Stability and performance of monetary and fiscal policies in the euro area

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Abstract

This research article examines the sustainability of fiscal policy and the impact of monetary policy on public debt management in the euro area from 1980 to 2014. This study applies the Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) unit root tests to verify the existence of stationarity and indicates that the relevant variables are integrated. The analysis is based on error correction models and cointegrated VAR-models. The empirical findings indicate that there is no evidence to support the existence of strong political coordination in the euro area. Additionally, the study supports the idea that monetary policy has a more stabilizing influence on economic activity than budget policy. An important policy implication resulting from this study is that the fiscal rule generates a divergent dynamic of the public debt. The results suggest the Keynesian effects of macroeconomic policies in the eurozone and conclude that there is a sort of complementarity between monetary and fiscal policies in some euro area countries. This means that a restrictive monetary policy (higher interest rates, interest) is always accompanied by a restrictive fiscal policy (higher taxes or lower public spending) and vice versa. Concerning the Vector Error Correction Model (VECM) techniques, the findings demonstrate that the debt has a positive effect on the budget deficit, which ultimately results in behavior that affects the debt's stability.

1. Introduction

The nature of the interdependence between monetary and fiscal policies is a recurring theme in macroeconomics and has also been a critical issue in a strongly integrated economic area like the European Union. Fiscal policy could affect the chances of success of monetary policy in various ways: through its impact on general confidence in monetary policy, through short-term effects on demand, and by changing long-term conditions for economic growth and lower inflation.

Based on the single monetary policy in the euro area since 1999, and the synchronization of monetary policies among the core euro area countries since the early 1990s, the aggregate analysis of fiscal policy for the area as a whole is a relevant undertaking. Although fiscal policy has been a country-specific issue over the past two decades[1], the use of historical data in a model of the aggregate euro area has practical value for policymakers[2].

The 2007-2012 crisis was a deep crisis of financial capitalism, which called for a strong policy response from governments to lower the weight of finance and the reliance on public and private debts, and to implement a macroeconomic strategy aiming at a return to full employment. Before the crisis, a combination of loose

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[1] This has also been the case in the operation of the Stability and Growth Pact, the agreement on the coordination of budgetary policies in place in the European Union since 1999.
[2] See, for example, Smets and Wouters (2003); Smets and Wouters (2005); Ratto, Roeger, and In't Veld (2009); Fagan, Henry, and Mestre (2005) and Gunter, Matthias, and Roland (2008).

monetary and regulatory policies encouraged excessive credit growth and a housing boom in many countries, which became a problem when the world economy slowed down (Claessens, Roe, & Rutte, 2009; Crowe, Dell'Ariccia, Igan, & Rabanal, 2013). The monetary policy stance will affect the capacity of the government to finance the budget deficit by affecting the cost of debt service and by limiting or expanding the available sources of financing. At the same time, the financing strategy of the government and its financial needs will place constraints on the operational independence of the monetary authority.

In fact, while the response of fiscal indicators such as the level of sovereign debt is of first-order importance in this regard, it generally does not provide a sufficient statistic for assessing the sustainability of debt. The same level of debt may have very different implications for debt sustainability in different countries. The joint determination of objectives and policies by the monetary and fiscal authorities is a fundamental requirement for efficient policy coordination. A situation where the different policies are made consistent with each other by the passive reaction in one policy area to the commanding position in the other policy area would not achieve the objective of maximizing the effects of policies. For example, setting a very restrictive monetary policy to offset a lax fiscal policy may crowd out and significantly increase the borrowing costs for the government.

The need for coordination raises the question of the appropriate institutional setup. Overall, as a result of the crisis, central banks have been given a larger role in maintaining financial stability. In the long term, the policy coordination problem rests on how to design a balanced monetary and fiscal policy mix that is conducive to maintaining the economy on its equilibrium growth path-controlling inflation, and promoting financial conditions for sustainable growth. This implies limiting the fiscal deficit to a level that can be financed through the operation of the capital markets without creating distortions in the allocation of resources in the economy, without having recourse to direct monetary financing from the central bank, and without relying on an excessive level of external borrowing. The efficient pursuit of the objectives of the authorities' overall macroeconomic policy framework requires a close degree of coordination of financial policies. In this paper, the interaction between monetary and fiscal policies is analyzed, stressing the need for policy coordination at two different levels: the fulfilment of the overall policy objectives (including financial sector development), and institutional and operational procedures. On the former, the main interactions between monetary and fiscal policies related to the financing of the budget deficit and its consequences for monetary management.

This paper examines the fiscal policy sustainability and the impact of monetary policy on public debt management in the Euro Area from 1980 to 2014. The evidence does not let suggest strong political coordination in Euro Area and supports the idea that the monetary policy has a more stabilizing influence on economic activity than the budget policy. The particular stance of monetary policy affects the capacity of the government to finance the budget deficit by changing the cost of debt service and limiting or expanding the available sources of financing. A lack of coordination between the monetary and fiscal authorities will result in inferior overall economic performance. A weak policy stance in one policy area burdens the other area and is unsustainable in the long term.

We show that the fiscal policy rule is such that the more public debt increased in the euro area countries, the more the deficit increased. In other words, we have succeeded in showing, according to our empirical study, that the budgetary rule generates a divergent dynamic of the public debt. On the other hand, the debt is not sustainable within the aggregated eurozone.

The remainder of the paper is organized as follows: Section 2 reviews the empirical literature. Section 3 analyses the Methodology and data. Section 4 presents the analysis of variables, section 5 presents the empirical results. Finally, we conclude with remarks.

2. Empirical Literature Review

We have presented some important studies to motivate our empirical work; these include studies for different countries as well as different time periods. As This paper examines the effect of the interaction between monetary and fiscal policies on the sustainability of developments in public debt and budget deficit, we have chosen to focus specifically on recent empirical works that consider policy interactions, and on the papers that deal with the effect of monetary and fiscal policy on public debt and deficits.

Taylor (1999) showed that economists have become increasingly skeptical about the effectiveness of discretionary monetary and fiscal policies, and how policy rules have been progressively imposed.

Leeper (1991) developed the Fiscal Theory of the Price Level (FTPL), he introduced two essential points: the distinction between active and passive policies, and highlighting two stable organizations of economic policies (active monetary policy and passive fiscal policy, or vice versa).

Leith and Wren-Lewis (2002) defined an active monetary-policy regime, which satisfies the Taylor principle. They concluded that monetary and fiscal policies should be either active or passive for stability.

The paper by Dixit and Lambertini (2001) analyses the interactions between monetary and fiscal policies in a setting where the monetary authority has control over inflation. The paper identifies a source of conflict where the fiscal authority aims to increase output and inflation more than the monetary authority. The authors find that non-cooperative Nash equilibrium results in both higher inflation and a decline in production. The paper concludes that commitment by the monetary authority may not be sufficient or appropriate or sufficient when fiscal policy is active, but a budget committee hearing could result in a better outcome.

Kirsanova, Stehn, and Vines (2005) extended the three equations of the monetary model to a five-equation model of monetary and fiscal policies by adding the government's inter-temporal budget constraint. They assumed that there is a lag period for implementing a fiscal policy that reflects the legislative and political processes required for significant modifications in discretionary fiscal policy. They also accounted for a one-period delay in the effect of the monetary policy, which reflects the transmission system. Kuttner and Posen (2002) raised concerns about whether the budget policy, taking into account these delays, could interact with the monetary policy in a timely manner.

In his study, Melitz (1997) analysed the effect of monetary and fiscal policy on public debt and deficits across 19 OECD (the Organisation for Economic Co-operation and Development) member countries from 1960/78 to 1995, using pooled data. He found several interesting results: Firstly, fiscal policy reacts to the report of the public debt in a manner of stabilization. Secondly, the laxist fiscal policy leads to a restrictive monetary policy, and vice versa. Lastly, the automatic stabilization of fiscal policy is weaker than generally perceived.

