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The effects of the interactions between Monetary and Fiscal Policy on the Euro Area's GDP – an ARDL approach

Ana Marta Gonçalves Peres de Almeida

Master in Economics

Supervisor:
Professor Doctor Diptes Chandrakante Prabhudas Bhimjee,
Assistant Professor (Invited), ISCTE-IUL Business School,
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BUSINESS SCHOOL

CIÊNCIAS SOCIAIS E HUMANAS

Department of Economics

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Para os meus Pais, a Nonô e o Mou

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Resumo

Esta Dissertação apresenta uma análise empírica dos efeitos das interações entre as políticas monetária e fiscal no PIB da Zona Euro, utilizando dados trimestrais de 2000 a 2020. Utilizando um modelo ARDL-EC para analisar os efeitos de longo e curto prazo sobre o PIB da Zona Euro, a equação inclui variáveis de política monetária, variáveis de política fiscal, e uma proxy para as interações entre as políticas. Conclui-se que o PIB da Zona Euro é positivamente impactado pela política monetária no longo e curto prazo, enquanto o impacto da política fiscal é negativo. O resultado para as interações entre política monetária e fiscal é animador para futuras investigações sobre o tema, devido à rápida velocidade de ajuste do modelo e à evolução favorável da proxy para o *policy mix*, no contexto da análise do seu significado económico ao longo dos diferentes ciclos económicos.

Palavras-chave: Política Monetária, Política Fiscal, *Policy mix*, Zona Euro, Modelos ARDL, PIB

Classificação JEL: E40, E50, F30

Abstract

This Dissertation provides an empirical analysis regarding the effects of the interactions between monetary and fiscal policies in the Euro Area's GDP, using quarterly data from 2000 until 2020. Using an ARDL-EC model to analyse the long run and short run effects on the Euro Area's GDP, the equation includes monetary policy variables, fiscal policy variables, and a proxy for its interactions. This Dissertation concludes that the Euro Area's GDP is positively impacted by monetary policy in the long run and short run, while the impact of fiscal policy is negative. The result for the interactions between monetary and fiscal policy is encouraging for further research on this topic, because of the model's quick adjustment speed and the favourable evolution of the proxy for the policy mix, in the analysis of its economic significance through the different business cycles.

Keywords: Monetary policy, Fiscal policy, Policy mix, Euro Area, ARDL models, GDP

JEL Classification: E40, E50, F30

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CHAPTER 1

Introduction

Since the beginning of the European Monetary Union (EMU), over two decades ago, the world went through the Global Financial Crisis (GFC), the Sovereign Debt Crisis (SDC), and now the crisis triggered by the Covid-19 pandemic. These major economic events left a great imprint in the Euro Area's economy, yet they may have initiated a new paradigm for the design and implementation of economic policy.

The GFC showed the importance of regulation in the economic and financial sectors (which was lacking), the need to develop new 'unconventional' policy tools, and more importantly, brought back the discussion and significant relevance of the interactions between Monetary and Fiscal policies, or the policy mix. Due to the damages provoked by this crisis – from which stand out the high levels of public and private debt, and the interest rates close to the zero lower bound, – both policies became quite limited/exhausted. Again, with the European SDC and Covid-19 crisis, it was demonstrated that monetary and fiscal policies individually considered could not ease the great economic shocks.

Given this context, we consider that the policy mix is an extremely relevant topic in the economic agenda, and one that still requires significant academic investigation, namely on the implementation and execution side. This Dissertation essentially revolves around the topic of the interactions between monetary and fiscal policy interactions, with the particular aim to study what are the effects of these interactions on the Euro Area's GDP, from the first quarter of 2000 until the fourth quarter of 2020. Additionally, this Dissertation aims at comparing the evolution of the economic effects of the policies through the period under analysis, which covers different business cycles.

The choice of the Euro Area as the subject of the empirical research falls on its characteristics, as one Central Bank (the ECB) designs/implements monetary policy, while in contrast there are 19 central Governments that design/implement fiscal policy, which represents an additional challenge to the policy mix. Nevertheless, the fact that the Euro Area was so severely impacted by the crises mentioned above, could also (and hopefully) mean that the Euro Area is a great candidate to have a successful case for an adequate design/implementation of the policy mix.

This Dissertation is structured as follows: chapter 2 discusses the main literature review, addressing both theoretical and empirical approaches to the topic; chapter 3 describes the data and methodology herein employed; chapter 4 contains a discussion to the main empirical results; lastly, chapter 5 concludes the Dissertation.

CHAPTER 2

Literature review

In addressing the effects of the monetary and fiscal policy interactions on the euro area's GDP, we divide the literature review in the following sub-sections: (i) the design/implementation of monetary policy; and the design/implementation of fiscal policy in the Euro Area. Accordingly, it is possible to understand the effects that each policy, separately, has on GDP, as well as other relevant aspects, namely: (ii) the theoretical literature of monetary and fiscal policy interactions; and (iii) some empirical approaches to the study of the policies' interactions.

2.1. Monetary and fiscal policies in the Euro Area

Monetary and fiscal policies are the two leading tools to achieve, and maintain, economic growth. Their design/implementation in a monetary union presents greater challenges, when compared to the case of a single economy, because of the divergences between the Central Bank and the corresponding (multiple) fiscal authorities (Buti et al., 2001). Yet, the macroeconomic policies goals are the same – to control inflation and promote sustainable public finances, as well as to stimulate economic activity (Tadesse & Melaku, 2019). Neck and Blueschke (2016) highlight another challenge for the Euro Area that was actually emphasized by the onset of the Great Recession – there are large differences among the Member States, which culminated in the fiscal divide between 'core' and 'peripheral' countries. High public debt is an issue that affected mostly the peripheral countries, thus leading to the Sovereign Debt Crisis, but there are also other differences that include the countries' competitiveness and productivity trajectories. Consequently, economic shocks have different effects among different countries, regardless of the European Central Bank (ECB) common monetary policy response.

Drakos and Kouretas (2015) describe the ECB's implementation of monetary policy before and after the Global Financial Crisis (GFC), showing that it changed during and after this extreme economic/financial episode, as the ECB's monetary policy became more active. From the beginning of the monetary union until mid-2008, the ECB's policy was towards targeting inflation, using mainly the nominal short-run interest rate in its refinancing operations. Then, at the peak of the GFC (third quarter of 2008), there is a structural break in the

design/implementation of monetary policy, as the short-term policy rate reaches an historic low, and in the following period several authors see a weaker response to inflation by the ECB, because stabilizing the Euro Area economy became the main goal.

Blot et al. (2020) show that the ECB's asset purchase during the Sovereign Debt Crisis was successful in reducing all sovereign yields, and the Bank's actions were effective at mitigating the disruption created by that crisis in the adequate implementation of monetary policy in the Euro area.

The Zero-Lower bound (ZLB) has been constraining the ECB's policy for over a decade, and Kocherlakota (2019) observes that the ZLB will still be an issue in policymaking for many years to come. The author states that "small but persistent reductions of the lower bound below zero" (Kocherlakota, 2019: p.231) seem the best solution to mitigate the ZLB problem. On the other hand, forward guidance, asset purchases, and inflation target increases (which are some of the instruments available to the ECB) are quite unlikely to improve the issue.

As for the effects of monetary policy on GDP, the literature is consensual that monetary policy plays an important role in the country's economic growth. Yet, this growth is attributed mostly to money supply growth, while the interest rate seems to have a minor impact on GDP (Hameed & Ume, 2011; Ryan-Collins et al., 2016). Moreover, Lee and Werner (2018) show that short and long-term interest rates follow the trend of GDP, and not the other way around, and they emphasize that Central Banks should focus on quantity – mainly of credit, which directly influences money supply, – instead of focusing on prices.

