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DOES THE IMPACT OF UNCONVENTIONAL MONETARY POLICY ON FISCAL MULTIPLIERS DEPEND ON PUBLIC DEBT OF EACH EURO AREA COUNTRY?

Catarina Barbosa Neto

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Supervised by
Filipe Macedo Pinto Grilo

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Abstract

Since the Global Financial Crisis, Monetary Policy has made great efforts to be a valuable complement to Fiscal Policy. Currently, the ECB faces the need to control inflation and combat the risk of a new sovereign debt crisis. In turn, monetary policy affects countries asymmetrically by several factors (analyzed in this dissertation), namely by their level of debt. Thus, this dissertation studies how the impact of unconventional Monetary Policy on fiscal multipliers is affected by the level of public debt. First, the literature that studies the impact of unconventional Monetary Policy on fiscal multipliers was analyzed, and then the literature that studies the impact of debt on fiscal multipliers. Second, this dissertation estimates fiscal multipliers in the Euro Area using the I-VAR methodology. This methodology allows adding three interaction terms that may be critical for the non-linear behavior of fiscal multipliers: the interaction between government spending and the shadow rate, the interaction between government spending and public debt, and the interaction between government spending, the shadow rate, and public debt. With this, it was possible to derive IRFs to an unexpected government spending shock for key macroeconomic variables, depending on different levels of debt and monetary policy regimes at different percentiles of the interactive variables' distribution.

The key result suggests that the impact of unconventional monetary policy generates a higher benefit in the short run for countries with high debt levels. However, in the medium run, low-debt countries derive a greater benefit from unconventional monetary policy.

The results have important policy implications for the new anti-fragmentation mechanism that the ECB is currently developing. Mainly, the results suggest that more indebted countries have more incentives to increase their debt, which can lead to higher fragmentation within the ECB.

JEL codes: E52, E62, E63, H63

Keywords: Fiscal Multipliers; Unconventional Monetary Policy; Shadow Rate; Public Debt

Resumo

Desde a Crise Financeira Global, que a Política Monetária tem feito grandes esforços para ser um complemento valioso da Política Orçamental. Atualmente, o BCE enfrenta a necessidade de controlar a inflação e combater o risco de uma nova crise de dívida soberana. Por sua vez, a Política Monetária afeta os países assimetricamente por vários fatores (analisados nesta dissertação), nomeadamente pelo seu nível de endividamento.

Assim, esta dissertação estuda como o impacto da Política Monetária não convencional nos multiplicadores orçamentais é afetado pelo nível da dívida pública. Primeiro, foi analisada a literatura que estuda o impacto da Política Monetária não convencional sobre os multiplicadores fiscais, e depois a literatura que estuda o impacto da dívida sobre os multiplicadores fiscais. Em segundo lugar, esta dissertação estima os multiplicadores fiscais na Zona Euro utilizando a metodologia I-VAR. Esta metodologia permite acrescentar três termos de interação que podem ser críticos para o comportamento não linear dos multiplicadores orçamentais: a interação entre as despesas governamentais e a *shadow rate*, a interação entre as despesas governamentais e a dívida pública, e a interação entre as despesas governamentais, a *shadow rate* e a dívida pública. Com isto, foi possível derivar as IRFs para um choque inesperado da despesa pública nas variáveis macroeconómicas chave, condicionadas a diferentes níveis de dívida e regimes de política monetária em diferentes percentis da distribuição das variáveis de interação.

O resultado principal sugere que o impacto da política monetária não convencional gera um benefício maior a curto prazo para os países com níveis de dívida elevados. No entanto, a médio prazo, os países com baixos níveis de endividamento obtêm um maior benefício de uma política monetária não convencional.

Os resultados têm implicações políticas importantes para o novo instrumento anti fragmentação que o BCE está atualmente a desenvolver. Principalmente porque os resultados sugerem que os países mais endividados têm mais incentivos para aumentar a sua dívida, o que pode levar a uma maior fragmentação no seio do BCE.

Códigos JEL: E52, E62, E63, H63

Palavras-chave: Multiplicadores Orçamentais; Politica Monetária Não Convencional; *Shadow Rate*; Dívida Pública

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Abbreviations

APP: asset purchase programme

EA: Euro Area

ECB: European Central Bank (ECB)

ELB: Effective Lower Bound

EONIA: Euro Overnight Index Average

FG: Forward Guidance

GDP: Gross Domestic Product

GFC : Global Financial Crisis

GIIPS : Greece, Ireland, Italy, Portugal and Spain

IRFs: impulse response functions

LTROS: long-term refinancing operations

MRO: Main Refinancing Operations

QE: Quantitative Easing

SR Shadow Rate

TLTROs: targeted longer-term refinancing operations

VLTROs: very long-term refinancing operations

ZLB: Zero Lower Bound

1. Introduction

Currently, the European Central Bank (ECB) is at a crossroads between controlling inflation and the risk of a sovereign debt crisis. Since the Global Financial Crisis (GFC), the Euro Area (EA) has become a rich environment for studying fiscal multipliers mainly for two reasons. On the one hand, there is a record of a large variety of fiscal shocks. In response to the economic contraction provoked by the GFC, EA governments immediately pursued expansionary fiscal policies. Afterwards, tensions in the EA sovereign bond markets compelled some governments to adopt austerity measures and threatened the stability of the European financial system.

On the other hand, besides the quantity and diversity of fiscal shocks within the EA, the monetary policy also contributed greatly to this rich environment. During this period, the ECB deployed a set of unconventional monetary policy tools to combat the deflation expectation that was threatening the EA. These unconventional monetary policies were characterized by purchasing assets in the secondary market, including bonds issued by EA central governments, agencies, and European institutions. By increasing the demand in EA sovereign bond markets, QE relieved the financial pressure from highly indebted sovereigns. Thus, the implementation of these measures had the secondary effect of relieving the financial tensions in the EA sovereign debt markets.

After all these years of low interest rates and to keep inflation close to 2%, COVID-19 forced governments to increase their spending and, consequently, their debt levels. In addition, there is currently an increase in inflation, with a sharp rise in energy and food prices due to the war (ECB, 2022a). To combat inflation, the ECB announced the end of the QE, but investors divided countries based on their debt levels, increasing interest rates exponentially for the most indebted countries. Thus, there seems to be a relationship between unconventional monetary policy and debt. Given this, the ECB is now preparing to rethink monetary policy, reconciling its objectives with the debt levels of each country. Hence, a new instrument of unconventional monetary policy is being designed and, since public debt asymmetrically affects fiscal multipliers (e.g. Afonso & Leal, 2019; Boussard, Castro & Salto, 2013), unconventional policies may have had an asymmetric effect on fiscal multipliers across the EA. Therefore, it is important to test if the impact of unconventional monetary policies on fiscal multipliers depend on public debt levels.

So far, the literature has estimated the effect of monetary policy on fiscal multipliers in two different directions. First, many authors have studied how conventional monetary policy affects the effectiveness of fiscal policy through fiscal multipliers (e.g. Zubairy, 2014). Second, other studies estimate larger multipliers in a ZLB or an Effective Lower Bound context (e.g., Amendola, Di Serio, Fragetta & Melina, 2020). However, to the best of my knowledge, none of these studies explicitly analyses the potential asymmetric impact of unconventional measures by the ECB on fiscal multipliers through the debt channel.

Therefore, this dissertation aims to fill this gap in the literature by studying the impact of unconventional monetary policy on fiscal multipliers, depending on each country's level of public debt. To this end, this dissertation first reviews the literature on fiscal multipliers, focusing on the standard factors that influence their magnitude. Afterwards, the remaining literature review of this dissertation focuses on the two specific factors that answer this dissertation's research question: public debt and monetary policy. To estimate the impact of unconventional monetary policy on fiscal multiplier, this dissertation uses an I-VAR framework for the EA. In the estimation, three interaction terms are added, consisting of the multiplication between: government spending and the shadow rate, government spending and public debt, and between government spending, the shadow rate and public debt. Thus, it was possible to derive IRFs and compute the multipliers to an unexpected government spending shock for the different macroeconomic variables depending on different levels of debt and monetary policy regimes at different percentiles of the interactive variables' distribution. Finally, analyzing the differences in the results obtained from the IRFs allows for answering the research question.

This dissertation contributes to the literature by analyzing the effects caused by the two added interaction terms. First, I add the interaction term between debt and government spending, which allows me to see the impact of debt on the fiscal multiplier. Using this interaction term and the I-VAR estimation allows estimating the impact of debt on fiscal multipliers without breaking the sample and isolating effects. Second, my key contribution, I add the interaction term between debt, shadow rate and government spending, which allows seeing the impact that monetary policy has on the fiscal multiplier depending on the debt level, i.e. it allows me to answer the research question. With this specification, it is possible to separate the effects that debt and monetary policy have on fiscal multipliers, as well as the interaction of both variables on fiscal multipliers. Thus, it is possible to compare

the fiscal behavior of high debt countries and low debt countries, of countries in normal times of monetary policy and countries in the ELB, and also to compare the impact of monetary policy in high and low debt countries.

The main findings are as follows. First, fiscal multipliers are larger in ELB relative to normal times. Second, I find higher fiscal multipliers in high-debt countries than in low-debt countries. Finally, both low-debt and high-debt countries have higher fiscal multipliers because of unconventional monetary policies. Despite both benefiting, in the short-term, unconventional monetary policy benefited more high-debt countries than low-debt countries. However, it is not true that unconventional monetary policy only benefited more the most indebted countries because less-indebted countries benefit more over the medium term.

These results have important implications for the new anti-fragmentation mechanism that the ECB is currently developing. Namely, the results suggest that more indebted countries may have more incentives to increase their debt under the new monetary policy regime than low-debt countries, leading to higher fragmentation within the EA.

The structure of this dissertation is as follows. The next section reviews the literature. Section 3 describes the empirical methodology, the variables and the model specification. In section 4, I present and analyze the data. Section 5 reports the results. In section 6, I discuss the policy implications of the new anti-fragmentation instrument being designed by the ECB. Finally, section 7 concludes.

2. Literature review

2.1. Definitions

This dissertation has four key concepts: fiscal multipliers, unconventional monetary policy, the Effective Lower Bound (ELB), and the Shadow Rate (SR). First, fiscal multipliers can be defined as the ratio of a change in output to an exogenous change in the fiscal balance, which can be driven by government expenditures or tax revenues (Spilimbergo, Symansky & Schindler, 2009). Several factors may affect the size of multipliers, such as financial frictions, government fiscal positions, and monetary policies, among others (Boussard et al., 2013; Spilimbergo et al., 2009).

Second, the ECB reacted to the financial crisis by seeking to manage money market liquidity to re-establish the normal functioning of the monetary policy transmission mechanism. Among the first extraordinary liquidity management measures were the weekly Main Refinancing Operations on a full allotment basis, and the increase of the maturity and the volume of long-term refinancing operations (LTROs). When faced with the sovereign debt crisis and the ZLB constraint, the ECB was forced to take more unconventional measures, which included: a negative interest rate on the deposit facility, targeted longer-term refinancing operations (TLTROs), Quantitative Easing and Forward Guidance.

Third, many authors refer to the Effective Lower Bound (ELB) instead of the traditional "zero" lower bound since the most recent studies of developed countries have shown that the lower bound for nominal interest rates is not zero but negative due to cash storage costs (Tristani & De Fiore, 2019). Thus the ELB refers to the rate at which further cuts in the main monetary policy interest rate no longer provide stimulus to the economy.