Melitz (1997) examined the interaction between monetary and fiscal policies using pooled regression annual data from 19 OECD countries. He noted that the monetary and fiscal policies tended to move in opposite directions, acting as substitutes for each other. He also noted that the budget policy played a stabilizing role in low debt, but the taxes behave in a preoccupation with stabilization, and moved the expenditure in a destabilizing way.

Favero and Monacelli (2003) studied the interactions of policies by using Markov-Switching Vector Autoregressive Models (Krolzi, 1997). They stipulated that although fiscal policy shall be subject to a given regime change in an endogenous way and the regime changes monetarist is imposed in an exegetic way. They note that in the U.S., only the period between 1987 and 2001 can be described as a passive fiscal regime. Thus, Woodford (1998) affirmed that since 1980 passivity would be a good description. Gali, Perotti, Lane, and Richter (2003) found that fiscal policy became increasingly passive during this period, after discussing significant contributions to monetary and fiscal policies and their interactions.

Muscatelli and Tirelli (2004) estimated a New Keynesian model with the generalized method of moments (GMM) in a system with multiple equations. They allowed fiscal policy to have two instruments, taxation and expenditure, and motivate policy interactions by first considering the cyclical nature of each policy, and secondly, by the direction of movement of the shocks of production. They found that monetary policy attenuates and satisfies the Taylor principle and reacts in a stabilizing manner. Thus, they concluded that the interaction depends on the shock. Shocks to the production of fiscal and monetary policy act as complements, whereas inflation shocks act as substitutes.

Reade and Stehn (2008) applied the cointegrated VAR method to study the interaction of monetary and fiscal policy and its effect on the sustainability of developments in public debt in the United States from 1960 to 2005. They concluded that fiscal policy ensured the sustainability of long-term debt by responding to the increase in debt in a way that the stabilization of the reaction was moderate. However, according to their results, discretionary fiscal policy did not ensure countercyclical behavior. Additionally, monetary policy followed a Taylor rule type and corrected the imbalance both in the short and long term.

Reade (2010) used multivariate cointegration methods to study the interactions between monetary and fiscal policies by examining the example of the United States since the early 1980s. They found that the elaboration of the monetary policy is prospective and passive in the sense that it meets the policy rules. In contrast, fiscal policy is found to be active in the sense that it does not respond to the rules of fiscal policy. Thus, interactions between the two spheres of politics seem limited so that no policy instrument enters the political rule of the other sphere. However, monetary policy is heavily passive in response to the movements of the tax policy. Furthermore, they found that the two policies are complementary since both policies respond in the same way to revitalize the economy in a downturn and to brake during a boom.

Daly and Smida (2016) analyzed the interaction between monetary and fiscal policies in Greece from 1980 to 2012. The particular stance of monetary policy affects the capacity of the government to finance the budget deficit by changing the cost of debt service and limiting or expanding the available sources of financing. The evidence does not reveal strong political interactions in Greece and supports the idea that the monetary policy is more stabilizing in its influence on economic activity than the budget policy.

Fragetta and Kirsanova (2010) studied monetary and fiscal policy interactions in three countries: the United Kingdom, the United States, and Sweden. They used a structural general equilibrium model of an open economy and the estimate using Bayesian methods. They assumed that the authorities could act in a strategic way in a non-cooperative policy game and compared different leadership regimes. Thus, they characterized monetary and fiscal interactions in the three countries as follows: in each country, monetary authorities and fiscal authorities used their instruments with substantial smoothing, and there was no evidence of debt stabilization in any country. Finally, they found that the feedback was low to maintain a stable economy, but no evidence on the goal of stabilizing the debt was obtained.

Traum and Yang (2011) aimed to analyze the mechanisms of transmission of fiscal policy by estimating the relationship between the primary surplus and the public debt. They also determined whether the public debt was significant and how it affected the rate of investment, output gap, and demand for money. To achieve this, they used the Johansen cointegration test and the unit root test (ADF), as well as simultaneous equation models, such as the generalized moment's method (GMM) with instrumental variables. They analysed the long-term

equations resulting from the cointegration tests and found that public debt had a significant impact on the real variable in the economy, especially the ratio of investment to Gross Domestic Product (GDP). This empirical evidence suggests the need for a clear prescription of public policy. Therefore, the government should aim to reduce the ratio of debt to GDP as it translates to an increase in the investment-to-GDP ratio, indicating the need for a clear prescription of public policy.

Belke and Dreger (2011) used multivariate cointegration methods to study the interactions of monetary and fiscal policies by studying the example of the United States and the euro area from 1999 to 2006. They specified two models: a partial correction of the Error Correction Models (ECM) and a general Vector Error Correction Model (VECM). In the partial VECM, they sought a long-term interdependence relationship between the interest rates of the two monetary zones and specified the modalities of the Taylor rule as an exogenous variable. In the general VECM, they considered all endogenous variables and sought long-run equilibrium relationships between them, which could reveal the monetary interdependence of policies between the two central banks. Both models were verified for weak homogeneity to establish a possible relationship between the leader and follower. The empirical results of these two models indicated interdependence between the European Central Bank (ECB) and the Fed, but only the VECM model demonstrated a leader-follower relationship between the two central banks.

Reade and Stehn (2011) used multivariate cointegration methods to study the interactions of monetary and fiscal policies by studying the example of the United States since the early 1980s. They found that monetary policy is prospective and passive in the sense that it meets the monetary rules. On the other hand, fiscal policy is active in the sense that it does not respond to the rules of fiscal policy. Thus, the interactions between the two spheres of politics seem limited in such a way that no policy instrument enters into the political rule of the other sphere. However, monetary policy, which is highly passive, acts as a reaction to the movements in fiscal policy. Moreover, they noted that the two policies are complementary since the two policies respond in the same direction to revive the economy in a period of slowdown and apply the brakes during a boom period.

In summary, the literature review above on the interactions between monetary and fiscal policies shows divergences in results that generally depend on the country or group of countries considered, econometric techniques, variables incorporated, and time series included in the study. Accordingly, one should be cautious in interpreting empirical results and delivering policy implications.

Hallett, Libich, and Stehlík (2011) used individual regressions by instrumental variables to study the interactions between monetary and fiscal policies in the United Kingdom and the euro area. He noted that monetary and fiscal policies act as substitutes in the UK but complement each other in the euro area.

3. Data and Methodology

The objective of this section is to implement the methodology to analyze our problem. The first step is to present a theoretical model that allows us to account for the interdependencies of monetary and budgetary policies. The second step consists of exposing the empirical strategy, where we will explain how to estimate a C-VAR model consistent with the theoretical model, and how to interpret the results of the estimation.

3.1. Data

The data used include the output gap y_t, the inflation rate π_t, the nominal interest rate r_t, the public debt d_t and the primary government balance pb_t, defined as government receipts minus spending. The latter two fiscal variables are represented as fractions of GDP. For inflation, we calculate this from the consumer price index (CPI) measure as the most appropriate measure. Debt, deficit, interest rate, and inflation rate variables are downloaded from the Annual Macro-Economic database (AMECO[3]), and the output gap is downloaded from the International Monetary Fund (IMF).

3.2. Theoretical Model

We present the theoretical model (Kirsanova et al., 2005), which is based on three macroeconomic equations: the IS equation, the Philips equation, and a representation of the monetary policy rule. This model is completed by two additional equations that formalize fiscal policy and public debt dynamics. Monetary policy is described as a generalized the Taylor rule, while fiscal policy follows a budget variant of Taylor rule[4] with a feedback effect on other state variables of the system.

Equation 1 presents an IS curve that represents the evolution of the deviation of production (yt), driven in particular by the real interest rate.

$$y_t = \gamma^f E_t y_{t+1} + \gamma^b y_{t-1} - \sigma[r_t - E_t \pi_{t+1}] + \varphi d_t + \delta b p_t + \varepsilon_{1,t} \qquad (1)$$

Where yt is the output gap, πt is the rate of inflation, rt is the nominal interest rate, dt is the stock of government debt, and bpt is the primary deficit. The two budget variables are represented as fractions of GDP. (εt) is a demand shock.