Contrarily to the ECB's monetary policy, which promotes a shared interest, fiscal policy in the euro area is primarily conducted to serve heterogeneous national interests. Countries must follow some common rules, for instance, regarding their public deficit, but each government has a large amplitude to pursue their specific fiscal policies. The debate over a common fiscal policy for the Euro Area has been growing in the literature, but that discussion goes beyond the topic of the Dissertation, so we typically focus on key aspects of monetary policy in the Euro Area's context.

Canh (2018) discusses the important role of fiscal policy in promoting economic growth. Nevertheless, the author's findings also suggest that fiscal policy's effects are worsened in countries with a high level of debt – "external debt creates constraints for the effectiveness of fiscal policy" (Canh, 2018: p.63) – which may be the case for the peripherical countries in the Euro area.

In their study of the macroeconomic effects of fiscal policy on developed economies, Afonso and Sousa (2012) conclude that government spending shocks have a small, but

positive effect on GDP, and government revenue shocks have a positive effect on GDP. A complementary conclusion is reached by Auerbach and Gorodnichenko (2012), which states that “fiscal policy is considerably more effective in recessions than in expansions” (Auerbach and Gorodnichenko, 2012: p.2).

Concerning fiscal policy at the ZLB, Boubaker et al. (2018) addresses this matter for some Euro Area countries, by analysing the effect of government spending and tax cut shocks. Similarly to Canh (2018), Boubaker et al. (2018) conclude that a high level of government debt reduces the effectiveness of fiscal policy. While tax cuts have a smaller effect on GDP, government spending programs can stabilize the economy and have a positive impact on GDP in the long-run.

2.2.Theoretical background on the policy mix

The study of monetary and fiscal policy interactions became a more recurrent topic of academic discussion after the 2007-2009 Global Financial Crisis. That specific crisis demonstrated policymakers’ needs in relation to the need to develop new tools and new targets, for the new post-crisis economic context, which thus justifies the growing interest about the policy mix. Blanchard et al. (2010) first examines this topic in 2010, when discussing new approaches to macroeconomic policy. They first discuss what they thought they knew regarding the design/implementation of macroeconomic policy; for instance, monetary policy was the main macro policy, as it was aimed at keeping inflation low and stable, and the policy rate was the (only) way to achieve it. Then, they explain where they were wrong (about the previous matter), and in the third part of the publication they provide some framework for the future.

In this regard, the authors believe the primary goal should still be to achieve a stable output gap and stable inflation, but policymakers should also target other variables, and make use of other tools, being in this case the combination of monetary and regulatory policy the most relevant for our study. They suggest primarily the use of the policy rate, and then cyclical regulatory tools, like the regulatory capital ratios, loan-to-value ratios, and margin requirements, as Central Banks could run both policies. Moreover, and although our research focuses on ‘traditional’ budgetary policy, run by each Government of the Euro Area countries, combined with monetary policy implemented by the ECB, Blanchard et al. (2010) provides a good context for the after-crisis period, for instance, where the use of Quantitative Easing as

a recurring tool, the Zero-Lower Bound, and the new frameworks for macroeconomic policy are concerned.

Blanchard et al. (2013) again conclude that, from an ambitious and innovative perspective, Central Banks should simultaneously employ monetary, macroprudential, and fiscal policy tools.

Years before the Global Financial Crisis, Sargent and Wallace (1981) were the first authors who innovatively discussed the relevance of the policy mix. For these authors, inflation is the variable that links monetary and fiscal policies, so, contrary to monetarists' beliefs, fiscal policy does have an important role in controlling the price level. The authors stipulate two scenarios, and in each one, one of the policies dominates. When monetary policy is dominant, it can control inflation through the known mechanisms. But if fiscal policy is dominant, by setting its budget and future deficits/surpluses without taking into consideration central bank guidance, monetary policy may have to take their price level, and ultimately endure a higher inflation.

Subsequently, some authors developed the Fiscal Theory of the Price Level, which is often cited in the literature related to our research topic. Leeper (1991) defends that monetary and fiscal policies can be either active or passive. By researching these policies' interactions in a stochastic maximising model, the author concludes that when monetary policy is active and fiscal policy is passive, the government takes into consideration the debt shocks when making policy decisions. On the other hand, when fiscal policy has an active role and monetary policy has a passive one, fiscal policy is not constrained by debt evolution, and it is considered to have dominance, using Sargent and Wallace's (1981) terms.

Sims (1994) argues against monetarist's views, by stating that the price level is determined by both monetary and fiscal policy, because the price level adjusts to the intemporal government budget. Woodford (1995) follows Sims (1994)' and Leeper (1994)'s ideas, by arguing that the quantity theory of money does not consider the effects of fiscal policy on the price level. To the literature on the Fiscal Theory on the Price Level, Woodford (1995) further adds that the price level changes the real value of net government liabilities, thus its importance in the government decision making process.

Šehović (2013) highlights an important research topic regarding the design/implementation of monetary and fiscal policies in the Euro Area – the policies are managed by different authorities, and different governmental agencies can have conflictive goals. The author discusses some aspects involving the said policies' coordination, namely the establishment of institutional and operational arrangements. However, there is a bigger

focus on Central Bank's characteristics, independence being the most important, but the author does not expand on how the different institutions involved should interact.

Alcidi and Thirion (2016) highlight that the policy mix can be harder to implement in the Euro Area, considering that there are some countries with high levels of sovereign debt. "Restrictive budgetary policies alone are unlikely to succeed, but debt cannot be ignored when defining the policy mix" (Alcidi & Thirion, 2016: p.18). Nevertheless, we address the policy mix in the Euro Area exactly because of the dynamics of 'one central bank, 19 central governments', and because of the challenges of the monetary union, already mentioned in the previous section.

Finally, Corsetti et al. (2019) provide a good economic context on the past 15 years. They address the problems associated with the Global Financial Crisis and the Sovereign Debt Crisis in the Euro Area, namely low economic activity and low inflation. The authors subsequently come up with a few proposals for the policy mix in the Euro Area. Their proposal for the long run is the benchmark institutional setup, which is becoming increasingly more recurrent in the literature, but it is a topic that deserves a different type of discussion and research. In the short run, the authors defend an accommodative monetary policy - which is already being implemented by the ECB -, along with an accommodative fiscal policy by the EMU countries' governments.

Although the topic of our research has gained increasingly more importance in the past decade, the corresponding academic literature is not very wide. There is some work developed, and Sargent and Wallace (1981), Leeper (1991), Sims (1994) and Woodford (1995) provide a first good theoretical framework. Nevertheless, there is a lack of academic studies about the topic for the current context. Corsetti et al. (2019) started developing some theoretical solutions, but future research should focus on theoretical-practical nexus to best implement the most adequate policy mix. For instance, the ECB should further address this important research topic, since Mario Draghi (2017), Christine Lagarde (2020), and Luis de Guindos (2019), among others, have all stated the need for a better understanding of the policy mix in recent years.

2.3. Empirical research on the policy mix

Most empirical studies in the academic literature focus on studying either monetary or fiscal policy separately, namely each of these policies' reactions to a given shock. By studying shocks on monetary and fiscal policies, from 1954 to 2006, Rossi and Zubairy (2011) conclude

these policies must be considered together, otherwise, fluctuations on the economy can be inaccurately attributed to the wrong source. Moreover, the authors find that “fiscal policy shocks are relatively more important in explaining medium cycle fluctuations, whereas monetary policy shocks are relatively more important in explaining business cycle fluctuations” (Rossi & Zubairy, 2011: p.1268). More recent academic literature now develops a few different approaches to the policies’ interactions.