Finally, the SR is an interest rate used in some financial models to measure the overall monetary policy stance when nominal interest rates are near the constraint of the ZLB (Wu & Xia, 2016). It represents a nominal short-term interest rate – unbounded by the zero lower bound – reflecting the Centrals Banks' additional easing through unconventional policies. The motivation behind its conception was the inability to quantify the effects of unconventional monetary policies when interest rates sit at or near zero when using traditional economic models. The SR used as a variable for estimation in this dissertation follows the one proposed by Wu and Xia (2016).

2.2. Factors impacting fiscal multipliers

The literature on fiscal multipliers has studied several factors impacting the magnitude of fiscal shocks. Among these factors, this dissertation contributes to two specific strands in the fiscal multiplier literature: public debt and monetary policy. To this end, this section has three subsections. First, subsection 2.2.1. generally describes the most used factors in the literature. Afterwards, subsection 2.2.2. describes the fiscal multiplier literature that focuses on monetary policy and 2.2.2.1 the transmission channels. Subsection 2.2.3. describes the fiscal multiplier literature that focuses on public debt and 2.2.3.1 the respective transmission channels.

2.2.1. Main factors

Fiscal multipliers measure the effectiveness of fiscal policy in stimulating economic activity, and their magnitude in the case of EA countries deserves special attention because it is predicted to be larger in economies that are part of a currency union (Born, Jüssen & Müller, 2013).

The value of the fiscal multiplier depends on many factors that may or may not be related to the shock itself. On the one hand, the factors intrinsic to the shock refer to its nature (temporary or permanent) and composition. Regarding the persistence of the measures, temporary reductions in income taxes decrease the multiplier (it reduce concerns about sustainability and adverse impact on risk premia); however, to the extent that consumers are forward looking, these reductions have less effect on consumption. Permanent measures generate higher multipliers than temporary ones when focused on income, while the reverse is true when the measures are focused on prices because changes in relative intertemporal prices are more likely to affect intertemporal consumption patterns (Spilimbergo et al., 2009).

On the other hand, the remaining factors are related to the economic environment (the economic situation, the economic situation of the partner countries, the stress in the financial market or even the cyclical conditions) and the economic policy regime (monetary and exchange rate policy) (Boussard et al., 2013). For instance, many authors have studied which transmission channels can affect the magnitude of fiscal multipliers (Afonso & Sousa, 2011; Brinca, Holter, Krussel, & Malafry, 2016; Zubairy, 2014) and also how a fiscal multiplier depends on various country characteristics including, among others, the distribution of wages and wealth, social security, taxes, government debt (Brinca et al., 2016; Ilzetzki,

Mendoza & Végh, 2013). I now review four of the most used factors in the empirical literature and finish with a brief presentation of other factors that are also used.

First, the effect of the business cycle on fiscal multipliers has been widely analysed (Gorodnichenko & Auerbach, 2013; Batini, Callegari, & Melina, 2012; Riera-Crichton, Végh, & Vuletin, 2015). In this sense, these studies tend to find more Keynesian reactions, i.e. the response of output to fiscal shocks is larger in recessions than in expansions (Gorodnichenko & Auerbach, 2013; Riera-Crichton et al., 2015). Consider the case of counter-cyclical policies. During booms, the lower value of the multiplier is justified by the fact that the reduction in government spending is offset by increases in consumption and net exports. During recessions, an increase in government spending has a positive effect on output, as it would lead to an increase in consumption and investment, as well as a decrease in net exports and inflation (Riera-Crichton et al., 2015).

Second, following the Mundell-Fleming model, exchange rate regimes have been used in the empirical fiscal multipliers literature (Born et al., 2013; Ilzetzki et al., 2013). For example, according to Ilzetzki et al. (2013), under predetermined exchange rate regimes, private demand rises together with public demand, which translates into a long-run multiplier that exceeds the unity (assuming that net exports remain unchanged). With regard to countries under a flexible exchange rate, the fiscal multipliers are close to zero. The transmission channel that generates these differences between responses to fiscal shocks is the degree of monetary accommodation. As argued in Zubairy (2014), the responses of monetary policymakers shift the output from the steady-state, which is important when determining movements of interest rates and when limiting the impact of spending shocks. Thus, the greater and faster the reaction of monetary policy to the shock, the more control over the effects caused by the impact of the shock.

Third, several studies include the level of openness to estimate fiscal multipliers (Barrell, Holland, & Hurst, 2012; Ilzetzki et al., 2013; Boussard et al., 2013). The literature tends to find a negative relationship between the degree of openness and fiscal multipliers. Closed economies tend to have long-run multipliers over the unity, whereas open economies can have negative multipliers in the short and long run (Ilzetzki et al., 2013). This result is consistent with the Mundell–Fleming model; in this model, the fiscal multiplier would be lower in a more open economy because part of the increase in aggregate demand would be met by a reduction in net exports rather than by an increase in domestic production. One of

the transmission channels of country openness that accounts for this difference is the volume of trade as a proportion of GDP. These authors' results indicate that this definition of trade openness conflates two main factors that affect the proportion of trade in a country's GDP (Ilzetzki et al., 2013): i) a country with a low trade level could have high tariffs or barriers to trade, ii) the economy may be too large, despite a country's high level of trade. However, both factors affect the magnitude of the fiscal economy and impact the multiplier independently.

Fourth, there is a vast literature devoted to studying the impact of tax progressivity on the magnitude of fiscal multipliers (Afonso & Leal, 2019; Brinca et al., 2016; Navarro & Ferriere, 2016; McKay & Reis, 2021). The effect of tax progressivity can be uncertain since it depends on other factors. For example, if agents at the bottom of the distribution change their behaviour much more than agents at the top, a progressivity shock may increase output and consumption (Afonso & Leal, 2019; Navarro & Ferriere, 2016). Another example is that a more progressive tax system could reduce the multiplier by reducing credit restrictions and then simultaneously delivering lower average asset holdings and a higher interest rate that counteracts this reduction in the multiplier by its positive effect (Brinca et al., 2016).

Finally, other variables have been sparsely analysed in the literature. First, Gorodnichenko and Auerbach (2013) find that labour rigidity enhances the effectiveness of fiscal policy during recessions. Second, the value of fiscal multipliers also depends on the relationship between the fiscal mechanism used and the private sector's reaction. In this sense, Blanchard and Perotti (2002) argue that private consumption is crowded-out by taxation and crowded-in by government spending. On the contrary, private investment is crowded-out by both government spending and taxation, which implies a strong negative effect on private investment of a fiscal expansion. The justification for this difference is based on the fact that the responses of investment to an increase in expenditure depend on the relative strength of the effects preceded by an increase in both output and interest rates, although in both theories increases in public expenditure and taxes have opposite effects on investment. Third, fiscal multipliers tend to be higher in countries with high inequality (Brinca et al., 2016; Ilzetzki et al., 2013). The results of these authors also show that the impact of fiscal measures sharply increases in response to a decrease in the capital-output ratio that when the tax levels go up, the economy becomes poorer (with less capital), interest rate increases, and wage rates decrease (Brinca et al., 2016).

2.2.2. Monetary Policy

The first strand of the two explored in this dissertation relates to the impact of monetary policy on fiscal multipliers. As argued by Zubairy (2014), monetary policy is crucial to determine the movements of interest rates, which in turn plays a role in how the economy reacts to fiscal shocks. This literature can be divided into two large groups depending on the focus on the ZLB.

The first group in the literature has analysed the impact of monetary policy on fiscal multipliers without focusing on the effect that the ZLB may have on their dimension (Boussard et al., 2013; Leeper, Traum & Walker, 2017; Zubairy, 2014). For example, Leeper et al. (2017) show that the expected inflation in the Taylor Rule can explain about 10% of impact multipliers by studying the importance of the monetary policy reaction. Also, regarding the speed of action of monetary policy, Barrell et al. (2012) showed that a faster response by central banks (reducing interest rates) would reduce fiscal multipliers during the first three years but would raise the values during the subsequent ones. In addition, Minea and Mustea (2015) highlight the importance of solid coordination regarding monetary policy to promote higher cohesion, coordination, and consequently, a more effective fiscal policy. Moreover, according to Boussard et al. (2013), the conduct of monetary policy also affects the level of debt through the interest-rate effect.

The second group of literature that studies the impact of monetary policy on fiscal multipliers has analysed the impact of monetary policy on fiscal multipliers at the ZLB. This group contributed in three different directions. First, theoretical studies, such as Christiano, Eichenbaum and Rebelo (2011), show that the Keynesian liquidity trap can have a stronger impact on fiscal multipliers when compared to "normal" times. Coenen et al. (2012), Eggertsson (2011), and Cogan, Taylor & Wieland (2010) also argue in favour of a higher multiplier at the ZLB. However, the key channel to explain the high multipliers in the ZLB context is the real interest rate (Di Serio, Fragetta & Gasteiger, 2020). As expected inflation increases, the real interest rate must fall with a nominal interest rate of zero. Consequently, private consumption and investment increase, raising aggregate output. The increased output leads to an increase in marginal costs, increasing once again the inflation rate. Thus, the ZLB amplifies the effects of government spending on output.

Second, various empirical studies on fiscal multipliers at the ZLB tend to find larger fiscal multipliers in a ZLB context in different countries (Almunia, Bénétrix, Eichengreen,

O'Rourke & Rua, 2010; Bonam, De Haan, & Soederhuizen, 2020; Di Serio et al., 2020; Klein & Winkler, 2021; Miyamoto, Nguyen & Sergeyev, 2018; Ramey & Zubairy, 2018). Almunia et al. (2010) use a sample of 27 advanced and emerging economies and, despite not explicitly analysing the impact of the ZLB on fiscal multipliers, find higher fiscal multipliers for the sub-sample that includes the ZLB period. Bonan et al. (2020) study the impact of ZLB on fiscal multipliers for a sample of 17 OECD economies and find higher government consumption multipliers at the ZLB. Also using OECD economies, Klein and Winkler (2021) find multipliers that are more than double at the ZLB relative to normal times. Di Serio et al. (2020) estimate fiscal multipliers for the United States and find higher government spending multipliers in recessions at the ZLB compared to normal times (multipliers range from 3.56 to 3.79 and from 2.31 to 3.05, respectively). Ramey and Zubairy (2018) also estimate multipliers for the United States but find mixed results that depend on the sample period under consideration, with a few specifications (such as excluding the WWII period) implying multipliers as high as 1.5. Miyamoto et al. (2018) find a fiscal multiplier of 1.5 or larger at the ZLB, using Japanese data.

Finally, Amendola et al. (2020) study not only the difference in magnitude but also explicitly identify the impact that ELB has on the multipliers. Specifically, Amendola et al. (2020) use the shadow rate – developed by Wu and Xia (2016) to account for the EA's overall monetary policy stance – to estimate the impact of the overall monetary policy (conventional and unconventional) on fiscal multipliers. They show that the size of the average cumulated government spending multiplier depends on the monetary policy regime, with the difference between the size of the government spending multiplier at the ELB and in normal times being positive with high probability and economically important and this difference increases at time horizons beyond the first year. The relationship between the multiplier and the shadow rate is inversely correlated: the higher the unconventional policy, the higher the fiscal multiplier.

To the best of my knowledge, no study has analysed unconventional monetary policy's effect on fiscal multipliers through the public debt channel.