Equation 2 presents a Philips accelerator curve. It describes the dynamics of inflation (πt) in terms of past and expected inflation and the output gap.

$$\pi_t = \chi^f \beta E_t \pi_{t+1} + \chi^b \pi_{t-1} + k_1 y_t + k_2 y_{t-1} + \varepsilon_{2,t} \tag{2}$$

In Equation 2, the interest rate is considered as the instrument of monetary policy, while bpt is defined as the tool of the budget maker.

There is disagreement on whether the budgetary instrument should be taxes, public expenditure, or the primary balance. In our study, we will use the primary deficit as an instrument of fiscal policy. In contrast, Kirsanova et al. (2005) insist that public spending be the tool, whereas Scmitt-Grohe and Uribe (2004) consider taxation as such, and several other authors take both at the same time, for example (Gali et al., 2003; Muscatelli & Tirelli, 2004).

3.3. The Budget Rule and the Budget Identity

The theoretical equation is an approximation of reality, like the cointegration relation which, is interpreted as the budget identity. So, the stochastic term of Equation 3 represents the error of this approximation. The government's budgetary identity is:

$$d_t \approx [1 + \rho_{t-1}]d_{t-1} - pb_t \tag{3}$$

In this equation, variables are represented as fractions of GDP, ρ_{t-1} represents the real interest rate. Kirsanova et al. (2005) align the budget identity around the reference level of the debt and the levels of the interest rate ρ and d, as shown in the equation:

$$d_t = [1 + \hat{\rho}]d_{t-1} + \rho_{t-1}\hat{d} + pb_{t-1} \tag{4}$$

The budget rule

$$pb_t = \psi_y y_t + \psi_\pi \pi_t + \psi_d d_t, \tag{5}$$

Ou` $\psi_y > 0, \psi_\pi > 0$ et $\psi_d > 0$.

The monetary policy rule

Taylor's rule makes the interest rate depend on inflation and the output gap.

A general form of this rule is:

$$r_t = \varphi_{E\pi} E_t \pi_{t+1} + \varphi_\pi \pi_t + \varphi_{\pi 1} \pi_{t-1} + \varphi_{Ey} E_t y_{t+1} + \varphi_y y_t + \varphi_{y1} y_{t-1} \tag{6}$$

An ≪ Active ≫ monetary policy (Leith & Wren-Lewis, 2002) would be described by Taylor's principle[5], so φEπ + φπ + φπ1> 1.

Production is generally interpreted as a criterion for inflation (Svensson, 1999); we would, therefore, expect: φEy + φy + φy1> 0.

3.4. The Empirical Strategy

After presenting the theoretical contributions to the interactions between monetary and fiscal policies, we will now outline our empirical strategy. Specifically, we will employ cointegration methods to study the interactions between monetary and fiscal policies.

The present study is carried out using annual time series for six countries in Euro Area (Ireland, Greece, Italy, Spain, Belgium, and France) during 1980-2014.

Our model allows for non-stationarity data and endogeneity, which means that questions such as the role of monetary policy in debt sustainability can be investigated using this approach.

The empirical strategy used in our study involves combining the vector autoregressive model (VAR) with the following equation.

$$X_t = \Pi_0 + \sum_{i=1}^{K} \Pi_i X_{t-i} + u_t, u_t \sim N(0, \sigma^2) \tag{7}$$

X_t is a p vector of data, while Π_0 is a p × p matrix of coefficients, where p = 5 is the number of variables in the system, and T is the number of observations. The matrix Π_0 refers to the constant terms in each ´equation of the VAR system. If the data are non-stationary, so Xt ~ I(1), and for Equation 7 to be equilibrated, it needs to be rewritable into the error-corrected form:

$$\Delta X_t = \Pi^* X_{t-1}^* + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + u_t, \tag{8}$$

Where $X_{t-1}^* = (X_{t-1}, 1)$, $\Pi^* = (\Pi, \Pi_0)$, $\Pi = \sum_{i=1}^{k} \Pi_i - I$ and $\Gamma_i = -\sum_{j=i+1}^{k} \Pi_j$. The coefficients for the lagged regressors and the constant term have been banded together for ease of exposition. Further, if $X_t \sim I(1)$,

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[5] The Taylor rule (Taylor, 1993) expressing the interest rate of monetary policy as a linear function of the output gap and the deviations of inflation. of a target level.

then given that $u_t \sim I(0)$ and $\Delta X_t \sim I(0)$ then Π must be of reduced rank for Equation 8 to be balanced. If Π is of reduced rank, then there exist $p \times r$ matrices α and β such that $\alpha\beta'$ and Equation 8 becomes:

$$\Delta X_t = \alpha\breve{\beta}'X^*_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-k} + u_t, \qquad (9)$$

Where $\breve{\beta} = (\beta, \beta_0)'$, $X^*_{t-1} = (X_{t-1}, 1)$, $\Gamma_i = -\sum_{j=i+1}^{k} \Pi_j$ and $X^*_{t-1} = (X_{t-1}, 1)$. The $\breve{\beta}'X^*_{t-1}$ terms are cointegrating vectors, the stationary relationships between non-stationary variables, or steady-state relationships. Importantly, $E(\beta'X_t)$ since these cointegrating vectors describe steady state relationships which must be mean zero.

In order to test the direction of causality between different variables, a three-stage procedure is followed. First, we search for the order of integration of the different time series using unit root tests. Generally, a variable is said to be integrated of order d, written by I(d), if it turns out to be stationary (integrated of order 0, I(0)) after differencing d times. Stationarily of a series is an important phenomenon because it can influence its behaviour. In this paper, we conduct unit root tests using the Augmented Dickey–Fuller (ADF)[6] and Phillips–Perron (PP)[7] tests. We use both tests in order to check the robustness[8] of the results. Akaike information criterion (AIC) is used to select the lag length in ADF test, while Newey-West Bartlett kernel is used to select the bandwidth for the PP test. Second, once the order of integration of the series is determined, we investigate the potential existence of a long-run equilibrium relationship (or cointegration) between variables. According to Engle and Granger (1987), if two series x_t and y_t are each I(1) or non-stationary, one would expect that a linear combination of x_t and y_t would be a random walk. To test the presence of cointegration of the variables in this study, Johansen's approach[9] is employed. Finally, if the presence of cointegration is confirmed between different variables, then Engle and Granger (1987) error correction specification can be used to test for Granger causality and show its direction.

We use two tests in order to check the robustness of the results. One advantage of the PP test over the ADF test is that the former is robust to general forms of heteroskedasticity in the error term. Akaike information criterion (AIC) is used to select the lag length in ADF test, while Newey-West Bartlett kernel is used to select the bandwidth for the PP test.

4. Empirical Results

In order to describe the economic cycle of the countries of the euro area, we will analyze key data such as the gross public debt, the budget deficit, the interest rate, inflation, and the output gap. Then, we will perform stationarity and cointegration tests[10] on the data. Finally, we will explain how to estimate a C-VAR model based on the theoretical model and how to interpret the results of the estimation.

4.1. Variables Trends in Economic Time Series
4.1.1. Gross Public Deb

Between the end of the third quarter of 2013 and the end of the fourth quarter of 2013, the ratio of public debt to GDP decreased in the euro zone (EA18) from 92.7% to 92, 6% of GDP, while in the EU28, the ratio increased from 87.0% to 87.1%.

When analyzing the Figure of the public debt of the euro zone in the period 1980-2014, some interesting characteristics emerge. Notably, the period of 1999 was marked by a joint effort by the States to reduce the weight of the public debt of the GDP in order to meet the criteria of the Treaty of Maastricht.

Since the 1980s, the debt ratio in almost all the countries in the euro zone has increased sharply. Over a span of 25 years, the ratio has risen from approximately 35% to 70% of GDP (20 to 70% in France). In the 1990s, the trend of increasing debt ratio continued, particularly in France. Between 1992 and 1997, the debt ratio in France increased by almost 25 percentage points of GDP.

