheta c_0}$	$\frac{1-n\beta\alpha D_2^{n-1}}{1-\vartheta c_0}+\frac{c_1\gamma(\theta-1)}{1-\vartheta c_0}$
$\theta=0$	$\frac{1-n\beta(\alpha+n_0\xi)D_1^{n-1}}{1+n_1+\delta(\alpha+n_0\xi)}$	$\frac{1-n\beta(\alpha+n_0\xi)D_2^{n-1}}{1-\vartheta c_0+n_1+\delta(\alpha+n_0\xi)}-\frac{c_1\gamma}{1+n_1+\delta(\alpha+n_0\xi)}$
$\delta=0$	$\frac{1-n\beta(\alpha+n_0\xi)D_1^{n-1}}{1-\vartheta c_0+n_1}$	$\frac{1-n\beta(\alpha+n_0\xi)D_2^{n-1}}{1-\vartheta c_0+n_1}+\frac{c_1\gamma(\theta-1)}{1-\vartheta c_0+n_1}$
$\theta=0$ $\delta=0$	$\frac{1-n\beta(\alpha+n_0\xi)D_1^{n-1}}{1+n_1}$	$\frac{1-n\beta(\alpha+n_0\xi)D_2^{n-1}}{1+n_1}-\frac{c_1\gamma}{1+n_1}$
$\theta=1$	$\frac{1-n\beta(\alpha+n_0\xi)D_1^{n-1}}{1-c_0+n_1+\delta(\alpha+n_0\xi)}$	$\frac{1-n\beta(\alpha+n_0\xi)D_2^{n-1}}{1-c_0+n_1+\delta(\alpha+n_0\xi)}$
$\beta=0$	$\frac{1}{1-\vartheta c_0+n_1+\delta(\alpha+n_0\xi)}$	$\frac{1}{1-\vartheta c_0+n_1+\delta(\alpha+n_0\xi)}+\frac{c_1\gamma(\theta-1)}{1-\vartheta c_0+n_1+\delta(\alpha+n_0\xi)}$
$\gamma=0$	$\frac{1-n\beta(\alpha+n_0\xi)D_1^{n-1}}{1-\vartheta c_0+n_1+\delta(\alpha+n_0\xi)}$	$\frac{1-n\beta(\alpha+n_0\xi)D_2^{n-1}}{1-\vartheta c_0+n_1+\delta(\alpha+n_0\xi)}$
$\theta=1$ $\beta=0$ $\gamma=0$	$\frac{1}{1-c_0+n_1+\delta(\alpha+n_0\xi)}$	$\frac{1}{1-c_0+n_1+\delta(\alpha+n_0\xi)}$

APPENDIX III
Data Description

For the estimation of the equations used in this work, the variables considered were[24]:

a) Repo rate: this is the central bank interest rate also called official interest rate. It is the main instrument of monetary policy to maintain price stability. The Federal Reserve Discount Rate is the rate at which member banks may borrow short term funds directly from a Federal Reserve Bank. The discount rate is one of the two interest rates set by the Fed, the other being the Federal funds rate;
b) Overnight rate: defined as the rate that constitutes the very starting point of the yield curve and is normally perceived as being within the control of the central bank, it is thus also important to understand its dynamics. For the ECB it is called EONIA and it is an average, calculated on a daily basis, of the (lending) turnover in the unsecured overnight market of the 49 panel banks. For the FED the federal funds rate (FEDON hereafter) is the interest rate at which depository institutions lend balances (federal funds) at the Federal Reserve to other depository institutions overnight. These variables are from the European Central Bank and Federal Bank of St. Louis.
c) Harmonised Consumer Survey (HCS): it is the proxy of inflation expectations used for Europe. The European Commission's monthly HCS is conducted every month across the European Union as part of the joint harmonised EU program of business and consumer surveys. The consumer survey was initiated in May 1972, and is now carried out in all 25 current members (Aren't there now 27 members???) of the EU. The survey is conducted on behalf of the European Commission by various national survey organizations. The sample size in each of the 15 countries that were members of the EU prior to the most recent expansion ranges between 1,000 and 3,300 consumers. The survey asks a standard set of questions in all countries, and the results are reported each month by the European Commission, and used as inputs to the monthly economic and consumer sentiment indexes (M. A. Wynne, 2005). The proxy of the inflation expectations used for the United States is the MCSI, conducted by the University of Michigan, which is a valuable guide to changes in consumer attitudes that may influence spending behaviour. The preliminary data are released on the tenth (except on weekends) of each month. A final report for the prior month is released on the first of the month.
d) Industrial production: due to the need to use monthly observations, industrial production is taken as proxy of GDP. The Index of Industrial Production shows the movement of the volume of output of the Industrial Sector. It is one of the most important industrial short-term indicators which aims to measure, on a monthly basis, the ups and downs of the volume of industrial output with a special focus on detecting, as early as possible, the turning points of the business cycle. This enables planners, decision makers and the business community at large to be aware of any sign of change in the progress of the economy in order to take appropriate and timely policy measures. Both indexes are from the IMF- Financial statistics.
a) Output gap ***(y_t)*:** it is the percentage deviation of monthly industrial production from the long-run trend computed with the Hodrick-Prescott filter;
b) The Consumer Price Index (CPI) is used to calculate effective inflation (π_t), that is π_t is equal to *100*[ln(CPIt/CPIt-12)]*;
c) US Deficit: it is general government deficit (-) or surplus (+), expressed as percentage points, series(t)/GDP(t). The EU Deficit is defined similarly as Euro area 12 (fixed composition), General government Deficit (change in aggregated debt), expressed as percentage points, series(t)/GDP(t);

Finally, the variable DM3 is the contribution to the M3 annual growth rate by central government[25] borrowing from Monetary and Financial Institutions (MFIs). "The relationship between MFI credit to general government and M3 can be illustrated in the context of the consolidated MFI balance sheet. An increase in the credit extended to general government by MFIs (either in the form of loans or as purchases of government debt securities) will expand the asset side of the MFI balance sheet. All other things being equal, the accounting identity underlying the balance sheet implies that either another item on the asset side must shrink or the liabilities side of the MFI balance sheet must also expand, for instance, through an increase in M3 (which represents the largest component of MFI liabilities)"[26].

[24] Data source: IMF - Financial Statistics, Federal Reserve Bank, European Central Bank, University of Michigan and European Commission.
[25] Balance Sheet Items; Frequency: Monthly; Reference area: Euro area (changing composition); Adjustment indicator: Working day and seasonally adjusted; BS reference sector breakdown: Monetary and Financial Institutions (MFIs); type: Contribution to the annual growth rate of M3; Counterpart area: Euro area (changing composition); BS counterpart sector: Central Government deficit.
[26] ECB Monthly Bulletin, April 2004, page 45.