2.2.2.1. Transmission channels

As discussed in the previous section, monetary policy impacts fiscal multipliers. In this section, I focus on the transmission mechanisms that the literature identified as how the ZLB might influence fiscal multipliers.

The monetary policy scenario that is constrained by the ZLB has been studied in the modern literature since it implies differences in the behavior of variables relative to the normal times regime. In the ZLB, output tends to be determined by demand, meaning that aggregate supply is mainly relevant because it reduces expectations about future inflation (Eggertsson, 2011). Accordingly, policies aimed at increasing aggregate supply may be counterproductive, ending up in deflationary expectations. Therefore, policies should not aim to increase the supply of goods when there is a problem of insufficient demand.

Thus, the main transmission mechanism identified by the literature that may justify the larger size of the multiplier is the expected inflation. With the nominal interest rate at zero, the increase in expected inflation lowers the real interest rate, which boosts other mechanisms (Christiano et al., 2011; Paries, Papadopoulou & Müller 2020). Accordingly, this expected inflation mechanism works whether there is an actual increase in government spending or if there is an expectation of a future increase in government spending. On the one hand, with an increase in government spending, there is an increase in output, marginal cost, and expected inflation. With the nominal interest rate at zero, the upward price pressures lower the real interest rate, leading to greater incentives for borrowing to boost household consumption and capital investment, which increases private spending. This increase in spending leads to a further increase in output, marginal cost, expected inflation, and a further decrease in the real interest rate. The net result is a large increase in output and a large drop in the deflation rate. In effect, the increase in government consumption counteracts the deflationary spiral associated with the zero-bound state. The net result is a large increase in inflation and output (Christiano et al., 2011).

On the other hand, the multiplier also works through the effect of a future increase in government spending on expected inflation. If the economy is at the zero bound, a future increase in government purchases increases future output and, therefore, future inflation. This effect leads to higher expected inflation and a lower real interest rate. Over time, this lower real interest rate reduces desired savings and increases consumption and output (Christiano et al., 2011).

Despite the expected higher multiplier caused by the increase in spending, other types of expansionary fiscal policy may have counterproductive effects. For example, Eggertsson (2011) analyzes the effects of tax cuts on labour and capital during the ZLB period. Accordingly, Eggertsson (2011) concludes that, in the face of the ZLB constraint, the signs reverse and tax cuts become contractionary. This result can be explained because cutting capital taxes gives people the incentive to save rather than spend when precisely the opposite is needed. If the aggregate saving increases, it will generate lower demand, which in turn leads to lower incomes for households, thus reducing their ability to save. Paradoxically, a consequence of lower capital taxes is, therefore, a collapse of aggregate savings in general equilibrium because everyone tries to save more (Eggertsson, 2011).

2.2.3. Public Debt

The second strand of literature studies the impact of public debt on fiscal multipliers. In this section, I subsequently review the importance of debt sustainability as a determining factor for the value of the multipliers. Even though it is quite consensual in the literature that higher debt leads to lower fiscal multipliers (e.g. Afonso & Leal, 2019; Boussard et al., 2013), the same is not true for the threshold level beyond which debt should be considered excessive. In fact, depending on the study, this threshold varies from 37% to 100% of GDP (e.g. Nickel & Tudyka, 2014; Corsetti, Meier & Müller et al., 2012; respectively).

Following the variety of thresholds in the literature, several studies compare fiscal multipliers across different thresholds. First, Reinhart and Rogoff (2010) divide countries into four distinct categories of debt levels: low debt (< 30% of GDP); medium debt (30% to 60% of GDP); high debt (60% to 90% of GDP); and very high debt (> 90% of GDP). These authors suggest that, in advanced economies, for very high debt levels, growth can be expected to be less than half that observed when public debt is considered low (1.7% compared to 3.7%, respectively).

Second, Kumar and Woo (2010) analyse a panel of advanced and emerging economies between 1970 and 2007. The empirical results suggest an inverse relationship between initial debt and subsequent growth, and they show that this effect has a more negative impact the higher the initial debt level at the time of policy implementation. Thus, the subsequent growth rate of per capita GDP over five-year periods during high initial debt episodes (above 90% of GDP) is on average lower than that during low initial debt episodes (below 30% of

GDP) across various groups of countries. On average, a ten percentage point increase in the initial debt-to-GDP ratio is associated with a slowdown in annual real per capita GDP growth of around 0.2 percentage points per year. Both Berben and Brosens (2007), De Mello (2013) and Sutherland (1997) corroborate these results by arguing that multipliers can become negative as the level of public debt increases.

Finally, Ilzetzki et al. (2013) also experiment with a range of sovereign debt ratios and find that the 60% of GDP threshold – used, for example, by the EA as part of the Maastricht criteria -- is indeed a critical value above which fiscal stimulus may hinder output in the long run. They show that during episodes where the public debt is high, the fiscal multiplier is not statistically different from zero in the short run and negative in the long run. Additionally, their estimates are consistent with the notion that fiscal stimulus in highly indebted countries may be counter-productive since it can signal future fiscal tightening and anticipating such adjustments can cause contractionary effects.

Also using the 60% threshold, Afonso and Leal (2019) show that in the case of countries with levels of public debt higher than the threshold, the primary expenditure multiplier is 0.29, the Income and wealth taxes multiplier is −0.26, and the multiplier for Production and imports taxes is −0.75. On the contrary, in countries with lower public debt, primary expenditure seems greater than the unity at the end of the first year (1.09), and the tax multipliers seem to have positive signs.

In turn, Checherita and Rother (2012) investigate the average impact of government debt on per-capita GDP growth in twelve euro area countries over 40 years starting in 1970 and find a non-linear impact of debt on growth with a turning point — beyond which the government debt-to-GDP ratio has a deleterious impact on long-term growth — at about 90-100% of GDP. They suggest that the negative growth effect of high debt may start already from levels of around 70-80% of GDP.

2.2.3.1. Transmission channels

The magnitude of fiscal multipliers can assess the impact of public debt on output. In the previous section, we presented several studies that show that the level of debt negatively impacts the effectiveness of fiscal policy as measured by the negative variation in the size of the multipliers. The literature has been devoted to studying not only the non-linear impact of public debt on economic growth and multipliers but also which channels and factors define the size of this impact. The adverse effects generated by an excessive debt

accumulation seem to partially offset the fiscal stimulus, especially on the risk premium (Reinhart & Rogoff, 2010).

Several factors have been studied over time. For example, common factors, such as consumption and private investment, are present in various studies. There are, however, more specific approaches, such as the study of public investment channels, total factor productivity and sovereign long-term interest rates (Checherita & Rother, 2012; Laubach, 2009; Afonso & Sousa, 2012).

Concerning public investment and total factor productivity, Checherita and Rother (2012) show that indebtedness has a decreasing stimulus on these two components, reflected in a decreasing economic growth. The dynamical model applied by these authors estimates that the debt-turning point of public investment will occur for a public debt level between 45% and 68% of GDP, while total factor productivity starts to decline when public debt exceeds 100% of GDP.

Laubach (2009) studies the impact of deficit and debt as a percentage of GDP on interest rates. The results suggest that a one percentage-point increase in the deficit-to-GDP ratio generates an increase in the 10-year interest rate in the range of 20 to 29 basis points. In turn, a one percentage-point increase in the forecasted debt-to-GDP ratio causes an increase in the interest rate of between three to four basis points, both results being statistically significant.

Internal and external crowding-out effects are also relevant factors for the impact of fiscal policy (Corsetti al., 2012). On the one hand, the increase in the nominal interest rate explains the slight impact on private consumption and strong impact on investment (internal crowding out). On the other hand, the effect of exchange rate appreciation under flexible exchange rates (external crowding-out effect) may ultimately cancel out the effect of fiscal policy.

Afonso and Sousa (2012) argue that successive deficits can reduce multipliers by raising nominal interest rates through two main mechanisms. The first is the decrease in aggregate savings (caused by the deficit). In the absence of compensation through private savings, the supply of capital decreases, which causes an increase in the interest rate and a contractionary effect (or at least a reduction of the multiplier). Second, an increase in the stock of government debt means an increase in the amount of government bonds in the market relative to other financial assets. In this case, the "portfolio effect" increases the interest rate

on government securities, resulting from a large increase in supply that generates a decrease in price.

The perception that agents have of the implemented fiscal policy is also a factor to which the literature has devoted attention. For example, according to Afonso, Checherita, Trabandt and Warmedinger (2010), the accumulation of debt and the perception that the policy is permanent means that the positive effect of increasing output in the short run – caused by a public spending shock – is quickly exhausted since taxpayers perceive the growing debt as a problem that will have to be solved soon. The agents, by anticipating the need to collect taxes in the future to compensate for the present indebtedness, reinforce the increase in savings in the present, which further decreases the multiplier - what in the literature is called Ricardian behavior. This behavior causes an effect contrary to the initial objective of the policy and is expected to be observed when agents are forward-looking, which leads them to anticipate future tax increases to finance present debt. However, Checherita and Rother (2012) contradict this approach based on Ricardian behavior. These authors observed that from a debt level between 82% and 91% of GDP, private savings start to decline. This happens as private agents anticipate the emergence of inflationary pressures, problems in financial markets, and capital outflows from the country.

3. Methodology

3.1 SVAR vs I-VAR

In the empirical literature on fiscal multipliers, the choice of the estimation technique is critical because it conditions the estimated magnitude of the fiscal multipliers (Boussard et al., 2013). Among the possible estimation techniques, the SVAR approach has been widely used to assess the macroeconomic effects of fiscal shocks (Blanchard & Perotti, 2002; Born et al., 2013; Gorodnichenko & Auerbach, 2013; Ilzetzki et al., 2013).

According to Boussard et al. (2013), the SVAR approach is better suited for studying fiscal multipliers for two reasons. First, in contrast to monetary policy, fiscal variables move for many reasons, namely, there are exogenous fiscal shocks. Second, decision and implementation lags in fiscal policy imply that, at high enough frequency (for example, within a quarter), fiscal policy has little or no discretionary response to unexpected contemporaneous shocks. Thus, with enough institutional information about the tax and transfer systems, one can construct estimates of the automatic effects of unexpected movements in activity on fiscal variables and, by implication, obtain estimates of fiscal policy shocks. Having identified these shocks, one can trace their dynamic effects on GDP and its components (Blanchard & Perotti, 2002). However, if agents are forward-looking, Structural VAR (SVAR) models may fail to correctly estimate fiscal shocks, thereby leading to biased estimates of their effects and, particularly, of fiscal multipliers (Boussard et al., 2013).

Despite the advantages of the SVAR approach, more recently, few studies have employed I-VAR frameworks to study fiscal multipliers (Amendola et al., 2020; Caggiano, Castelnuovo & Pellegrino, 2017; Di Serio et al., 2020; Sá, Towbin & Wieladek, 2014; Towbin & Weber, 2013). The key advantage of using the I-VAR methodology is the interaction term, which allows us to derive impulse response functions (IRFs) to a government spending shock at different percentiles of the interactive variables' distribution (Di Serio et al., 2020). For example, this methodology allows computing multipliers for the entire public debt distribution, with no need to restrict the sample. Thus, I can compute the multiplier for the case where a high public debt state coincides with unconventional monetary policies, allowing me to answer the main question of this dissertation which is to analyse if unconventional monetary policies changed fiscal multipliers in countries with different public debt levels.