This increase in debt ratio was due to the widening gap between the interest rate and the growth rate, which in France reached 6 points in 1993. This resulted in the rapidly increasing share of cumulative interest in the outstanding capital. From Figure 1, we can see a change in the public debt for all countries, including France, Italy, Spain, Belgium, Ireland, and Greece from 1980. On one hand, we note that Belgium, from 1980 until 1992, had a rate in% of GDP which is the highest of public debt. In contrast, France and Spain have the lowest rates. From 1992 until 2007, Ireland's public debt gradually declined.

Despite all efforts, the ratio of public debt as a percentage of GDP calculated as an average for the euro area cannot be lowered by 60%, even if it has recorded a downward trend. With the establishment of the Monetary Union and the emergence of the Euro, the trend began to reverse. The upward trend in public debt has been continually influenced by government injections to address macroeconomic disruptions. The average public debt

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[6] Dickey and Fuller (1979).
[7] Phillps and Perron (1988).
[8] One advantage of the PP test over the ADF test is that the former is robust to general forms of heteroskedasticity in the error term.
[9] Johansen (1988); Johansen and Juselius (1990).
[10] The cointegration test is used to discover the number of long-run equilibrium relationships that exist between the variables dt, pbt, rt, πt and yt. It is based on the statistical procedure of Johansen (1988); Johansen (1991).

of the euro zone reached a minimum of 66% in 2007, followed by a strong upward trend, which still marks the current situation.
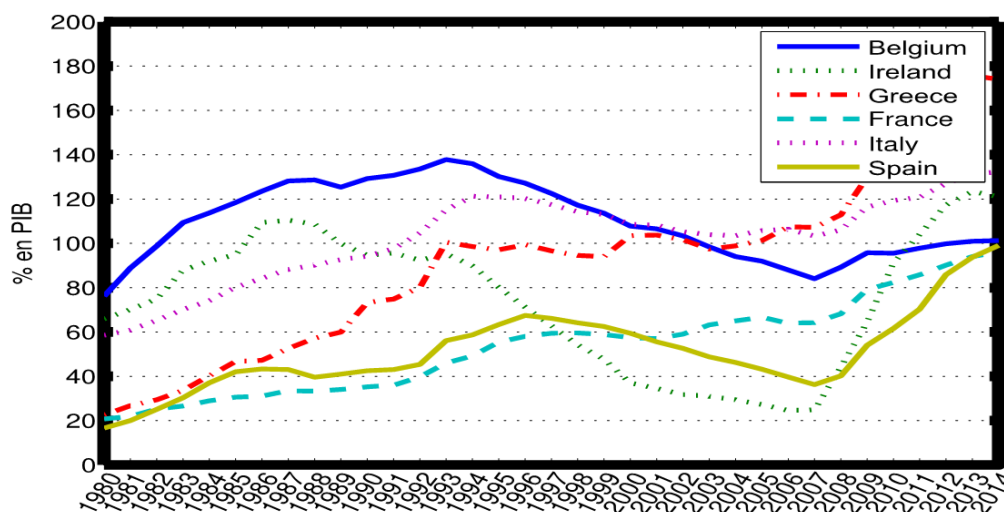

Figure 1. Evolution of gross debt in the euro area.

The first cycle reached maturity in 2004, and most of the debt was accumulated during an extended period until 2007.

The violation of the PSCs by Germany and France in 2002 and 2003 indicated a lower degree of credibility of this mechanism designed to oversee budget developments in member states. Without strong coordination at the level of the euro zone, the situation could not have a favorable outcome. The downward trend in public debt was reversed after the emergence of the single currency, due to the absence of a strong fiscal mechanism.

4.1.2. Budgetary Deficit

In Figure 2, we notice that all the countries had a budget deficit throughout the period (1980-2014), except for Ireland, which had a surplus during 1997-2008, and Spain between 2004-2008. From 1994, we can observe that the six countries reduced their public deficit to comply with a threshold above 3% in order to join the euro zone.

In France, the economic crisis of 1993 contributed to widening the budget deficit, and the good economy around 2000 mechanically reduced the deficit. In 2000, there was talk of a 'budget pot' when the overall deficit was not filled. Between 2010 and 2013, several countries made significant efforts to reduce their public deficit, resulting in a decrease of 12.2% in Greece and 6.8% in Spain. In contrast, in Ireland, we observe that the deficit increased rapidly between 2009-2010, but was then reduced by 26.7 percentage points of GDP to reach the same level as other countries in 2014. In 2013, France was still above the 3% threshold, with a public deficit equal to 4.3% of GDP. However, the country reduced it by 35.86% between 2010 and 2013, which is a decrease of 2.7 points of GDP.

4.1.3. Interest Rates

From Figure 3 we notice that the interest rate for all countries fell between 1980 and 1999 except in Greece. From 1987 the interest rate in Greece increased and reached 25% in 1994, then it fell gradually from 1994 until 2001 to reach the same rate for all the countries of the eurozone.

The single monetary policy interest rate does not always correspond with the good behavior of public finances in many euro area countries, particularly during the economic crisis, Greece, Portugal, Spain, and Ireland are among these countries. It is evident that under such conditions, the budgetary austerity imposed on certain countries was much more severe than that imposed on other states. The financial solidarity was called into question, at least by the slow response of governments to financing needs and budget deficits compared to the quick reaction of the ECB and other central banks (Fed, Bank of England, the Bank of Japan) for monetary issues.