Neck and Blueschke (2016) use a game theory approach to study the policy mix, which is quite interesting, since the topic is being studied as a form of strategic interactions. Although we are following a different approach in our empirical study, these authors’ methodology and conclusions are nevertheless quite pertinent. Neck and Blueschke (2016) use a stylized non-linear model to analyse the interactions of governments and the joint Central Bank, and they consider two blocs of countries, which are interpreted as the core and peripheric countries in the EMU. Their methodology consists of using an algorithm to study two different strategies in a game (ie cooperation and non-cooperation), which the authors associate as a Pareto optimal and a Nash game, respectively. As expected, the results show that there is an increased difficulty for the peripheric countries in keeping their output and employment close to their natural levels, without avoiding a bigger debt rise. Their most important finding is that “the cooperative solution dominates the non-cooperative equilibrium solution” (Neck and Blueschke, 2016:p.146), which is understood as a good case for the interactions between the central governments and the ECB.

Game theory approaches previous the Great Recession, from Buti et al. (2001) and Dixit and Lambertini (2003), show a non-cooperative equilibrium among monetary and fiscal policies, resulting in very extreme, and different results for GDP and inflation than the ones expected by the economic authorities. In addition, Dixit and Lambertini (2003) state that under equilibrium, a fiscal leadership provides a better outcome for the economy.

Hollmayr and Kühl (2019) run a New Keynesian DSGE model to study the policy mix when the central bank conducts Quantitative Easing programs. Since we are addressing the evolution of the policy mix in the Euro Area, the authors’ research provides some hindsight on what we may find in our empirical study. The authors conclude that under fiscal dominance unconventional monetary policy has a similar effect as conventional monetary policy does on inflation. Tristani and De Fiore (2019) reach a similar conclusion, namely that unconventional monetary policy can be effective under financial shocks. Although this is a good indicator for the policy mix, and even for the current economic context (under the present pandemic crisis), where the ECB is conducting big asset purchases, it is important to take into consideration that Quantitative Easing, or other forms of unconventional monetary policy, can cause market

distortions, potential loss of Central Banks' independence, and delay some necessary macroeconomic adjustments (Afonso & Gonçalves, 2020).

A different type of approach present in the academic literature of the policy mix is the one developed by Cavalli et al. (2019). The authors run numerical simulations in a nonlinear model for the real economy, and they address the policies' interactions and different dynamics in the steady state. The fiscal policy dimension is represented by the government sector in the model, while monetary policy is represented by the money markets. The interaction of both policies causes many different scenarios, but the important conclusion for this research topic is the following: introducing the money markets in the model can lead the economy toward the full employment income, and, in a different dynamic, it can be responsible for the generation of the business cycle.

A very relevant literature for this line of argumentation is the one developed by Afonso and Gonçalves (2020), because of its data and results. The authors use a SVAR model to analyse both the effects of fiscal and monetary policies and their interactions, in the EMU and in the United States. Their main conclusion for the Euro Area is that the policies act as complements in more recent years. In addition, these authors state that previous studies, from before the Great Recession, shows the policies were acting as strategic substitutes.

Moreover, a similar study is conducted by Afonso et al. (2019), where a different methodology – OLS, OLS-Fixed Effects, and 2SLS – show similar results. Although they address some Euro Area countries separately, they find evidence that monetary and fiscal policies act as complements in some countries.

Regarding our empirical approach, the ARDL model is often used in researches like ours. Hawkins (2013) employs an ARDL to study the effects of unconventional monetary policy on Euro Area's GDP and concludes that the alternative policy tools have a positive effect on GDP growth. Lawal et al. (2018) address the effects of monetary and fiscal policy interactions on Nigeria's stock market performance, showing that the best outcome is achieved when both policies are "considered in tandem and not in isolation" (Lawal et al. 2018: p.113). There are some studies related to the effects of monetary and fiscal policies on GDP, using an ARDL approach, by Khosravi and Karimi (2010), and Özer and Karagöl (2018), among others. For Ethiopia's case, Tadesse and Melaku (2019) conclude that there is a stable long run relationship among policies, proposing that the Central Bank and the corresponding Government should coordinate their actions.

As previously mentioned, most empirical studies for the Euro Area case analyse the policies interactions through economic shocks, while the ARDL is often used to study the effects of the policy mix on GDP in other countries. To the best of knowledge, the academic literature does not have an ARDL model to study the effects of the interactions between monetary and fiscal policy on GDP in the Euro Area, so our empirical approach will reflect an important innovation to the academic literature.

CHAPTER 3

Data and methodology

This section is organized as follows: (i) it first provides a description of the data used; (ii) a subsequent description of the empirical model and its hypotheses; and (iii) the preliminary variables' tests, namely the unit roots tests; and the explanation for the chosen empirical methodology approach (the ARDL and the Error Correction model). We use Stata (14) to empirically implement/develop the econometric study.

3.1. Data and model

In the econometric model, we use quarterly data for the Euro Area, from the first quarter of 2000 to the fourth quarter of 2020 (84 observations). The sample is somewhat limited in its dimension, because some variables are only available from 2000 onwards, since the series start with the introduction of the euro as a currency. Accordingly, it covers most of the duration of the monetary union.

The implemented model aims to explain the effects of the monetary and fiscal policy interactions on GDP, following a version of the 'St. Louis equation', developed by Anderson and Jordan (1968). It is specified as follows:

$$GDP = f(MP,FP) \tag{3.1}$$

Our dependent variable is the Gross Domestic Product, GDP of the Euro Area (measured in millions of euros), and was extracted from the FRED database.

The monetary policy (MP) instruments are proxied by the money supply, M3 (in millions of euros), and the Eonia rate, INT (in percentage), both extracted from the FRED database.

The variable ASSETS represents the assets of the European Central Bank, and was extracted from the ECB database. We introduce this variable in our research because it can be understood as a proxy for Quantitative Easing programs and other monetary policy tools, as well as a proxy for fiscal policy, since the ECB presently owns private and public assets (like sovereign bonds).

The fiscal policy (FP) instruments are proxied by two variables: DEBT, which represents the debt ratio (as percentage of GDP), and was extracted from Eurostat; and CAPB, the cyclically adjusted primary balance (in percentage of potential GDP), which was extracted from the IMF on an annual basis, and was transformed to a quarterly series on gretl (2018c).

Figures A1 to A6 in the Appendix contain the plots of the variables, Table A1 (Appendix) contains summary statistics, while Table A2 (Appendix) contains the correlations coefficients among them.

By expanding equation (3.1), we can express GDP as a function of all the variables as follows:

$$lnGDP_t = \beta_0 + \beta_1 lnM3_t + \beta_2 INT_t + \beta_3 lnASSETS_t + \beta_4 DEBT_t + \beta_5 CAPB_t + \mu_t \quad (3.2)$$

β_0 is the constant, β_1 to β_5 are the coefficients of the model, μ_t is the error term, and the variables have been explained above. We take logs of some of the variables to capture the short and long-run effects and reduce heteroskedasticity (Lawal et al., 2018).