In addition, using the I-VAR methodology has three further improvements to regime-switching approaches. First, the I-VAR does not require defining a particular threshold for the critical variable. For instance, regime-switching approaches use a threshold to distinguish two regimes. However, such a threshold may be subject to discretion as the researcher frequently chooses it (Ramey & Zubairy, 2018). In contrast, the I-VAR allows distinguishing between as many states of the economy as there are observations for the variable used in the interaction term as, for example, the public debt. Second, the I-VAR uses all the information available for the full sample, while a threshold model uses each state's information under consideration separately. Third, in I-VAR, the interaction term can capture abrupt policy changes next to smooth policy changes (Di Serio et al., 2020).

Aligned with the advantages of using I-VAR, I will use this methodology for estimating multipliers in this dissertation.

3.2 Variables

This subsection initially presents the list of variables commonly used in the literature of fiscal multipliers that uses the VAR methodology. The variables used are traditionally variations of the following vector of endogenous variables:

$$Y_{i,t} = \left[G_{i,t};\ GDP_{i,t};\ T_{i,t}\right]'$$

where $G_{i,t};\ GDP_{i,t}$ and $T_{i,t}$ are real government purchases, real gross domestic product and real net taxes, respectively.

This dissertation adds two key endogenous variables to the set of seminal variables. First, in line with Amendola et al. (2020), this dissertation uses the European Central Bank's shadow monetary policy rate SR_t to capture the effect of the monetary policy. Second, for the ley innovation of this dissertation, I also add public debt, $PD_{i,t}$. These two variables are critical to this study because they allow studying whether the impact of unconventional monetary policy on fiscal multipliers depends on each country's level of public debt. Thus, it is possible to analyze how the implementation of unconventional monetary policies interacts with the different values of debt over the time period under study.

$$Y_{i,t} = \left[G_{i,t};\ GDP_{i,t};\ T_{i,t}; SR_t; PD_{i,t}\right]'$$

Besides the key endogenous variables, I also add three sets of variables to overcome some issues raised by the literature (Amendola et al., 2020; Gorodnichenko & Auerbach, 2013; Forni, Giannone, Lippi & Reichlin, 2009; Leeper, Walker, Todd & Yang, 2008). First, VAR models are characterized by a trade-off between parsimony and omission of relevant variables, which may contribute to misidentifying shocks (Forni et al., 2009). A solution to overcome this limited information problem is adding variables that can summarize unobserved factors affecting most macroeconomic variables (Amendola et al., 2020; Bernanke, Boivin & Eliasz, 2005; Fragetta & Gasteiger, 2014). To this end, I can add common factors, which can be extracted via principal components from a large number of macroeconomic times series to the set of endogenous variables:

$$Y_{i,t} = \left[G_{i,t};\ GDP_{i,t};\ T_{i,t}; SR_t; PD_{i,t}; F_t\right]'$$

where F_t is a 1×5 vector common to all countries. Despite this vector is common to all countries, it may have different impacts for each country and the ability to capture potential spillovers across countries.

Second, due to legislative and implementation delays in fiscal policy, people may anticipate movements in future government spending or tax rates (Leeper et al., 2008). Because of this, fiscal foresight may contaminate what, in principle, is intended to be unanticipated shocks, generating endogeneity and biasing the results (e.g. Forni & Gambetti, 2010; Leeper, Walker & Yang, 2013). Almendola et al. (2020) propose a solution to mitigate this problem. By adding government spending forecasts into the model, anticipated movements in government spending are controlled. To this end, I adopt the same solution and add a variable $f_{(\mathrm{t}|\mathrm{t}-1:\mathrm{t}-4)}$ that accounts for the forecast of time-t government spending over the past twelve months (four quarters), among the exogenous variables.

Lastly, in order to account for international factors which may influence our variables of interest, I add, as exogenous variables, a set of U.S. variables, z_{t-1}, including the U.S. output gap, U.S. inflation and the U.S. shadow monetary policy rate developed by Wu and Xia (2016).

3.3 Empirical framework/Model specification

The empirical model uses the Interacted Vector Auto-Regressive (I-VAR) framework applied to a panel context. This framework was first developed by Caggiano et al. (2017) and was extended to a panel context by Amendola et al. (2020).

I adapt the model specification of Amendola et al. (2020) to account for the interaction effects of public debt. To this end, this empirical model has three interaction terms. First, in line with Amendola et al. (2020), there is an interaction term between government spending and the shadow rate. This interaction term accounts for the effect that monetary policy may have on fiscal multipliers. Second, I add an interaction term between government spending and public debt. This interaction term accounts for the effect that the level of public debt may have on fiscal multipliers. Finally, I add an interaction term between government spending, the shadow rate, and public debt. This interaction term is my key innovation and accounts for the fact that monetary policy may have different impacts on fiscal multipliers, depending on the level of public debt. The model specification is displayed below:

$$Y_{i,t} = \sum_{i=1}^{N} C_i D_{i,j} \; + \; \sum_{i=1}^{N}\sum_{k=1}^{L} A_{i,k} D_{i,j} Y_{i,t-k} \; + \left[\sum_{i=1}^{N}\sum_{k=1}^{L} A^1_{i,k} D_{i,j} G_{i,t-k} \times SR_{t-k}\right] +$$
$$+ \left[\sum_{i=1}^{N}\sum_{k=1}^{L} A^2_{i,k} D_{i,j} G_{i,t-k} \times PD_{i,t-k}\right] + \left[\sum_{i=1}^{N}\sum_{k=1}^{L} A^3_{i,k} D_{i,j} G_{i,t-k} \times SR_{t-k} \times PD_{i,t-k}\right] +$$
$$+ \sum_{i=1}^{N} V_i D_{i,j} \, f_{(t|t-1:t-4)} \; + V^1 z_{t-1} + \sum_{i=1}^{N} B^1_i D_{i,j} \, t \; + \sum_{i=1}^{N} B^2_i D_{i,j} \, t^2 \; + u_{i,t} \qquad (1)$$

where t = 1,...,T represents the time dimension; i= 1,...,N represents the country dimension; and k = 1,...,L denotes the lag structure. $Y_{i,t}$ denotes the vector of endogenous variables; the interaction terms are represented by $G_{i,t-k} \times SR_{t-k}$, $G_{i,t-k} \times PD_{i,t-k}$, and $G_{i,t-k} \times SR_{t-k} \times PD_{i,t-k}$; while the vectors of two sets of exogenous variables are denoted by $f_{(t|t-1:t-4)}$ and z_{t-1} (foreign exogenous variables). Moreover, coefficient C_i is the country-specific intercept of country i; $A_{i,k}$ is the matrix of autoregressive coefficients attached to the endogenous variables; $A^1_{i,k}$ is the matrix of country-specific coefficients of the first interaction term; $A^2_{i,k}$ is the matrix of country-specific coefficients of the second interaction; $A^3_{i,k}$ is the matrix of country-specific coefficients of the third interaction term; V_i is the matrix of country-specific coefficients attached to the first set of exogenous variables; V^1 represents the pooled estimated coefficients of the another set of exogenous variables; B^1_i and B^2_i are the matrices of country-specific coefficients for time trends t and t^2, respectively; $D_{i,j}$ is an indicator variable for each country (equal to 1 if i = j, and 0 otherwise);

and, lastly, $u_{i,t}$ is a vector of normally distributed residuals with mean zero and covariance matrix Σi.

Given that the FAIPVAR-X model requires the estimation of a large number of parameters, for the sake of parsimony, I follow Amendola et al. (2020) and use a lag structure of one quarter (L=1).

4. Data

The dataset is composed of quarterly data, covering the period from 2002Q1, which corresponds to the date when the euro came into circulation as the single currency of the Euro Area countries, to 2017Q4. This period is in line with Amendola et al. (2020) as well as the consideration of ten of the eleven countries that joined the EA initially: Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal, and Spain. Luxembourg is not included because it is considered a small economy and tends to exhibit volatile changes in government spending.

As already discussed in section 3.2, the most important endogenous variables are the gross domestic product, net taxes (constructed as the sum of government receipts of direct and indirect taxes minus transfers to businesses and individuals), government spending (constructed as the sum of government gross fixed capital formation and government consumption), the European Central Bank's shadow rate, and the public debt.

All these variables are obtained from the Eurostat database and are transformed in real terms using the implicit GDP price deflator from 2015. The treatment of the data involved several procedures. First, the real potential GDP of the corresponding country is computed using the filter recently proposed by Hamilton (2018). Second, government spending and net taxes are normalized by diving by real potential GDP of the corresponding country. This normalization avoids potential biases that could arise from using constant sample averages of the ratios of fiscal variables to GDP in the ex-post conversion of the estimated elasticities to euro equivalents (Gordon & Krenn, 2010; Ramey & Zubairy, 2018). Third, the European Central Bank's shadow rate is the one developed by Wu and Xia (2017). Since this rate is available from 2004Q3 onward, for the very beginning of the sample, it was complemented with the Main Refinancing Operations (MRO) rate, given that the two, until 2008, are virtually indistinguishable. Lastly, I use the government consolidated gross debt in percentage of the gross domestic product as an endogenous variable and interaction term.

The informational dataset used to extract the five common factors that summarize the countries' characteristics is composed of 250 series downloaded from the Eurostat database. The variables downloaded from each country can be found in Annex 1. Dickey and Fuller (1979) stationarity tests were applied to all these variables and, when necessary, the variables were transformed to guarantee stationarity. Similar to Amendola et al. (2020) and Bernanke et al. (2005), I implemented a two-step estimation procedure. The first step is the extraction

of the five common factors, using the IC_{p2} information criterion as established by the Bai and Ng (2007). The second step is adding the five factors to the vector of endogenous variables.

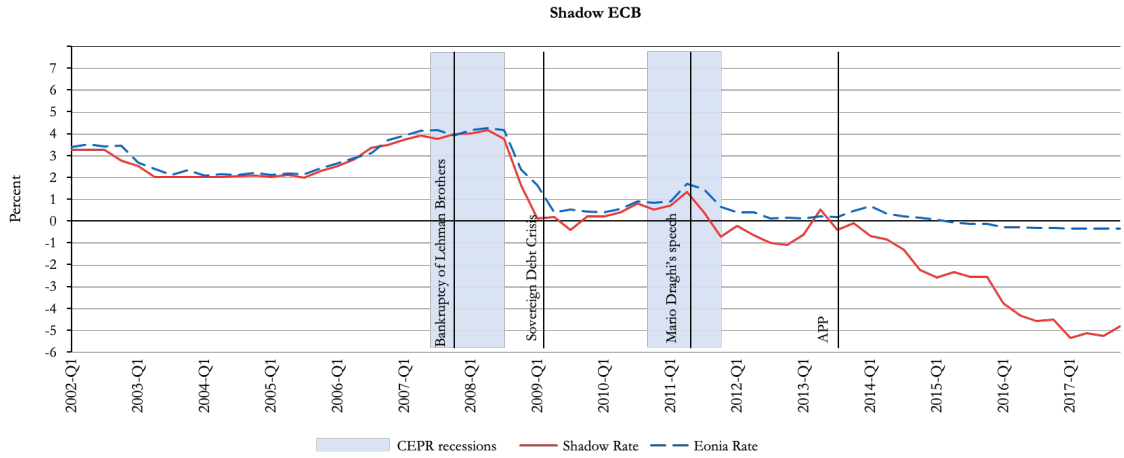
With regard to the exogenous variables, there are two groups of variables. First, to account for the fiscal foresight problem, I use the forecast of the annualized growth rate of total government expenditure over GDP. This series uses the OECD economic projections and was computed as the average forecast for the current year over the past 12 months. The other group of exogenous variables are the U.S. output gap, and the U.S. inflation downloaded from the Federal Reserve Bank of St. Louis database, and the U.S. Shadow Rate developed by Wu and Xia (2016).