4.1.4. Inflation

Figure 4 clearly shows two major trends or patterns that are strongly linked to the appearance of the common currency in 2001. A sort of contour point (delineating two contrasting zones) is clearly visible around this date. Before that, the six countries had different but generally high values. These rates have gradually decreased over time, although s specific fluctuation particular has been identified in Greece. Since 2001, the rate has stabilized below 5%.
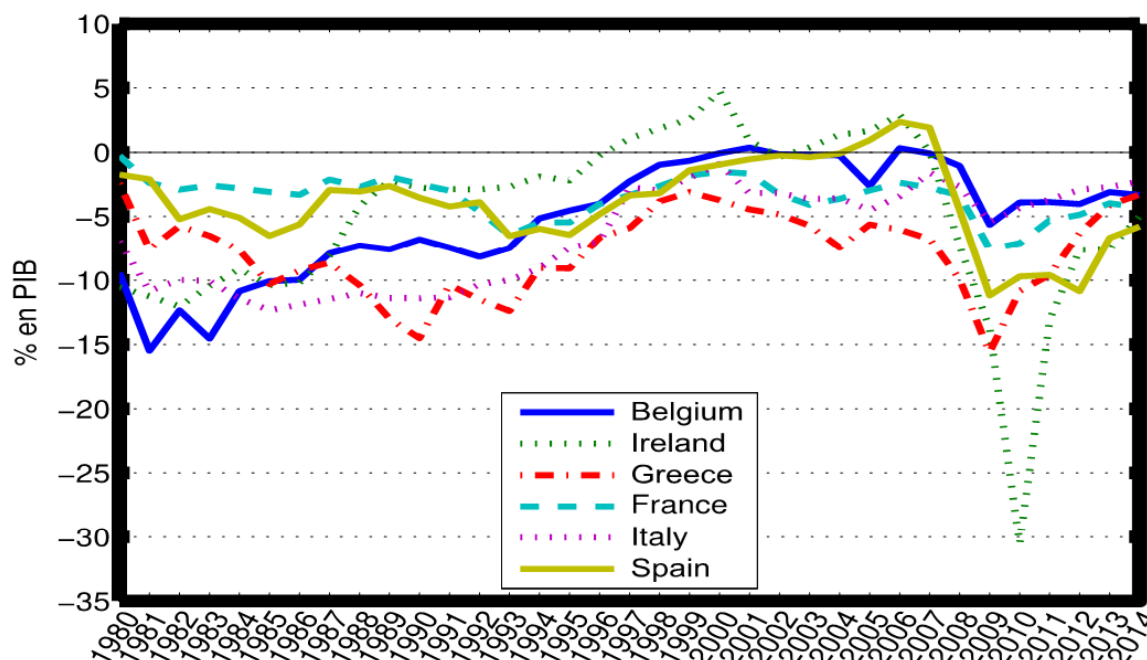
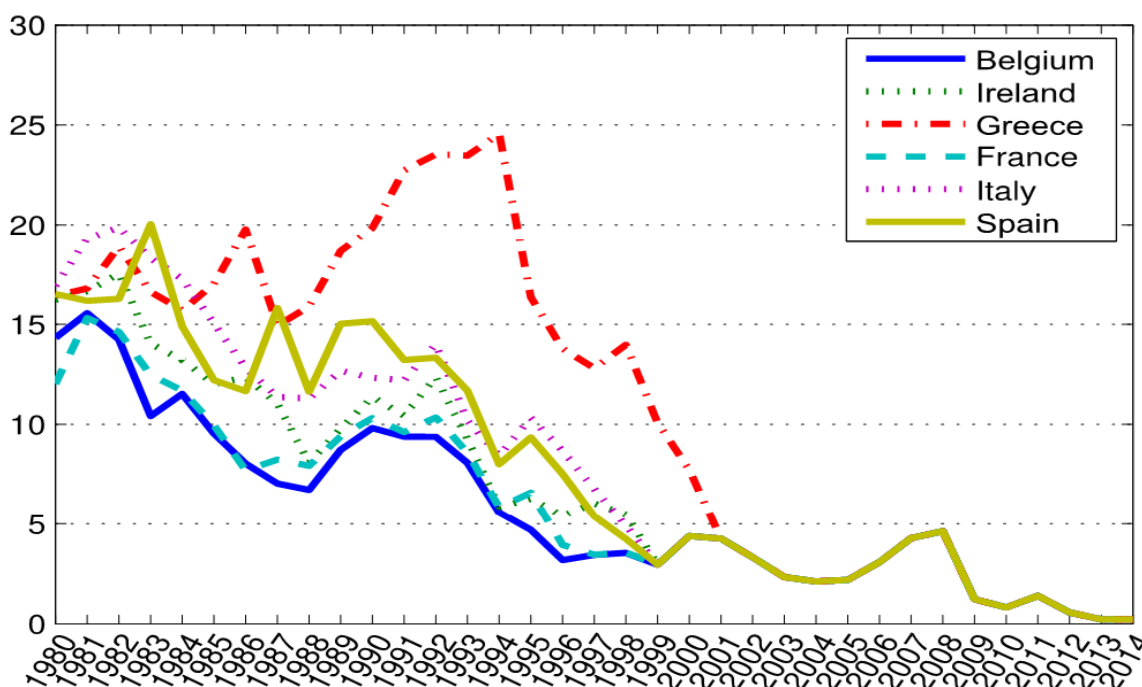**Figure 2.** Evolution of budgetary deficit in the euro area.

Figure 3. Evolution of interest rate in the euro area.

4.1.5. Output Gap

If we disregard the last years in Greece, we can easily distinguish from Figure 5 a sinusoid around zero and with an almost constant period of 12 years for all six countries. This suggests that a positive trend is expected around 2016-2017. Would this really be the case? Note that this alternative is in bold between -5 and 5.

The stationarity of variables and the eventual cointegration relations are essential steps as they condition the dynamics of the system according to the degree of persistence.

In order to test the non-stationarity of the data, each of the variables was tested for unit roots using the traditional ADF test which tests the null hypothesis of non-stationarity. To ensure the robustness of the order of integration of the variables, the ADF test is supplemented by the Phillips Perron (PP) stationarity test. In constructing the unit root tests, the variables in levels were tested in the presence of both an intercept and a trend. The subsequent tests of first differences included only an intercept given the lack of trending behavior in the first-differences series.
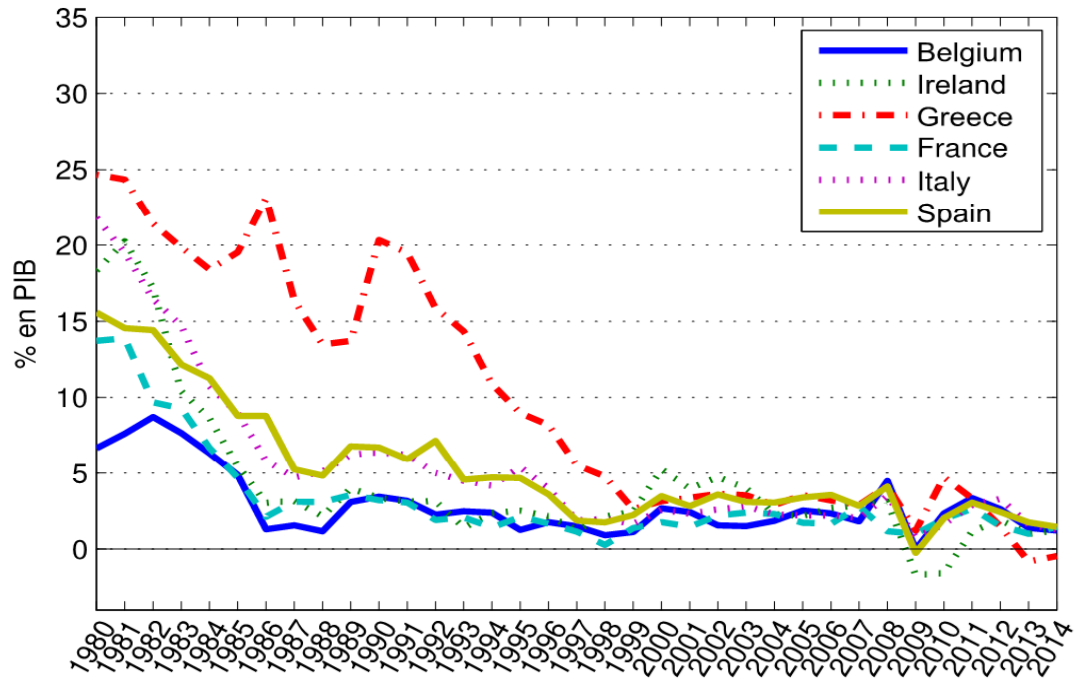
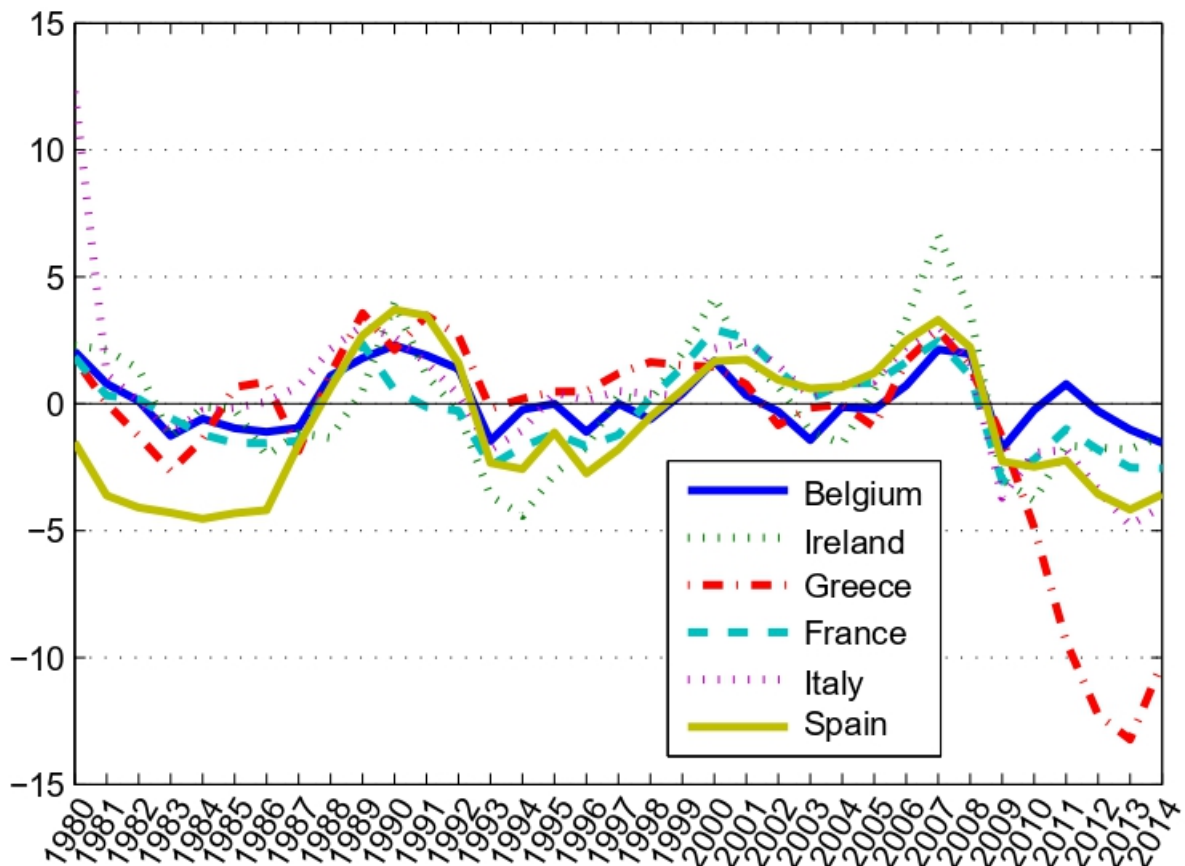**Figure 4.** Evolution of inflation in the euro area.