Regarding equation (3.2), we established the following expected effects for each explanatory variable on GDP as follows, based on previous literature:

$$\beta_1>0,\ \beta_2 \gtrless 0,\ \beta_3>0,\ \beta_4 \gtrless 0,\ \beta_5 \gtrless 0 \quad (3.3)$$

The variables referring to money supply and the ECB assets are expected to have a positive impact on GDP, while interest rates, the debt ratio, and the cyclically adjusted primary balance may affect GDP in a positive or negative way, depending on whether the policy employed is expansionary or contractionary.

3.2. Unit roots tests

To avoid a spurious regression, the variables under research must typically be stationary. After choosing the appropriate lag length, based on the SB information criterion, we perform the Augmented Dicky-Fuller (1979) test and the Phillips-Perron (1998) test, and the results are presented below (Tables 3.1 and 3.2). For both tests, the null hypothesis is that the variable has a unit root, meaning it is not stationary. The alternative hypothesis is that the variable does not have a unit root (it is stationary).

Table 3.1 – *P-values of the ADF unit root tests*

Variable	Level			First Difference		
	Constant	Trend and Constant	Drift and constant	Constant	Trend and Constant	Drift and constant
lnGDP	0.4165	0.3957	0.0439	0.000	0.0000	0.0000
lnM3	0.5952	0.2418	0.0869	0.1310	0.5366	0.0086
INT	0.3212	0.1107	0.0291	0.0000	0.0003	0.0000
lnASSETS	0.9799	0.1414	0.6401	0.0001	0.0008	0.0000
DEBT	0.9150	0.6831	0.3563	0.0000	0.0000	0.0000
CAPB	0.3532	0.7025	0.0337	0.0000	0.0002	0.0000

Table 3.2 – *P-values of the PP unit root test*

Variable	Level		Fisrt Difference	
	Constant	Trend and Constant	Constant	Trend and Constant
lnGDP	0.4189	0.2514	0.0000	0.0000
lnM3	0.5408	0.7861	0.0000	0.0000
INT	0.6911	0.3728	0.0000	0.0004
lnASSETS	0.9884	0.4928	0.0000	0.0000
DEBT	0.9445	0.7163	0.0000	0.0000
CAPB	0.7220	0.9329	0.0092	0.0475

Considering the results of the tests, we conclude that the variables are either stationary in levels or stationary in first differences. Although the result of the ADF test for the variable lnM3 might be ambiguous, the result of the PP test confirms that lnM3 is integrated of order one. We conclude that none of the variables is integrated of order two, which is a requirement for the econometric approach we decided to use, the ARDL.

3.3. The Autoregressive Distributed Lag model and the Error Correction model

The econometric model proposed by this research is the Autoregressive Distributed Lag model – ARDL – developed by Pesaran (1997) and further expanded by Pesaran and Shin (1999) and Pesaran et al. (2001).

It is a suitable approach for our research because this estimation method allows to have a mix of variables that are integrated of order zero and one, and it is more efficient in studies with small samples, which is the case related to our research. Moreover, the ARDL can produce unbiased and consistent estimates for the short and long-run, and it also produces reliable estimates in terms of consistency and efficiency (Pinho & Barradas, 2021). These aspects are very important since we aim to research the short and long-run equilibrium relationship between GDP and the interactions of monetary and fiscal policy, and our sample covers different business cycles and major economic and financial events.

The ARDL (p, q_1, q_2, …, q_k) model, according to Pesaran and Pesaran (2009), can be represented as follows:

$$\emptyset\ (L, p)\ y_t = \sum_{i=1}^{k} \beta_i\ (L, q_i) x_{it} + \delta' w_t + u_t \quad (3.4)$$

, where:

$$\emptyset\ (L, p) = 1 - \emptyset_1 L + \emptyset_2 L^2 - \ldots - \emptyset_p L^p \quad (3.5)$$

$$\beta_i\ (L, q_i) = \beta_{i0} + \beta_{i1}\ L + \ldots + \beta_{iqi}\ L^{qi},\ i=1, 2,\ldots,k \quad (3.6)$$

The proposed model explains the behaviour of y_t, the dependent variable (lnGDP), by lagged values of itself and by the current and lagged values of x_{it}, the independent variables. L is a lag operator, such that $Ly_t = y_{t-1}$, and w_t is a s x 1 vector of deterministic variables (Pesaran & Pesaran 2009).

Pesaran et al. (2001) further introduce the ARDL bound approach, to test for cointegration. The null hypothesis of the Bound test is that there is no cointegration between the variables, and it can be safely rejected if the F-statistic value is above the upper bound. The alternative hypothesis is that variables are not cointegrated (when the F-statistic is below the lower bound).

Table 3.3 – *Bounds test for cointegration*

F-statistic	Critical value	Lower bound value	Upper bound value
7.282	1%	3.41	4.68
	2.5%	2.96	4.18
	5%	2.62	3.79
	10%	2.26	3.35

Considering the results above (Table 3.3), we reject the null hypothesis, and confirm that our variables are cointegrated, demonstrating that they have a long-run relationship. Under this scenario, we must run the Error Correction model (ECM).

The error correction model of the ARDL ($\hat{p}$, $\hat{q}_1$, $\hat{q}_2$, …, $\hat{q}_k$), according to Pesaran and Pesaran (2009), can be represented as follows:

$$\Delta y_t = - \emptyset(1,\hat{p})EC_{t-1} + \sum_{i=1}^{k} \beta_{i0} \Delta x_{it} + \delta' w_t - \sum_{j=1}^{\hat{p}} \emptyset_j^* \Delta y_{t-j} - \sum_{i=1}^{k} \sum_{j=1}^{\hat{q}-1} \beta_{ij}^* \Delta x_{i,t-j} + u_t \quad (3.7)$$

, where EC_t is the error correction term, defined by:

$$EC_t = y_t - \sum_{i=1}^{k} \hat{\emptyset}_1 x_{it} - \hat{\varphi}' w_t \quad (3.8)$$

$\emptyset(1,\hat{p}) = 1 - \hat{\emptyset}_1 - \hat{\emptyset}_2 - \ldots - \hat{\emptyset}_p$ measures the quantitative importance of the error correction term, and $\emptyset_j^*$ and β_{ij}^* are related to the short-run dynamics of the convergence to equilibrium (Pinho & Barradas, 2021).

CHAPTER 4

Empirical findings and discussion

In the previous chapter, we assess that the variables under study are integrated of order zero and one, and they are cointegrated. This fully justifies the choice of the ARDL approach with an Error Correction model. In this chapter, we further complete the empirical research by (i) performing diagnostic tests and (ii) estimating the ARDL model, while subsequently discussing the relevance of the obtained findings.

4.1. Diagnostic tests

To assess the adequacy of the ARDL Error Correction model, we perform the following diagnostic tests: (i) the Breusch-Godfrey LM test for autocorrelation, (ii) the Ramsey's RESET test, (iii) the normality test, and (iv) the White's test for heteroskedasticity. Moreover, we test for the presence of structural breaks, by performing the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSMQ) tests. The results are presented below.

Table 4.1 – *Diagnostic tests for the model estimation*

Test	Null hypothesis	p-value
Autocorrelation	No serial correlation	0.4787
Ramsey's RESET	No omitted variables	0.0008
Normality	Normal distribution	0.1110
Heteroskedasticity	Homoskedasticity	0.4474

Considering the results above (Table 4.1), we first conclude that there is no evidence of autocorrelation, as we do not reject the null hypothesis of no autocorrelation of the residuals. Moreover, we reach the same conclusion of no autocorrelation for a higher number of lags, and again when performing the Durbin Watson test. Regarding the Ramsey test, it suggests that the model is not entirely in its correct form since we reject the null hypothesis. Nevertheless, Agung (2008) states that the Ramsey's test should be applied to OLS estimations, which is not our case, so we consider this result is not a problem for our model. A

most likely explanation related to this finding involves the impact of non-linear effects. This test result thus suggests the application of the NARDL (the non-linear ARDL), which might capture the impact of non-linearities, an application which is nevertheless beyond the scope of the present Dissertation. Finally, the model's residuals are normally distributed and homoscedastic since we do not reject the null hypothesis on both tests. The residuals' homoskedasticity is also confirmed when testing for different lag lengths.