4.1 Shadow rate

The shadow rate has the ability to summarize the overall monetary policy stance, overcoming the difficulty of capturing the recently enhanced policy intricacy. The shadow rate used in this dissertation was derived by Wu and Xia (2016) and Wu and Xia (2017) through an approximation of a nonlinear term structure model.

To understand better the dynamics of the shadow rate, Figure 1 plots two interest rates during our sample: the EA shadow rate and Euro overnight index average (EONIA).

Figure 1 Euro Overnight Index Average (Eonia) Rate and Shadow Monetary Policy Rate in the Euro Area.



The graph plots the Eonia Rate and Shadow Monetary Policy Rate in the Euro Area between 2002Q1 and 2017Q4
Sources: European Central Bank and Wu and Xia (2017).

As Figure 1 shows, these two interest rates almost overlapped before the start of the GFC. They started to diverge after 2008Q3 – a quarter made infamous in economic history by the bankruptcy of Lehman Brothers. This initial divergence can be justified by the implementation of measures such as changing the bidding rules to a full-allotment bid, increasing LTROs and implementing VLTROs. Accordingly, in line with Amendola et al. (2020), I define the "normal times" regime as the period before 2008Q3.

After the end of the GFC, the sovereign debt crisis has pushed the shadow rate back into positive territory – as it follows the EONIA – due to increased uncertainty about the solvency of some banks. Then, after the well-known "Whatever it takes" speech of former ECB's President Mario Draghi, which aimed to respond to the uncertainty created (reflecting the measure of unconventional forward guidance), the EONIA rate was brought first to the ZLB and then turned negative, while the SR continued to sink into the negative territory. This divergence between interest rates reflects the impact of unconventional monetary policy. The shadow rate going into negative territory thus represents the effects of unconventional monetary policy that cannot be reflected by the EONIA since it is constrained by the ZLB.

Despite all the efforts made by the ECB in applying unconventional measures to keep the interest rate low so that its inflation target would be achieved, it was the application of the APP program that, as we see in the graph, had the most effect, pushing the shadow rate away from the EONIA significantly. The asset purchase programme (APP) is an unconventional policy measure implemented by the ECB that consists in buying a range of assets, including government bonds, securities issued by European supranational institutions, corporate bonds, asset-backed securities and covered bonds in order to influence financial conditions and, eventually, economic growth and inflation (ECB, 2022).

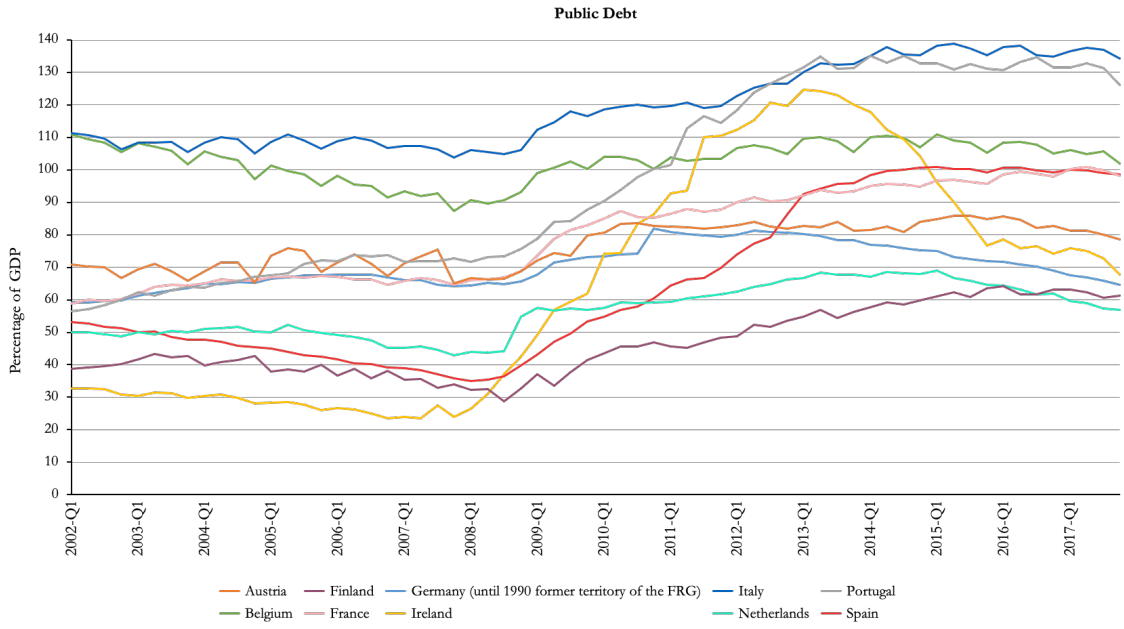
For the design of the IRFs, I consider two different monetary policy regimes. The first one is the Normal Times regime that corresponds to the period between 2002Q1 and the bankruptcy of Lehman Brothers in 2008Q3. The second one is the ELB regime corresponding to the period between 2012Q4 (the quarter following ECB's former President Mario Draghi's "whatever it takes" speech) to 2017Q4.

4.2 Public Debt

The use of government consolidated gross debt in percentage of the gross domestic product as an endogenous variable and interaction term aims to study how a country's higher level of public debt affects the impact of unconventional monetary policy on fiscal multipliers. Thus, the objective of its use in this dissertation is to understand how a country with a lower (or higher) level of debt can benefit from the implementation of unconventional policy measures.

Since this dissertation aims to understand how the public debt level can affect the impact of unconventional policy measures in fiscal multipliers, it is important to describe not only the average level of debt within our sample but also its evolution over time and in different countries. To do so, Figure 2 presents the evolution of the ratio of public debt across countries throughout the sample.

Figure 2 Evolution of the public debt level as a percentage of GDP.

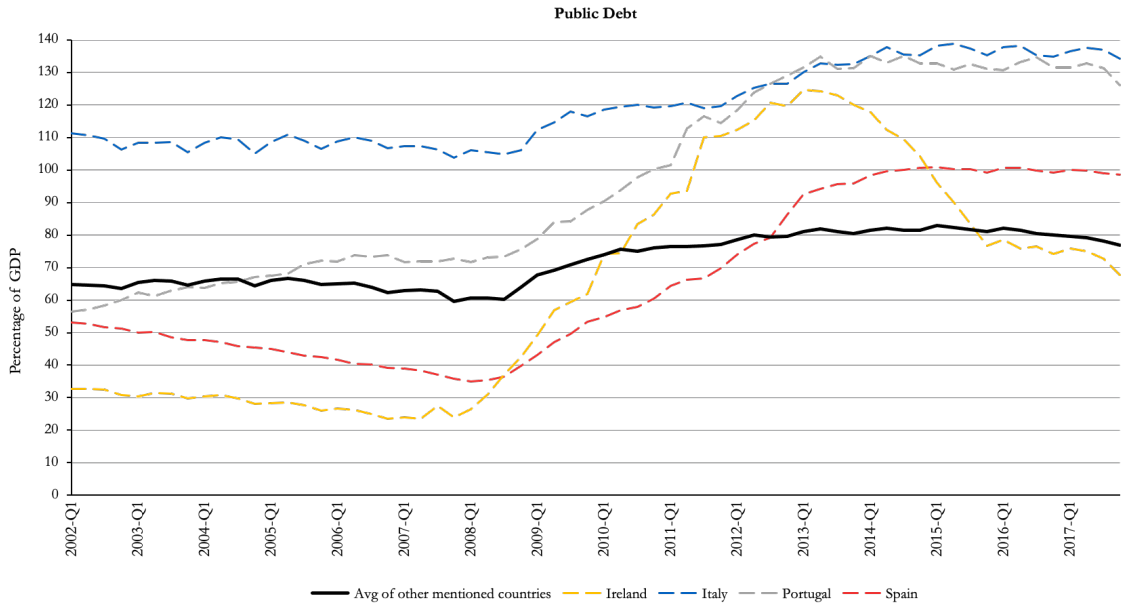


The graph plots the public debt level as a percentage of GDP of all the countries in the sample between 2002Q1 and 2017Q4. Source: OCDE

According to Figure 2, following the GFC, there was an abnormal increase in public debt ratios as a percentage of GDP. This increase in EA countries' public debt was (and still is) particularly alarming in the so-called GIIPS countries – Greece, Ireland, Italy, Portugal, and Spain – the ones that were most affected by the sovereign debt crisis, which caused the impacts on interest rates already analyzed in the previous section. As can be seen in Figure

3, which represents the evolution of debt as a percentage of debt of GIIPS relative to the total average of the countries analyzed in the sample.

Figure 3 Evolution of the public debt level as a percentage of GDP in GIIPS.



The graph plots the public debt level as a percentage of GDP in GIIPS and the average debt as a percentage of GDP of the other countries in the sample between 2002Q1 and 2017Q4. Source: OCDE.

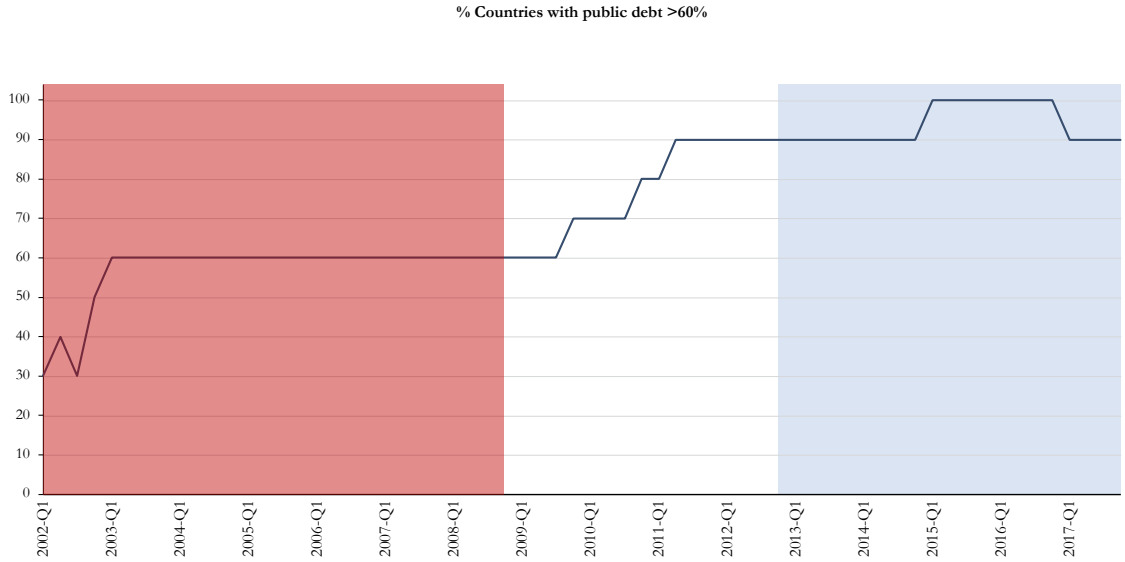
Three main causes were at the origin of this budgetary decontrol. The first concerns the behavior of the automatic stabilizers, which decrease government revenue and increase expenditures (with, for example, unemployment benefits and government transfers). The second was the implementation of very ambitious measures of fiscal stimulus in an attempt to reverse the economic recession experienced, which ended up somewhat limiting the extent of the recession. Lastly, the extraordinary measures that governments took in order to avoid the collapse of their financial systems (bank bailouts, support for financial institutions, among others) also contributed to the further deterioration of fiscal imbalance (Cimadomo, 2011).