Figure 5. Evolution of the output gap in the euro area.

The results of the unit root tests indicate that most of the variables were generated via an integrated order one I(1) process (see Table 1). The first-differenced variables were found to be stationarity in at least two of the three tests undertaken for most cases. Overall, the results of the ADF and PP tests indicate that all variables are stationary in the first differences. Finally, we can state that all variables are I(1).

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Table 1. Stationarity test results.

Country	Variables	ADF		PP	
		Level	First difference	Level	First difference
Ireland					
	y_t	-1.650(6)	-4.513(5)*	-2.343(8)	-5.259(19)*
	d_t	-2.268(1)	-3.147(3)**	-1.218(4)	-3.818(3)*
	bp_t	-2.215(0)	-5.593(0)*	-2.288(1)	-5.706(5)*
	r_t	-1.658(4)	-4.518(3)*	-1.471(9)	-6.156(0)*
	π_t	-1.431(8)	-3.591(1)*	-3.208(0)	-4.812(2)*
Greece					
	y_t	-0.991(4)	-3.916(3)*	-0.845(2)	-3.781(1)*
	d_t	-1.486(0)	-5.995 (0)*	-1.707(3)	-5.992(2)*
	bp_t	-2.327(0)	-5.984(0)*	-2.468(1)	-5.984(1)*
	r_t	-0.569(1)	-5.049(0)*	-0.476(1)	-5.049(0)*
	π_t	-1.391(0)	-5.723(0)*	-1.673(3)	-5.723(1)*
France					
	y_t	-2.884(1)	-4.981(1)*	-2.547(1)	-4.938(7)*
	d_t	-2.401(1)	-3.602(1)**	-1.489(1)	-3.522(4)**
	bp_t	-2.829(1)	-4.942(0)*	-2.815(8)	-6.096(13)*
	r_t	-0.980(0)	-6.147(0)*	-0.986(1)	-6.186(6)*
	π_t	-1.645(8)	-3.465(1)**	-3.333(3)	-5.355(3)*
Belgium					
	y_t	−1.158(10)	−6.254(0)*	−3.693(0)	−6.254(0)*
	d_t	−0.466(1)	−3.136(0)*	-0.167(4)	−3.134(2)*
	bp_t	-1.426(0)	−9.144(0)*	−1.327(3)	−8.738(2)*
	r_t	−1.717(3)	−4.812(0)*	−2.526(1)	−4.812(1)*
	π_t	−1.630(6)	−3.971(5)*	−1.913(2)	−7.043(1)*
Spain					
	y_t	−1.433(0)	−3.935(0)*	−1.853(2)	−3.993(1)*
	d_t	0.552(1)	−2.448(4)**	1.222(4)	−6.765(2)*
	bp_t	−1.396(1)	−4.415(0)*	−1.168(2)	−4.415(1)*
	r_t	−1.781(0)	−7.005(0)*	−1.781(0)	−7.005(1)*
	π_t	−0.767(12)	−6.7518(0)*	−3.960(3)	−6.751(0)*
Italy					
	y_t	−1.294(5)	−4.722(1)*	−5.373(4)	−8.884(1)*
	d_t	0.978(1)	−2.434(0)**	1.700(4)	−2.315(5)**
	bp_t	−0.869(0)	−6.382(0)*	−0.869(1)	−6.329(2)*
	r_t	−2.097(0)	−4.856(0)*	−2.179(3)	−4.838(2)*
	π_t	−0.516(12)	−3.790(0)*	−5.919(1)	−3.661(2)*

Note: For the ADF and the PP tests, the values in parentheses indicate the optimum number of lags and bandwidths, respectively are obtained from Mackinnon (1996).
The critical values for the ADF and PP tests t-statistics.
* Significance level at 1%.
** Significance level at 5%.

Since the series are integrated of the same order (I(1)), Johansen's approach is used to test if the variables are cointegrated. The cointegration test uses an intercept but no trend. Both the Johansen maximum eigenvalue (Max-Eigen) and trace statistics are used to test the null hypothesis of no cointegration. Results, which are reported in Table 2, suggest that in each country the five variables are cointegrated. The number of cointegration vectors is denoted by rank r, which is formally chosen based on a likelihood ratio test known as the trace test (Johansen, 1988, 1995). Therefore, we will use additional information to help determine rank, e.g., examination of the remaining roots of the system, size of eigenvalues, and correlations between cointegration vectors and different data. The interpretation of these cointegration vectors is important: they are stationary linear combinations and nonstationary static economic variables. Taylor rules relations (Taylor, 1993) are static and stationary relationships between variables; thus, the persistence of time requires an autoregressive structure in order to provide unbiased estimates of the coefficients. In cases where the number of variables is greater than two, there may be more than one cointegration equation (Engle & Granger, 1987).

Therefore, it is necessary to determine the cointegration rank, which is the number of cointegration relationships among the variables. In the evaluations, we first check the cointegration rank and then use the results of the cointegration rank and then use the results as a predetermined state for further evaluations in the partial and general framework of VECM. In our empirical analysis, the cointegration test is a prerequisite for

applying the empirical framework of VECMs. We will try to identify the equations of the error corrections for all countries, which have an economic meaning.

Table 2. Johansen cointegration results.

Country	Eigenvalue	Hypothesized $H_0: r^a$	Trace statistic	Max-eigen statistic	Critical value trace	At 5% max-eigen
Ireland						
	0.855	0 *	126.734	59.941	69.818	33.876
	0.660	1 *	66.792	33.477	47.856	27.584
	0.456	2 *	33.314	18.891	29.797	21.131
	0.298	3	14.422	10.970	15.494	14.264
	0.105	4	3.4525	3.452	3.841	3.841
Greece						
	0.955	0 *	178.654	96.601	69.818	33.876
	0.774	1 *	82.052	46.186	47.856	27.584
	0.518	2 *	35.866	22.628	29.797	21.131
	0.310	3	13.238	11.537	15.494	14.264
	0.053	4	1.700	1.700	3.8414	3.841
France						
	0.992	0 *	246.535	141.828	47.856	27.584
	0.860	1 *	104.706	57.024	29.797	21.131
	0.797	2 *	47.681	46.368	15.494	14.264
	0.044	3	1.3130	1.3130	3.841	3.841
Belgium						
	0.899	0 *	151.419	71.090	69.818	33.876
	0.722	1 *	80.329	39.698	47.856	27.584
	0.596	2 *	40.631	28.150	29.797	21.131
	0.260	3	12.480	9.344	15.494	14.264
	0.096	4	3.1360	3.136	3.841	3.841
Spain						
	0.831	0 *	135.937	55.283	69.818	33.876
	0.728	1 *	80.654	40.397	47.856	27.584
	0.532	2 *	40.256	23.567	29.797	21.131
	0.397	3	16.689	15.727	15.494	14.264
	0.03	4	0.961	0.961	3.841	3.841
Italy						
	0.860	0 *	140.084	61.001	69.818	33.876
	0.780	1 *	79.083	47.054	47.856	27.584
	0.502	2 *	32.028	21.621	29.797	21.131
	0.266	3	10.407	9.621	15.494	14.264
	0.025	4	0.786	0.786	3.841	3.841

Note: Trace and Max-eigenvalue tests indicates 3 cointegrating eqn(s) at the 0.05 level.
*Denotes rejection of the hypothesis at the 0.05 level.
a. Indicates the number of cointegration relationships.