Regarding the CUSUM test (Figure A7 in the Appendix), it indicates the absence of instability of the coefficients or structural breaks, because the plot of the test falls inside the critical bounds, which supports the conclusion that the ARDL EC model presents a good dynamic. As for the CUSUMQ test (Figure A8 in the Appendix), although it reveals that the residuals fall outside the critical bounds, this test captures non-systematic movements in the series, while the CUSUM test confirms the stability of the model, thus we have strong reason to believe the model is stable and well specified[1].

In short, the performed diagnostic tests indicate that the model does not have *ex-ante* any major econometric issues, thus validating the following estimation, its critical discussion, and the corresponding implications.

4.2. Model estimation and results discussion

As described in previous chapters, our econometric model aims at explaining the effects of monetary and fiscal policy interactions on the Euro Area's GDP. Thus, GDP is the dependent variable, and the money supply (M3), the EONIA rate (INT), the ECB assets (ASSETS), the debt ratio (DEBT), and the cyclically adjusted primary balance (CAPB) are the main explanatory variables, in accordance to the specification proposed by the St. Louis equation. More specifically, we employ an ARDL EC model. When the model is estimated, Stata automatically selects the optimal lag length for each variable. The results for the long-run are presented in Table 4.2, and the estimation results for the short-run are presented in Table 4.3.

[1] Notwithstanding a potential non-linear bias, the study of which is beyond the scope of the present Dissertation.

Table 4.2 – *Long-run estimation*

Variable	Coefficient	Std. Error	p>|t|
lnM3	0.4809	0.015	0.000
lNT	-0.0075	0.002	0.001
lnASSETS	0.0151	0.008	0.076
DEBT	-0.0017	0.0004	0.000
CAPB	-0.0025	0.002	0.311

In the long run, all the variables are statistically significant at the traditional significance levels (up to 10% significance level), except for the cyclically adjusted primary balance, although this variable is often used in the academic literature to assess the fiscal policy stance, as it includes government's revenues and expenditures. The variables lnM3 and lnASSETS have the expected signs (positive), regarding the hypothesis proposed in the previous chapter and support the evidence previously discussed regarding the existing empirical literature. lnM3 and lnASSETS are the variables that have the biggest impact on GDP, while INT and DEBT have a negative and smaller coefficient.

From these results, we conclude that monetary policy has a significant and positive impact on the Euro Area's GDP in the long run, accordingly it effectively impacts the economy. On the other hand, fiscal policy has a small, yet negative impact on GDP in the long run (when analysing solely the variable DEBT). It must be noted that the analysed period includes different types of fiscal policy and different business cycles, hence the variable's small coefficient captures opposite effects belonging to different stages of the economy. The results obtained for INT have a similar economic rationale, aggravated by the fact that interest rates are constrained to the Zero Lower Bound, hence their impact on GDP is indeed more limited.

Regarding the ECB's assets, proxy to the interactions of monetary and fiscal policy, its coefficient is an encouraging sign that in the long run the policy mix has a positive effect on GDP, and like other empirical studies suggest, monetary and fiscal policy should actually work 'in tandem', in order to overcome any limitations associated with any of these policies' individual use.

Table 4.3 – *Short-run estimation*

Variable	Coefficient	Std. Error	p>|t|
$\Delta lnGDP_{t-2}$	-0.3547	0.142	0.016
$\Delta lnGDP_{t-3}$	-0.5946	0.181	0.002
$\Delta lnM3_{t-1}$	-0.2329	0.139	0.099
$\Delta lnM3_{t-2}$	0.2184	0.128	0.095
$\Delta lnM3_{t-3}$	-0.1640	0.117	0.167
ΔINT_{t-1}	0.0106	0.004	0.017
ΔINT_{t-2}	0.0083	0.005	0.076
$\Delta lnASSETS_{t-1}$	-0.0150	0.017	0.392
$\Delta lnASSETS_{t-2}$	-0.0347	0.018	0.065
$\Delta lnASSETS_{t-3}$	0.0058	0.018	0.749
$\Delta lnASSETS_{t-4}$	-0.0212	0.015	0.169
$\Delta DEBT_{t-1}$	-0.0086	0.001	0.000
$\Delta DEBT_{t-2}$	-0.0051	0.002	0.001
$\Delta DEBT_{t-3}$	-0.0070	0.002	0.000
$\Delta DEBT_{t-4}$	0.0041	0.002	0.007
$\Delta CAPB_{t-1}$	-0.0217	0.006	0.000
$\Delta CAPB_{t-2}$	0.0646	0.010	0.000
$\Delta CAPB_{t-3}$	-0.0238	0.016	0.149
$\Delta CAPB_{t-4}$	-0.0106	0.012	0.369
β_0	0.2081	0.249	0.406
$\Delta lnGDP_{t-1}$	-0.6781	0.135	0.000
R-squared = 0.9316		**Adjusted R-squared** = 0.8999	

Regarding the short run results, the first aspect to be highlighted is the $\Delta lnGDP_{t-1}$, as it represents the speed of adjustment of the Error Correction model. The coefficient is statistically significant, and its sign is negative, which means the model converges to an equilibrium (a positive sign would mean that the model "explodes"). In the previous chapter, we assess the variables' cointegration, indicating there is a long-term equilibrium among variables, and that is again demonstrated by the coefficient of $\Delta lnGDP_{t-1}$. According to the results, the previous errors of the model will be corrected in the current period, at a 67,8% adjustment time, which means that, when there is a shock in the model (during the period under analysis), the implementation of both monetary and fiscal policy will bring the Euro Area's economy to its

equilibrium in less than two quarters period. Once again, this result is promising for the design/implementation of monetary and fiscal policy together, as it indicates a shorter time lag between the latter policy mix's implementation and its corresponding impact on the real economy.

Secondly, we emphasize the model's high explanatory power, with an R-squared of 93%, and an Adjusted R-squared of around 90%, indicating the very good fitness of the model in explaining the effects of the interactions of monetary and fiscal policy on GDP.

Analysing the coefficients for the short-term estimation, we firstly note that the Euro Area's GDP depends highly on its lagged values, in a negative way, showing inertia. Regarding the lagged explanatory variables that are statistically significant, contrarily to the long run, the EONIA rate shows a positive impact on GDP, while the ECB assets show a negative impact. The rest of the variables present both positive and negative influence on GDP, depending on the period.

In both the long run and the short run, we note that monetary policy has a bigger (and positive) impact on GDP, while fiscal policy has mainly a negative impact. These results contradict some of the existing academic literature, namely Rossi and Zubairy (2011), Tadesse and Melaku (2019), and Özer and Karagöl (2018), whose empirical studies, applying ARDL models to study the effects of monetary and fiscal policy interactions on GDP, show that fiscal policy positively impacts economic growth in the short run and plays a more effective part on GDP growth on the long run. Additionally, Özer and Karagöl (2018)'s literature states that GDP is not significantly impacted by monetary policy in the long run, which is the opposite result of our research. Our results, contrary to the just mentioned literature, may be due to the fact that we use different samples from the authors mentioned above. Furthermore, our results show the positive impact of the monetary integration of the Euro Area, when compared with samples from different countries, which do not have a single currency.