While the average public debt as a percentage of GDP of countries that were not the most affected by the sovereign debt crisis was around 60% in 2007 and increased until it was highest at around 80% in 2015.

For better analysis and interpretation of the results, it is important to understand how the use of the 60% threshold defined by the Maastricht Treaty affects the separation of countries as being characterized as high and low debt countries. Thus, Figure 4 represents the

percentage of the countries in the sample that have a public debt higher than 60% throughout the period under study.

Figure 4 Percentage of countries with public debt >60%



The graph plots the percentage of countries in the samples with public debt >60% between 2002Q1 and 2017Q4. The period shaded in red represents the monetary policy regime in normal times and the period shaded in blue represents the monetary policy regime in ELB.

Thus, by observing Figure 4, it is confirmed that, after the GFC, the countries that started to violate the fiscal rule increased. The 30% of countries that start the period with a debt level already above 60% are Belgium, Italy and Austria. The peak in the number of countries considered highly indebted around 2003 incorporated Germany, France and Portugal. In the aftermath of the global financial crisis, the number of high-debt countries - Ireland, Spain and the Netherlands - has risen significantly, with only Finland joining this group of countries in 2015.

5. Results

This section has three subsections. First, Subsection 5.1 presents and discusses the results on the impact of the monetary policy regime on fiscal multipliers. Second, Subsection 5.2 focuses on the impact of public debt on fiscal multipliers. Lastly, Subsection 5.3 discusses the key contribution of this dissertation, i.e. the effect that public debt may have on the impact of unconventional monetary policy on fiscal multipliers.

5.1 The Impact of Monetary Policy Regimes on Fiscal Multipliers

5.1.1 Impulse Response Functions

Figure 5 presents the IRFs for the key endogenous variables – government spending, output, net taxes, the shadow rate, and the public debt – to an unexpected shock to government spending. Since this section aims to assess the impact of monetary policy regimes on fiscal multipliers, the IRFs are conditional on the two regimes defined in Section 4.1. To this end, Figure 5 has two panels of graphs. In the first panel, each graph plots two lines: the red line represents the median response for the normal times, whereas the blue line represents the response for the ELB. The second panel of graphs presents the differences between the two regimes, which allows for assessing the significance of the impact that the monetary policy regimes have on the effects of the shock on each variable.

From Figure 5, I highlight five key results. First, the shock in government spending continues to persist in both policy regimes, and it takes about seven quarters for it to die out. Analyzing the difference in this variable between the regimes, it is possible to conclude that, in the first five quarters, the difference is significant and spending persistence is higher in ELB. Thus, in normal times governments may have felt more pressured to reduce spending more quickly.

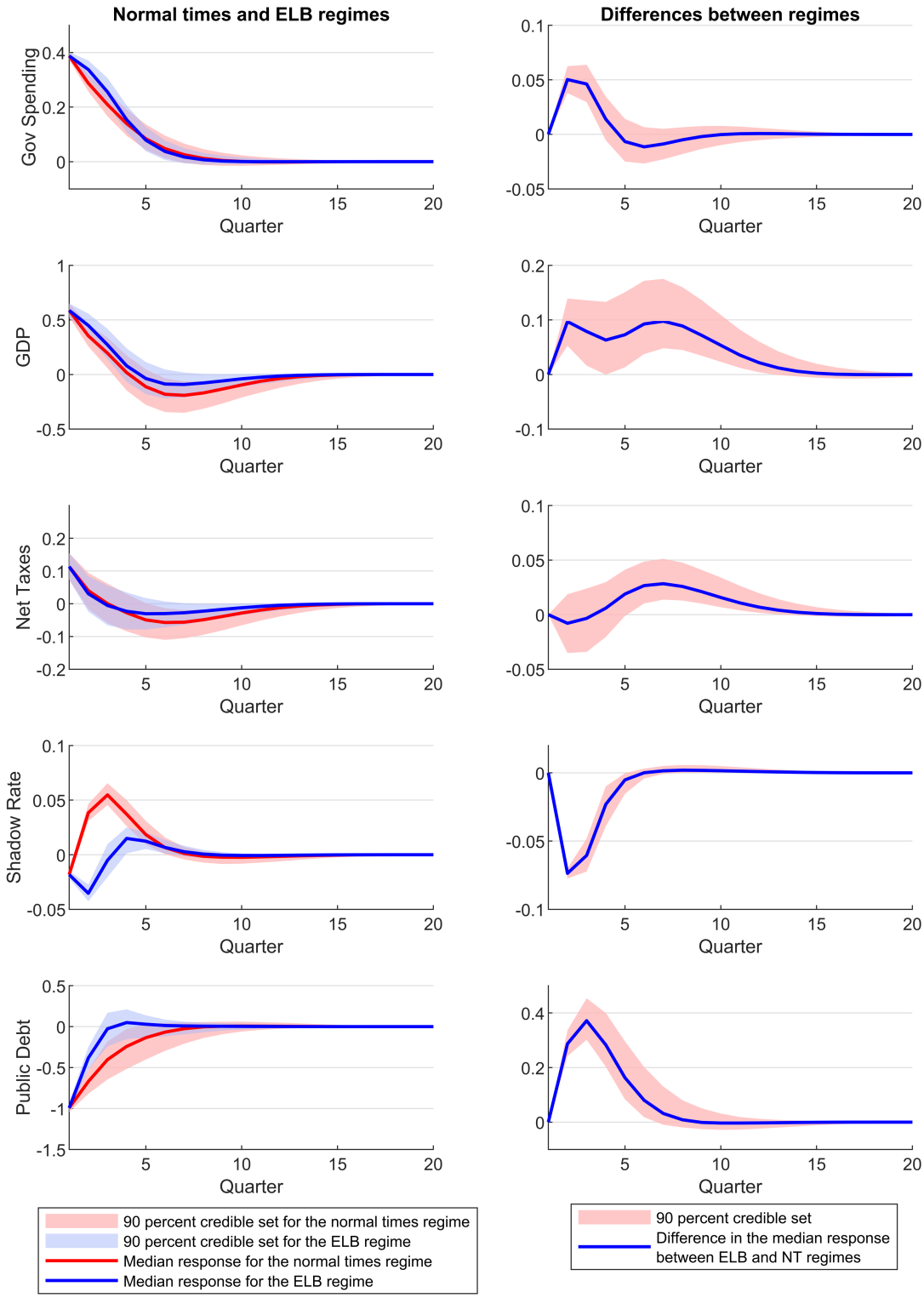
Second, GDP responds positively to the unexpected shock in government spending, showing an immediate and significant difference that lasts for approximately 14 quarters. This difference suggests a higher increase in GDP in ELB and, in this way, higher multipliers can be found at ELB. Third, regarding net taxes, despite the immediate increase for both regimes, Figure 5 also shows a significant difference in the medium term where the decrease in taxes is smaller in ELB than in normal times.

Fourth, the shadow rate responds positively in normal times but negatively at the ELB, which leads to the conclusion that the main transmission channel is the interest rate channel, as

demonstrated by Di Serio et al. (2020). As this figure shows, in the face of an unexpected shock to government spending in normal times, the Central Bank tended, on average, to respond with a contractionary Monetary Policy.

Lastly, an unexpected shock to government spending allows countries to decrease their debt ratio significantly. This decrease is possibly due to the significant increase in GDP, which consequently decreases the relative share of debt in the ratio. Also, the reduction is more accentuated in normal times than in ELB, possibly because countries tend to indebt more in the face of the greater financial ease brought about by unconventional monetary policies.

Figure 5 Impulse Responses Functions to a Government Spending Shock in Normal Times and at the ELB.



This figure plots the Impulse Responses Functions to a Government Spending Shock in Normal Times and at the ELB for the key endogenous variables. The IRFs are in percent to a shock of size one standard deviation. Bold lines represent median responses. Shadowed areas represent 90 percent credible sets.

5.1.2 Cumulated Government Spending Multipliers

Based on the impulse responses, Table 1 presents the government spending multipliers at several time horizons.

Table 1 Cumulated Government Spending Multipliers in Normal Times and at the ELB

Horizon	H	Normal Times	Effective Lower Bound
1 year	4	0,9412	1,1146
2 years	8	0,3078	0,8126
3 years	12	0,1301	0,7461
4 years	16	0,1195	0,7427
5 years	20	0,1199	0,7426

This table presents the computed multipliers for the *normal times* and the *ELB* regime. *H* identifies the number of quarters after the shock.

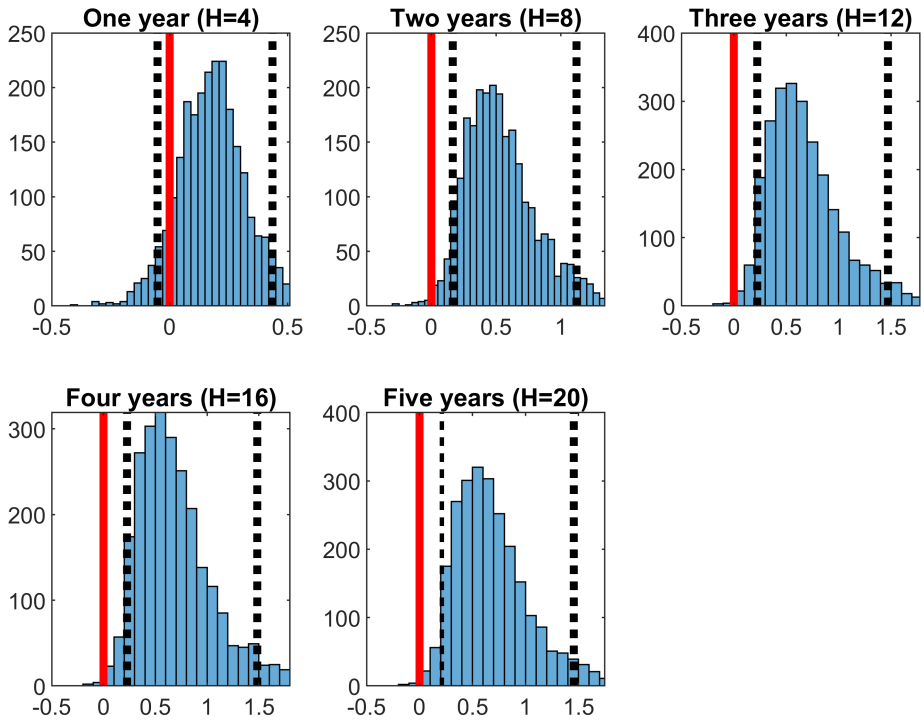
According to Table 1, for all time horizons, the multiplier is higher in ELB than in normal times. At a one-year horizon, the multiplier is below the unity in normal times (approximately 0.94) and above the unity at the ELB (1.11). After the first year, both multipliers decrease but at different rates. Because of that, the difference between the multipliers becomes larger, converging to a multiplier of 0.12 in normal times and 0.74 at the ELB. Higher multipliers at the ELB relative to normal times are in line with that suggested by the theoretical literature (e.g. Christiano et al., 2011; Coenen et al., 2012; Eggertsson, 2011).