As can be seen in Table 2, the trace and maximum eigenvalue statistics show that both hypotheses, r=0, r=1, and r=2 are rejected at the 5% significance level, which indicates the presence of three cointegrating relationships.

In our empirical analysis, the cointegration test is a prerequisite for an application of the empirical framework of VECM. Therefore, we will try to identify the equations of the error corrections for France that have economic significance in relation to the economic model studied in the previous section.

We will now explain the three equations of cointegration relation in France.

$$\alpha\beta X_{t-1}^* \begin{pmatrix} -0.97 & -0.02 & -0.05 \\ -0.14 & 0.12 & 0.46 \\ 0.29 & -0.31 & 0.45 \\ 0.34 & 0.15 & 0.21 \\ -0.24 & 0.35 & 0.04 \end{pmatrix} \begin{pmatrix} yt-1 + 2.372\pi t-1 - 0.139rt-1 + \rho 1t \\ dt-1 - 18.894\pi t-1 + 6.609rt-1 + \rho 2t \\ bpt-1 - 0.627\pi t-1 + 0.037rt-1 + \rho 3t \end{pmatrix} \quad (10)$$

In the first cointegration equation, the coefficient of the interest rate rt is negative. In addition, a long-term Philips relation in which $\pi_{t-1} = \frac{1}{-2.372} y_{t-1} + \epsilon_{1;t-1}$. In this equation, we tested the coefficient of r_{t-1} and found that the coefficient (-0.139) is not significantly different from zero.

In this case, in the long term, the output gap will be:

$$\pi_{t-1} = -0.421 \, y_{t-1} \qquad (11)$$

If production increases by 1% of potential output, i.e., if the output gap increases by 1, the inflation rate decreases by 0.421% per year in the long term. Economic activity has a negative but a low effect on the rate of inflation. There are two other cointegration relationships that have an economic meaning.

$$d_{t-1} + 178.621 bp_{t-1} = -5.909 \, \pi_{t-1} \qquad (12)$$
$$bp_{t-1} = 0.0036 \, d_{t-1} + 05.212 \, \pi_{t-1} \qquad (13)$$

We find in Equation 13 that an increase in debt by 1 percentage point of GDP implies an increase in deficit by 0.0036 points of GDP. This highlights the fact that the fiscal rule generates a convergent dynamic of the public debt. An increase in inflation by 1% per year leads, in the long term, to a primary deficit increase by 0.5212 points of GDP.

$$d_t = -15\rho_t + 25pb_t \quad dt = -15\rho t + 25pbt \qquad (14)$$

This equation shows that in the end a positive debt must be accompanied by a positive primary deficit, i.e., a primary deficit is necessary, and this is what we observe in Equation 14.

In this equation, the budget identity result is a balanced budget in the long term. This is consistent with the previous equation, which suggests that an increase in public debt implies a decrease in the fiscal deficit. This suggests that fiscal policy is sustainable in France. The results obtained from the estimate show that in the short and long-term monetary and fiscal policies influence economic activity in the case of France. Fiscal policy, captured by revenue, is more effective than monetary policy over the short and long term. The component of the fiscal variable of total expenditure has a very little short-term and long-term negative impact on economic activity. Monetary policy, on the other hand, has short-term and long-term positive effects on economic activity. The elasticities of the error-correction model show that in the short and long run, inflation has an adverse effect on economic growth.

So far, we have noted that when designing monetary policy rules, it is important to consider the specificities of countries, including differences in growth, inflation, and competitiveness. Similarly, we have stressed the need to impose budgetary rules in either a decentralized or centralized approach. However, relying solely on these rules has significant limitations when it comes to determining an approach policy mix for the monetary union. In the euro area, simply setting an inflation target for the ECB and a deficit target for governments cannot guarantee the effectiveness and overall coherence of the policy mix. Therefore, we need to consider whether there is an optimal combination of monetary and fiscal policy that can ensure non-accelerating inflation growth in a heterogeneous monetary union. More specifically, we aim to answer the question of whether there is a better combination of monetary and fiscal policy exists to achieve this goal.

We have shown that fiscal policy influences public debt, real interest rates, the output gap, and the primary balance. These variables must be systematically taken into account in the context of a monetary policy geared towards price stability. It is also known that monetary policy has an impact on short-term interest rates, the real value of debt, and long-term inflation expectations. Changes in these parameters can result in a change in the economic environment in which fiscal policy operates. It is clear from these interconnections that the implementation of monetary and fiscal policy rules cannot be a solution to the problem of the effectiveness of the policy mix, unless certain conditions are met. The main condition is that the effects induced by a change in the nature of one of these two policies do not affect the credibility of supranational monetary policy or the commitment of national fiscal policies. This suggests that fiscal policy is sustainable in France and Spain but not in Belgium, Ireland, Italy, and Greece.

5. Conclusions

The study, which is based on six countries of the Eurozone, is extremely useful because it allows us to assess how these policies align with their assigned objectives and examine the short and long-term possibilities of policy choices. As the fiscal policy is decentralized in the Euro area, each government becomes responsible for the economic activity of their respective countries.

Macroeconomic modelling of the influence of monetary and fiscal policy is an approach that, in the context of this analysis, studies the short, medium, and long-term effects of each policy on economic activity. To achieve this, we use an analysis of cycles, causal relationships, and cointegrated VAR models. There is an abundance of literature on these models, which aim to explain the credibility of macroeconomic policies and their suitability for studying macroeconomic variables in general. These analytical methods are used to identify the effects of short and long-term imbalances in different macroeconomic variables. These dynamic models incorporate both short-term and long-term evolution of the variables.

The study of this model allows us to identify the conditions of consistency and transmission of monetary and fiscal policies. With this model, we aim to assess the interaction between the various authorities responsible for the management of monetary and fiscal policies. Our results in this paper suggest the Keynesian effects of

macroeconomic policies in the Eurozone and conclude that there is a sort of complementarity between monetary and fiscal policies in some Euro area countries, insofar as a restrictive monetary policy (higher interest rates, interest) is always accompanied by a restrictive fiscal policy (higher taxes or lower public spending), and vice versa. This type of behavior appears to be specific to an expansionary period. Using a VAR model, we distinguish two regimes: one regime of expansion of the economy and the other of recession, and we introduce a probability of transition from one regime to another that depends on the current regime, which is supposed to be exogenous and constant.

The results that were obtained from the estimate indicate that monetary and fiscal policies have an influence on economic activity in the case of France, both in the short term and in the long term. In both the short term and the long term, fiscal policy – captured by revenue – is more effective than monetary policy. There is very little negative impact on economic activity from the component of the fiscal variable that is total expenditure, whether in the short or the long term. On the other hand, monetary policy can have both positive short-term and long-term effects on the overall level of economic activity. The error-correction model's elasticities demonstrate that inflation has a negative impact on economic growth, both in the short run and the long run, regardless of the time considered. Up to this point, we have emphasized the importance of taking into account the unique characteristics of individual nations when establishing rules governing monetary policy. Specifically, these rules need to take into account variations between nations with regard to growth, inflation, and competitiveness. Similarly, we have emphasized the importance of imposing budgetary rules, whether through a decentralized or centralized method.