On the other hand, our research does effectively corroborate Hameed and Ume (2011)'s, Tadesse and Melaku (2019)'s, and Ryan-Collins et al. (2016), that state that monetary policy's great impact on GDP is attributed to money supply growth, while interest rate has a minor impact. As previously stated, the variable lnM3 is the one with the biggest impact in the model, in the long run and in the short run, and it has mostly a positive impact on the Euro Area's GDP, contrarily to the variable INT.

The disappointing and unexpected result from the fiscal policy variables – either not statistically significant or they have mostly a negative effect on GDP – may be in line with some

authors' findings, for instance Boubaker et al. (2018) and Canh (2018), that acknowledge that the effectiveness of fiscal policy has worsened due to a high level of debt, which is certainly the case of the Euro Area, whose public debt has grown significantly since the GFC (figure A5 in the Appendix).

Our empirical study incorporates economic data from different business cycles, hence during this time different types of monetary and fiscal policies were implemented. Accordingly, we divide the sample in four periods, to analyse its economic significance of the long term. The periods are as follows: (i) 2000-2007, (ii) 2008-2010, (iii) 2011-2014, and (iv) 2015-2020, and they correspond to the pre-crisis, Global Financial Crisis (GFC), Eurozone Sovereign Debt Crisis (SDC), and post-crisis periods. The results are presented below (Table 4.4). The actual cumulative change represents the variable's growth rate during the corresponding period, and the economic effect is obtained multiplying the long-term coefficient by the actual cumulative change, following Pinho and Barradas (2021).

Table 4.4 – *Economic significance of the long-term estimates*

Period	Variable	Long-term coefficient	Actual cumulative change	Economic effect
Pre-crisis	lnM3	0.4809	0.0204	0.0098
	INT	-0.0075	0.2031	-0.0015
	lnASSETS	0.0151	0.0399	0.0006
	DEBT	-0.0017	-0.0769	0.0001
	CAPB	-0.0025	-0.8873	0.0022
GFC	lnM3	0.4809	0.0009	0.0004
	INT	-0.0075	-0.8515	0.0064
	lnASSETS	0.0151	0.0211	0.0003
	DEBT	-0.0017	0.2768	-0.0005
	CAPB	-0.0025	2.6494	-0.0066
SDC	lnM3	0.4809	0.0031	0.0015
	INT	-0.0075	-1.0223	0.0077
	lnASSETS	0.0151	0.0033	0.0001
	DEBT	-0.0017	0.0728	-0.0001
	CAPB	-0.0025	-1.7228	0.0043
Post-crisis	lnM3	0.4809	0.0107	0.0052
	INT	-0.0075	9.239	-0.0693
	lnASSETS	0.0151	0.0788	0.0012
	DEBT	-0.0017	0.0492	-0.0001
	CAPB	-0.0025	-4.1400	0.0103
Full period	lnM3	0.4809	0.0380	0.0183
	INT	-0.0075	-1.1434	0.0086
	lnASSETS	0.0151	0.1621	0.0024
	DEBT	-0.0017	0.3720	-0.0006
	CAPB	-0.0025	-3.6935	0.0092

Note: Although the variable CAPB is not statistically significant in the long run estimation of the ARDL EC model, we highlight that its economic effect on GDP has been positively growing.

Since the discussion of the interactions between monetary and fiscal policy – as a solution to the policies' limitations in recent years – has strongly regained importance after the GFC, the major point of this analysis is to capture how each policy tool's economic effect on GDP changed between periods, especially how it differs between the first and the last period of analysis.

For the pre-crisis period, money supply was the main driver of the Euro Area GDP, among the five tools (as it is in the full period), as the coefficient of the economic effect of lnM3 (read

in the first line and last column of table 4.4) is the greater among variables. The EONIA rate's relationship with GDP is negative, as the ECB was likely encouraging private investment, while fiscal policy tools had a positive yet very small effect, which is in accordance with the Great Moderation's period policies. During the GFC, there was a shift in the rate policy, and while monetary policy had a positive effect on GDP, fiscal policy's effect was negative. Surprisingly, during the SDC, both policies' effects were the same – fiscal policy had a negative effect on GDP, while monetary policy's positive impact grew, since the variables lnM3 and INT show a positive economic effect and DEBT has a negative economic effect (table 4.4).

lnASSETS took a bigger role in the Euro Area's GDP in the later period (2015-2020) (table 4.4), comparing to the previous ones, in a scenario of the Zero Lower Bound and high debt levels. As the ECB owns monetary policy related assets, like securities, they also own debt from the Euro Area's countries, like sovereign bonds, thus the choice of lnASSETS as the proxy to the policy's interactions. Therefore, the evolution of this variable in recent years can be a good indicator for the evolution of the design/implementation of the policy mix in the Euro Area.

Our empirical findings often showed that monetary and fiscal policy were working 'in different directions'. Although this can be, in part, justified by the evolution of different business cycles, it shows policy divergence instead of the desired complementarity. This complementarity demands a robust framework for both the monetary and fiscal institutions, based on their credibility, for instance, to stick to an inflation target, or to keep a stable public debt. On the other hand, this idea of a better coordination between institutions can result in a loss of independence, which is a key factor for Central Banks and Central Governments, and is an aggravated issue in the context of a monetary union.

In conclusion, from 2000 to 2020, the Euro Area's GDP growth was mostly associated with the growth of money supply, while fiscal policy showed a negative economic effect. Although some of our findings were not expected, taking into consideration the state of the academic literature, in the matter of the interactions between monetary and fiscal policy – the major topic of this Dissertation, – the results are overall positive, especially because of the adjustment speed of our model and the positive evolution of the economic effect on lnASSETS (the proxy to the policy mix).

CHAPTER 5

Conclusion

This Dissertation empirically analyses the effects of the interactions between monetary and fiscal policy on the Euro Area's GDP, from the first quarter of 2000 to the last quarter of 2020. For that purpose, an ARDL-EC model is employed – due to the presence of cointegration, – as this approach captures the long run and the short run relationship among the variables.

The empirical findings show a positive impact of monetary policy on GDP in both the long run and the short run, especially from the money supply, while fiscal policy has mostly a negative impact, which somewhat contradicts existing academic literature.

Overall, the obtained results in our empirical study are relatively mild, as we expected to find greater evidence of the impact of the interactions between monetary and fiscal policy on the Euro Area's GDP. Nevertheless, there are a couple of findings that we consider especially important/relevant for the study of this research topic. The first one is the adjustment speed of the model; with the chosen policy tools, given a shock in the period of analysis, the Euro Area's GDP would go back to its equilibrium in less than two quarters. Perhaps, with different tools/types of monetary and fiscal policy instruments, the adjustment speed would be even faster.

The second important finding relates to the variable lnASSETS (proxy for the policy mix), both in the ARDL-EC estimation and in the economic significance analysis, as the ECB's assets have a positive effect on GDP, and its economic effect grew in the period after the GFC and the SDC, when the traditional policies 'lost power'. From these results, we conclude that the economy has benefited when monetary and fiscal policy work together (in tandem).

The academic literature, either the theoretical or the empirical one – backed by recent economic events, – shows that the economy benefits from the coordinated design/implementation of monetary and fiscal policy, and this Dissertation provides a similar conclusion. Yet, the literature lacks practical ways to design/implement the policy mix, hence further research should focus especially on the development of that framework.