Figure 6 plots the distributions of the difference between the two multipliers cumulated at various time horizons together with 90% credible sets. Thus, from the second year following the shock in government spending that at least 90% of each distribution is located above zero, which means that the difference between the two multipliers is significant and positive with high probability.

The results from Figure 5 can help to understand the difference between multipliers. As concluded in the previous section, there is a differentiated reaction of the interest rate across regimes, with the central bank response being, on average, contractionary in the case of the normal times regime, which may be an effect that justifies the difference in the size of the multipliers in the different regimes. Furthermore, it was also verified that the persistence of the shock, that is, the fact that government spending lasts for a certain period of time, is

higher in ELB, which leads to the conclusion that in the case of greater persistence in spending, the multiplier is higher.

Figure 6 Distributions of Differences in Cumulated Government Spending Multipliers between Normal Times and the ELB regimes.



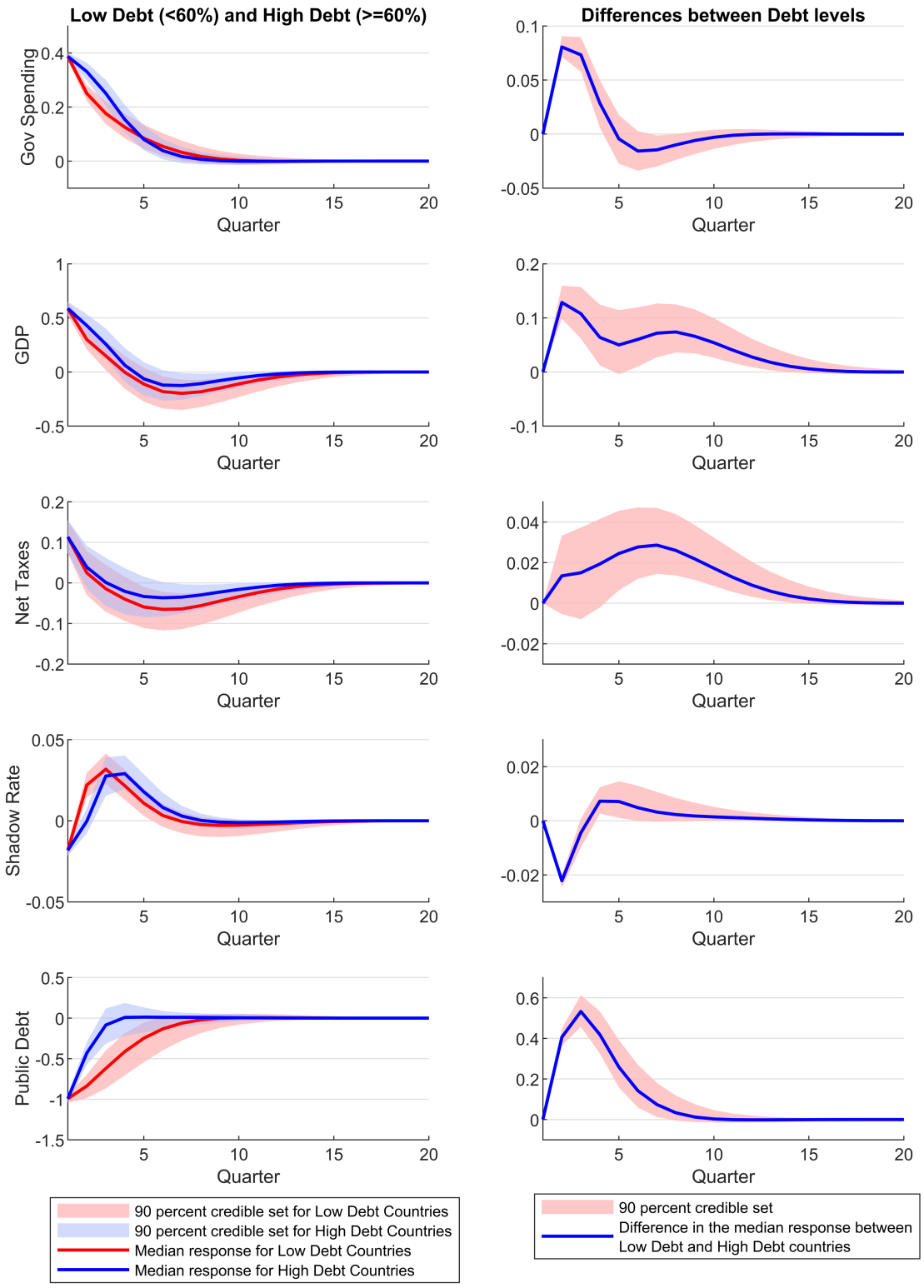
This figure plots the distributions of the differences computed as multipliers conditional on the economy being in the ELB regime minus multipliers conditional on the economy being in the normal times regime. Multipliers are computed for each of the 10,000 parameter draws from the posterior distribution. Vertical dotted lines represent the 5th and the 95th percentiles of the distribution of differences. *H* identifies the number of quarters after the shock.

5.2. The Impact of Public Debt on Fiscal Multipliers

5.2.1 Impulse Response Functions

Figure 7 follows the same presentation strategy as Figure 5, but instead of the IRFs depending on the monetary policy regimes, they are conditional on the ratio of public debt to GDP.

Figure 7 Impulse Responses Functions to a Government Spending Shock in countries with low debt and in countries with high debt.



The figure plots the Impulse Responses Functions to a Government Spending Shock in countries with low debt and in countries with high debt for the key endogenous variables. The IRFs are in percent to a shock of size one standard deviation. Bold lines represent median responses. Shadowed areas represent 90 percent credible sets.

Thus, in the first panel of graphs, the red line represents the median response for the observations where public debt is below 60%, whereas the blue line represents the response for the observations where public debt is above 60%. The use of the 60% threshold follows the criteria used in the EA as part of the Maastricht criteria. The second panel presents the differences between the two observation groups, which allows for assessing the significance of the impact that the ratio of public debt has on the effects of the shock on each variable.

A few remarks are in order. First, in the face of an unexpected shock to government spending. There is a positive difference in the persistence of the shock between the two regimes in the first four quarters, meaning that the more indebted countries tend to have more persistence of the shock (which may indicate a lower ability to contain spending). Second, when it comes to GDP, the difference is positive in the first four quarters, which means a higher multiplier in the most indebted countries in the first year, which is not in line with the literature – more on this below. Third, in the case of net taxes, both types of countries reduce taxes, with the difference between both being significant from the fourth quarter to the 12th, implying that less indebted countries reduce taxes more than more indebted countries.

Fourth, the negative difference in the case of the shadow rate allows us to conclude that the more indebted countries have had a more accommodative monetary policy. This result occurs because, as it was stated in Section 4.2, there is a higher predominance of the most indebted countries in a situation of ELB.

Finally, with respect to debt, there is a positive difference until the eighth quarter, which implies that the more indebted countries feel a smaller decrease in debt than the less indebted countries.

5.2.2 Cumulated Government Spending Multipliers

Based on the impulse responses, Table 2 presents the government spending multipliers at several time horizons for low-debt and high-debt countries.

According to Table 2, for all time horizons, the fiscal multipliers are higher in high debt countries than in low debt countries. For example, at the one-year horizon, the fiscal multiplier is approximately 0.89 in low-debt countries and 1.05 in high-debt countries. After the first year, both multipliers decrease, but the difference between the two groups becomes

larger, favoring high-debt countries. Higher multipliers for high-debt countries are not in line with the literature (Afonso & Leal, 2019; Boussard et al., 2013; Ilzetzki et al., 2013).

Table 2 Cumulated Government Spending Multipliers in countries with Low Debt and High Debt.

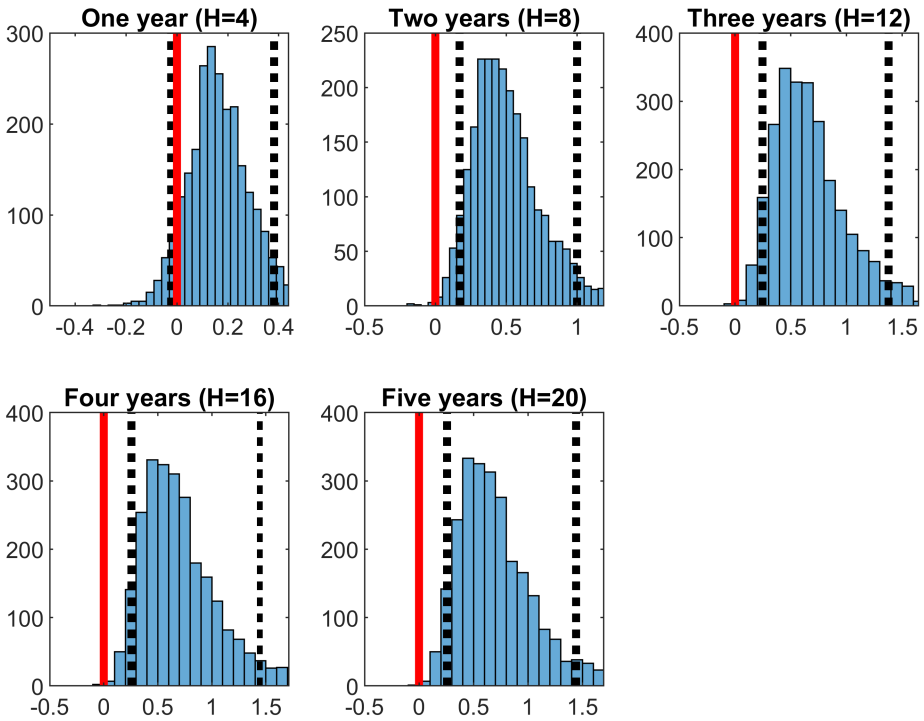
Horizon	H	Low Debt	High Debt
1 year	4	0,9017	1,0593
2 years	8	0,1879	0,6645
3 years	12	-0,0401	0,5753
4 years	16	-0,0598	0,5723
5 years	20	-0,0595	0,5724

This table presents the computed multipliers for the low debt countries and the high debt countries. *H* identifies the number of quarters after the shock.

Figure 8 plots the distributions of the difference between the two multipliers cumulated at various time horizons together with 90% credible sets. Thus, from the second year following the shock in government spending that at least 90% of each distribution is located above zero, which means that the difference between the two multipliers is significant and positive with high probability.

I argue that higher fiscal multipliers in high-debt countries may arise in the sample for two reasons. First, as mentioned in the previous section, countries with more debt have more difficulty containing spending than less indebted countries, which may generate higher multipliers. Second, the higher public debt ratios have coincided with the ELB, contributing to higher multipliers. Thus, countries with high debt may have higher fiscal multipliers since they coincide with the period when monetary policy conditions generate higher multipliers. This effect is visible in Figure 8 since the difference in the shadow rate of countries with higher debt is negative, i.e., they benefit from a more favorable monetary policy. This effect may be critical because the literature has supported that high debt countries have successive deficits, which reduce their multipliers by raising nominal interest rates (e.g. Afonso & Sousa, 2012). Indeed, this effect was captured in Figure 5 in normal times but not in the ELB regime. Thus, this mechanism is absent in ELB, which may justify how fiscal multipliers may be higher in high-debt countries in the EA.

Figure 8 Distributions of Differences in Cumulated Government Spending Multipliers between countries with Low Debt and High Debt.