Moreover, during times of recession, macroeconomic policies may not be complementary, but rather substitute each other, with governments responding rather expensively to monetary restrictions. However, these results are not universally accepted in the literature. Alberto and Tabellini (2007) argue for the presence of more expansionary fiscal policy measures in periods of growth, coupled with tight monetary policy, and a lack of government action in recession, when monetary policy seems to become more lax to encourage the resumption of the activity. Some of the studies, such as that of Sabate, Gadea, and Escario (2006), carried out in specific countries in the euro area, particularly in Spain over the period 1874 to 1935, attest to the dominance of fiscal policy vis-à-vis monetary policy.

References

Alberto, A., & Tabellini, G. (2007). Bureaucrats or policians? Part I: A single policy tassk. *American Economic Review, 97*(1), 169-179.

Belke, A., & Dreger, C. (2011). Ramifications of debt restructuring on the euro area: The example of large European economies' exposure to greece. *Intereconomics, 46*(4), 188-196. https://doi.org/10.1007/s10272-011-0382-7

Claessens, B., Roe, R., & Rutte, G. (2009). Time management: logic, effectiveness & challenges. In: Roe, R., Waller, M. & Clegg, S. (Eds), Time in organizational research. In (pp. 23-41). London, UK: Routledge.

Crowe, C., Dell'Ariccia, G., Igan, D., & Rabanal, P. (2013). How to deal with real estate booms: Lessons from country experiences. *Journal of Financial Stability, 9*(3), 300-319. https://doi.org/10.1016/j.jfs.2013.05.003

Daly, H., & Smida, M. (2016). Monetary and fiscal policy interaction in the Greece: A cointegration approach. *International Review of Business Research Papers, 12*(1), 1-16. https://doi.org/10.21102/irbrp.2016.03.121.01

Dickey, D. A., & Fuller, W. A. (1979). Distrution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association, 74*(366), 427-431. https://doi.org/10.2307/2286348

Dixit, A., & Lambertini, L. (2001). Monetary–fiscal policy interactions and commitment versus discretion in a monetary union. *European Economic Review, 45*(4-6), 977-987. https://doi.org/10.1016/s0014-2921(01)00134-9

Engle, R. F., & Granger, C. W. J. (1987). Co-integration and error correction: Representation *Estimation, and Testing, Econometrica, 55*(2), 251-276. https://doi.org/10.2307/1913236

Fagan, G., Henry, J., & Mestre, R. (2005). An area-wide model for the euro area. *Economic Modelling, 22*(1), 39-59. https://doi.org/10.1016/j.econmod.2004.04.002

Favero, C. A., & Monacelli. (2003). *Tommaso, monetary-fiscal mix and inflation performance: Evidence from the U.S.* Retrieved from IGIER Working Paper No. 234.

Fragetta, M., & Kirsanova, T. (2010). Strategic monetary and fiscal policy interactions: An empirical investigation. *European Economic Review, 54*(7), 855-879. https://doi.org/10.1016/j.euroecorev.2010.02.003

Gali, J., Perotti, R., Lane, P. R., & Richter, W. F. (2003). Fiscal policy and monetary integration in Europe. *Economic Policy, 37*(18), 533-572.

Gunter, C., Matthias, M., & Roland, S. (2008). Fiscal consolidation in the euro area: Long-run benefits and short-run costs. *Economic Modelling, 25*(5), 912-932.

Hallett, A. H., Libich, J., & Stehlík, P. (2011). Welfare improving coordination of fiscal and monetary policy. *AUCO Czech Economic Review, 5*(1), 7-26.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Jounal of Economics Dynamics and Control, 12*(2-3), 231-254.

Johansen, S. (1991). Estimation and hypothesis testimg of cointegration vectors in Gaussian vector autoregressive models. *Econometrica: Journal of the Econometric Society, 59*(6), 1551-1580.

Johansen, S. (1995). A statistical analysis of cointegration fpr I(2). *Econometric Theory, 11*(1), 25-59.

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration with applications to demand for money. *Oxford Bulletin of Economics and Statistics, 52*, 169-210.

Kirsanova, T., Stehn, S. J., & Vines, D. (2005). The interactions between fiscal policy and monetary policy. *Oxford Review of Economic Policy, 21*(4), 532-564.

Krolzi, H. M. (1997). Markov-switching vector autoregressions, modelling, statistical inference, and application to business cycle analysis, book, lecture notes in economics and mathematical systems. *LNE, 454*, 6-28.

Kuttner, K. N., & Posen, A. S. (2002). Fiscal policy effectiveness in Japan. *Journal of the Japanese and International Economies, 16*(4), 536-558.

Leeper, E. M. (1991). Equilibria under 'active'and 'passive'monetary and fiscal policies. *Journal of Monetary Economics, 27*(1), 129-147. https://doi.org/10.1016/0304-3932(91)90007-b

Leith, C., & Wren-Lewis, S. (2002). *Taylor rules in the open economy.* Retrieved from Discussion Papers 0203, University of Exeter, Department of Economics.

Mackinnon, J. G. (1996). Numerical distribution function for unit root and cointegration tests. *Journal of Applied Econometrics, 11*(6), 601-618.

Melitz, J. (1997). *Some cross-country evidence about debt, deficits and the behaviour of monetary and fiscal authorities.* Retrieved from Cepr Discussion Papers No. 1653, C.E.P.R.

Muscatelli, A., & Tirelli, P. (2004). *Analyzing the interaction of monetary and fiscal policy: Does fiscal policy play a valuable role in stabilisation?* Retrieved from Working Papers No. 2005-17, Business School - Economics, University of Glasgow.

Phillps, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika, 75*(2), 335-346. https://doi.org/10.2307/2336182

Ratto, M., Roeger, W., & In't Veld, J. (2009). OUEST III: An estimated open-economy DSGE model of the euro area with fiscal and moneatry policy. *Economic Modelling, 26*(1), 222-233.

Reade, J. (2010). *Modelling monetary and fiscal policy in the us: A cointegration approach.* Retrieved from Discussion Papers No. 11-02, Department of Economics, University of Birmingham.

Reade, J., & Stehn, J. (2008). *Modelling the interactions of monetary and fiscal policies in the us.* Retrieved from Discussion Papers, Department of Economics, University of Birmingham.

Reade, J., & Stehn, J. (2011). *Modelling monetary and fiscal policy in the us: A cointegration approach.* Retrieved from Discussion Papers No. 11-02.

Sabate, M., Gadea, M., D., & Escario, R. (2006). Does fiscal policy influence monetary policy? *The Case of Spain, 43*(2), 1874-1935.

Scmitt-Grohe, S., & Uribe, M. (2004). Solving dynamic gneral equilibriu models using a second-order approximation to the policy function. *Journal of Economic Dynamics and Control, 28*(4), 755-775.

Smets, F., & Wouters, R. (2003). An estimated dynamic stochastic general equilibrium model of the euro area. *Journal of the European Economic Association, Mit Press, 1*(5), 1123-1175.

Smets, F., & Wouters, R. (2005). Comparing shocks and frictions in US and euro area business cycles: A Bayesian DSGE approch. *Journal of Applied Econometrics, 20*(2), 161-183.

Svensson, L. O. (1999). Inflayion targeting as a monetary policy rule. *Jornal of Monetary Economics, Elsevier, 3*(43), 607-654.

Taylor, J. B. (1993). *Discretion versus policy rules in practice.* Paper presented at the Carnegie-Roshester Conference Series on Public Policy.

Taylor, J. B. (1999). The robustness and efficiency of monetary policy rules as guidelines for interest rate setting by the European Central Bank. *Journal of Monetary Economics, 43*(3), 655-679. https://doi.org/10.1016/s0304-3932(99)00008-2

Traum, N., & Yang, S.-C. S. (2011). Monetary and fiscal policy interactions in the post-war US. *European Economic Review, 55*(1), 140-164. https://doi.org/10.1016/j.euroecorev.2010.11.009

Woodford, M. (1998). Doing without money: Controlling inflation in a post-monetary world. *Review of Economic Dynamics, 1*(1), 173-219.