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Appendix

Figure A1 – *The logarithm of the Euro Area's GDP*

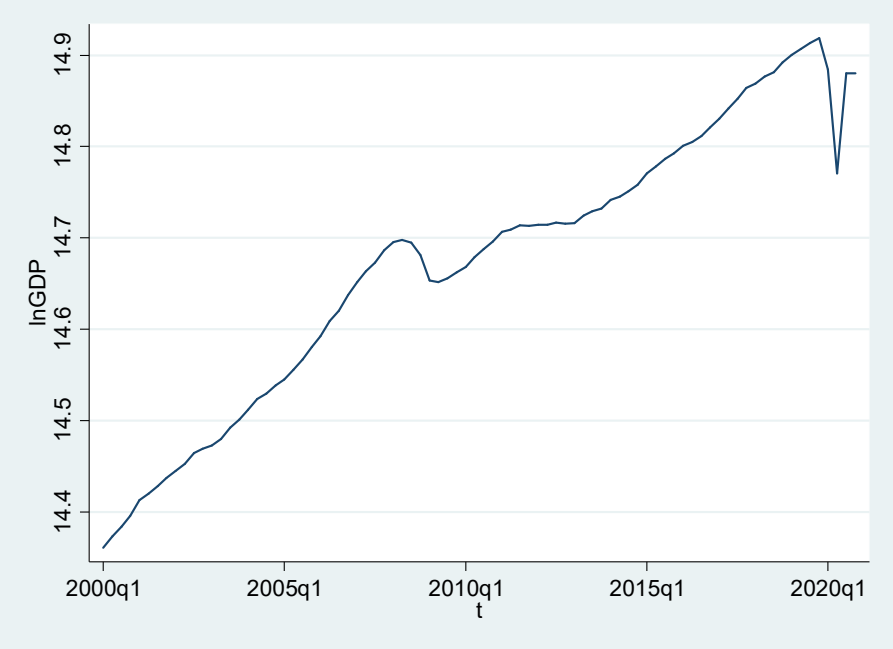

Figure A2 – *The logarithm of the Euro Area's Money Supply*

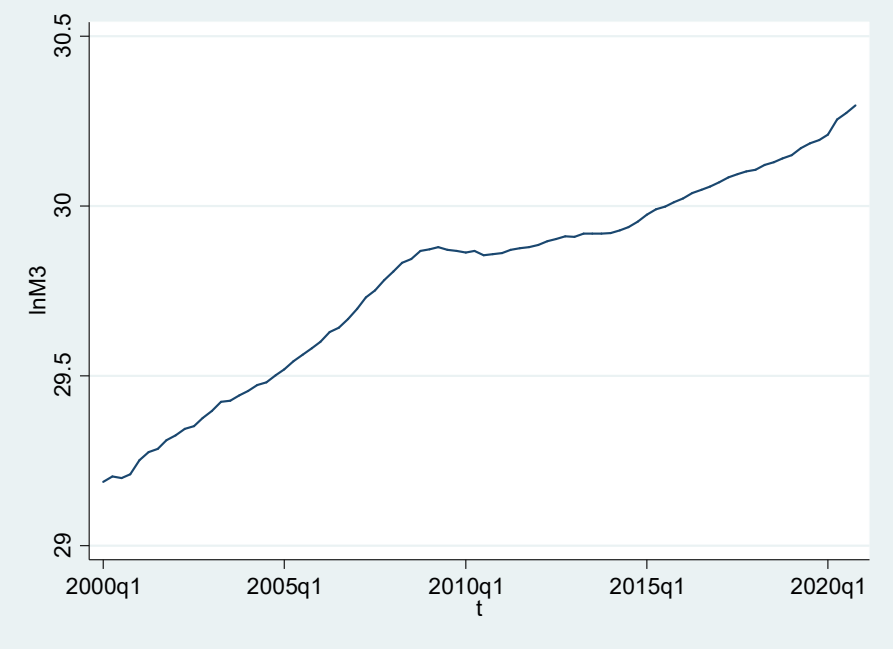

Figure A3 – *The ECB's EONIA Rate*

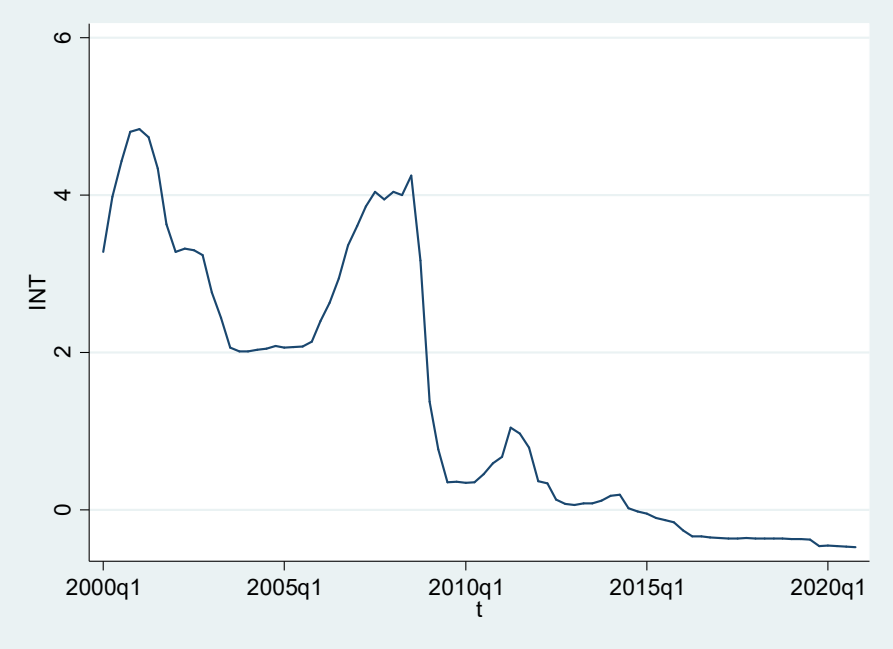

Figure A4 – *The logarithm of the ECB's Assets*

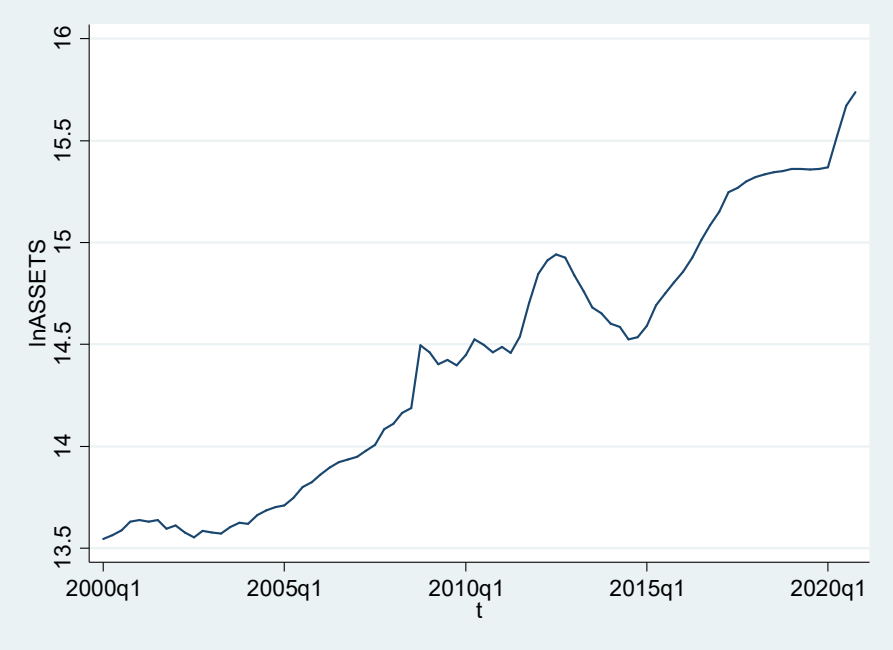

Figure A5 – *The Euro Area's Debt Ratio*

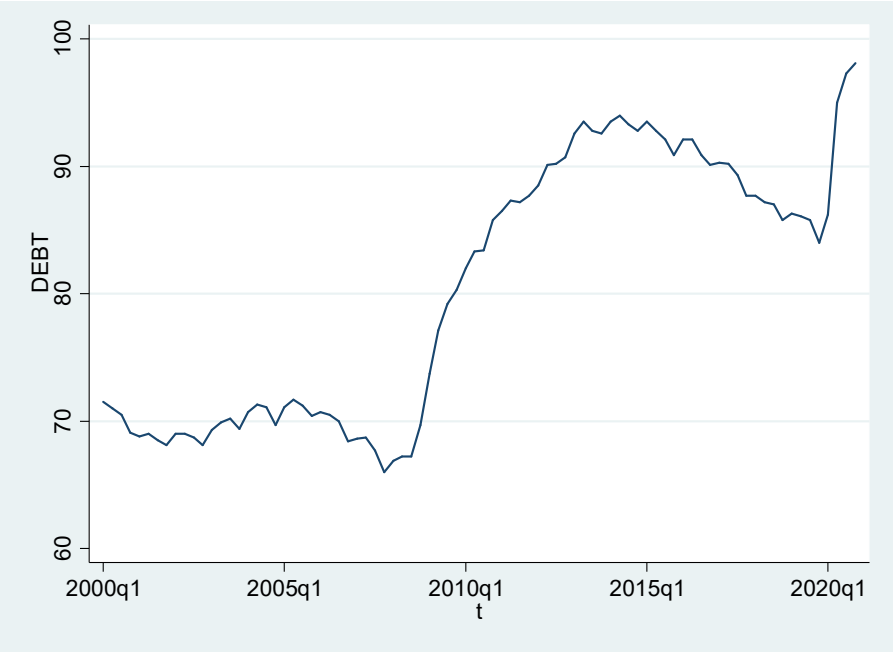

Figure A6 – *The Euro Area's Cyclically Adjusted Primary Balance*

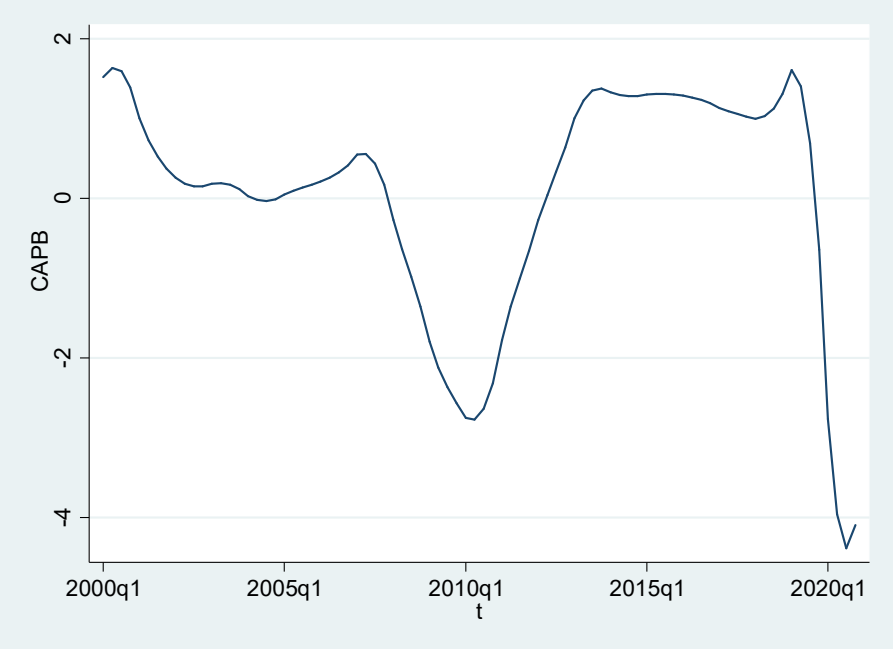

Table A1 – *The descriptive statistics of the data*

Variable	Obs	Mean	Std. Dev.	Min	Max
lnGDP	84	14.67294	0.1514565	14.36083	14.91848
lnM3	84	29.78742	0.3001551	29.18781	30.29638
INT	84	1.393667	1.723933	-0.471	4.839
lnASSETS	84	14.41972	0.6499114	13.54378	15.73931
DEBT	84	80.42262	10.33947	66	98.1
CAPB	84	0.047397	1.43532	-4.383406	1.638174

Table A2 – *The correlation matrix of the data*

	lnGDP	lnM3	INT	lnASSETS	DEBT	CAPB
lnGDP	1.0000					
lnM3	0.9833	1.0000				
INT	-0.8118	-0.8357	1.0000			
lnASSETS	0.9393	0.9517	-0.8495	1.0000		
DEBT	0.7667	0.7982	-0.9040	0.8468	1.0000	
CAPB	-0.0816	-0.2092	0.1064	-0.1457	-0.0226	1.0000

Figure A7 – *The model's cumulative sum of recursive residuals*

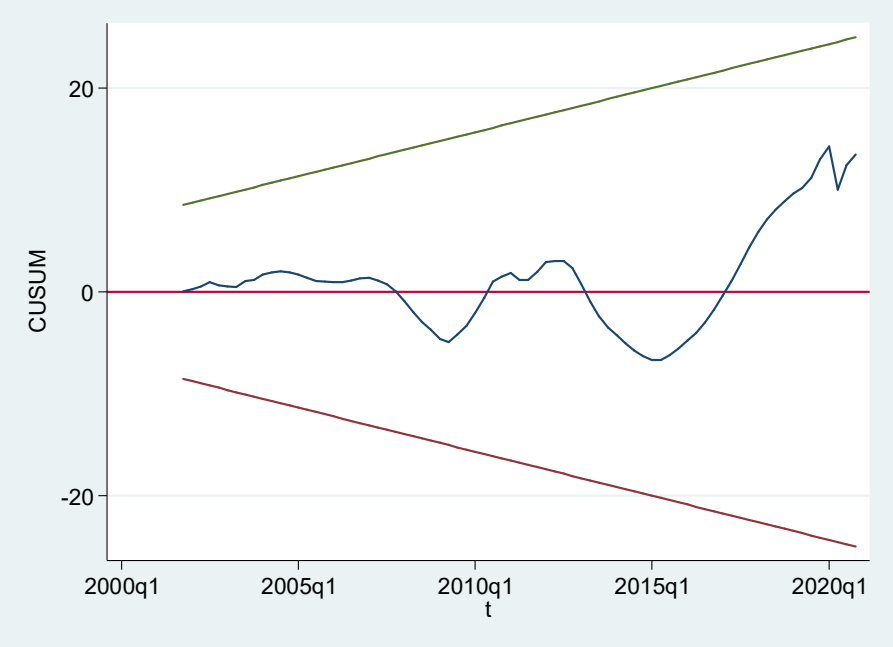

Figure A8 – *The model's cumulative sum of squares of recursive residuals*