This figure plots the distributions of the differences computed as multipliers conditional on low debt countries minus multipliers conditional on high debt countries. Multipliers are computed for each of the 10,000 parameter draws from the posterior distribution. Vertical dotted lines represent the 5th and the 95th percentiles of the distribution of differences. *H* identifies the number of quarters after the shock

Finally, it is important to note that the methodology used in this dissertation (IVAR) is not the same as the one commonly used in the literature (SVAR). As already mentioned in section 3.1, the SVAR methodology does not allow for the possibility of multiplying the endogenous variables. Thus, to study the effect of public debt on fiscal multipliers, one has to estimate the model with two distinct sample observations (one with low debt observations and the other with high debt observations). However, by estimating two models for observations with different characteristics, bias can arise due to endogenous effects from other variables. For example, in this sample, monetary policy may bias the results since it is more accommodative in high-debt observations. Thus, by accounting for the interaction terms between monetary policy and the ratio of public debt, this dissertation is safeguarded from this source of potential bias.

5.3. Public Debt and the Impact of Monetary Policy on Fiscal Multipliers

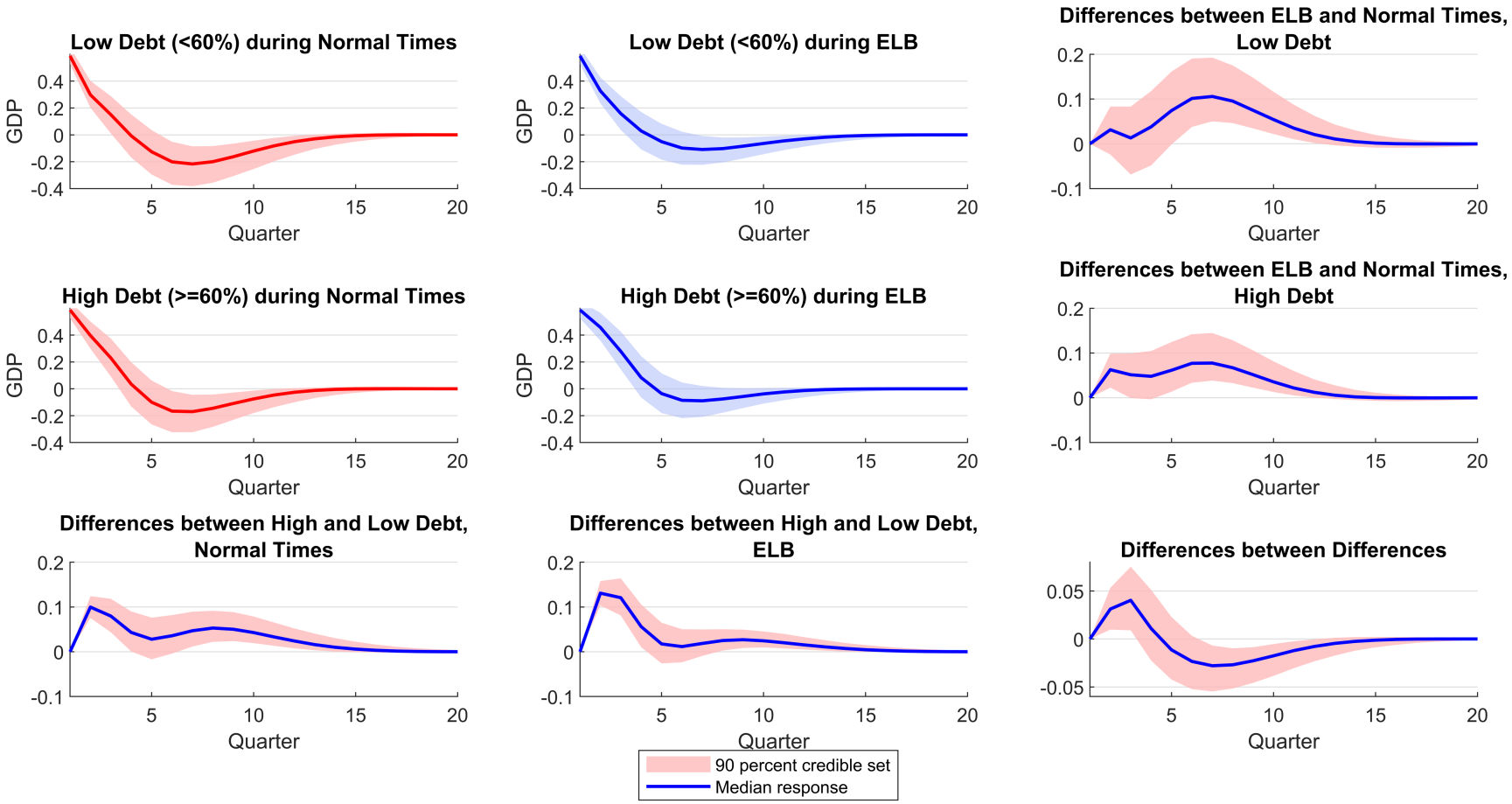
Figure 9 presents the IRFs for the GDP to an unexpected shock to the government spending and has three panels of graphs. The first panel presents the IRFs for high and low-debt countries during normal times and the difference between them. This last graph allows for assessing the impact of public debt on fiscal multipliers during normal times. The second panel presents the IRFs for the ELB, and the last graph allows for assessing the impact of public debt on fiscal multipliers during the ELB. The last panel of graphs presents the difference between the first and the second panel of graphs. The first two graphs allow for assessing the impact of the monetary policy regimes on fiscal multipliers for low and high-debt countries, respectively. The last graph allows for assessing the key research question, i.e. whether the differences in the impacts of monetary policy regimes on fiscal multipliers depend on the ratio of public debt.

Starting by analyzing the first two rows, Figure 9 indicates that all countries (with low and high debt) tend to have higher multipliers in the ELB than during normal times. Although both groups of countries benefit from the unconventional monetary policies, the dynamics of these benefits differ across groups. In low-debt countries (first row), the ELB, although not immediate, has a positive effect on fiscal multipliers from the fifth quarter to the 12th quarter. In countries with high debt (second row), the effect is consistently positive until the 10th quarter.

Turning to analyze the first two columns, Figure 9 shows that the higher fiscal multipliers that high-debt countries have relative to low-debt countries occur both during normal times and in the ELB. Despite the higher multiplier, the difference between high-debt countries and low-debt countries has distinct dynamics across monetary policy regimes. In normal times (first column), the positive difference occurs in the first four quarters, disappears for three quarters and then reappears until the 12th quarter. In the ELB (second column), the positive difference only occurs for the first four quarters.

Finally, turning to the last graph, Figure 9 indicates that both groups of countries benefit from the ELB regime, and there is not a clear gainer from unconventional monetary policies. In the short term, unconventional monetary policy tends to benefit more the high-debt countries than the low-debt countries. However, from the seventh to the 12th quarter, the less-indebted countries benefited the most.

Figure 9 Impulse Responses Functions to a Government Spending Shock in countries with low debt and in countries with high debt and in Normal Times and at the ELB.



This figure plots the Impulse Responses Functions to a Government Spending countries with low debt and in countries with high debt and in Normal Times and at the ELB for the key endogenous variables. The IRFs are in percent to a shock of size one standard deviation. Bold lines represent median responses. Shadowed areas represent 90 percent credible sets.

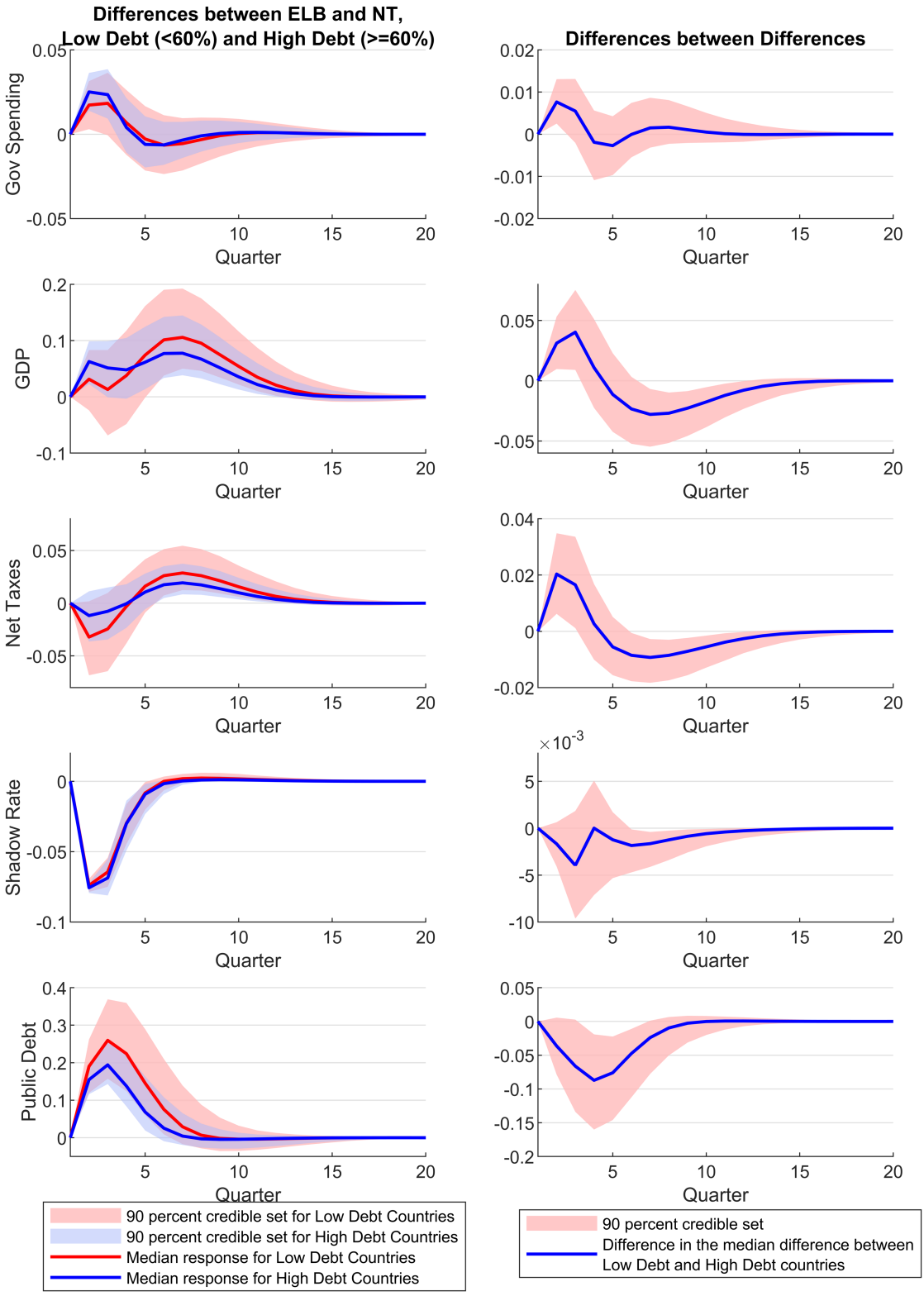
To understand why there is a distinct marginal gain from unconventional monetary policies across these two groups of countries, Figure 10 presents the differences in the IRFs for the dependent variables – government spending, output, net taxes, the shadow rate, and the public debt – between normal times and ELB for both groups of countries. To this end, Figure 10 has two panels of graphs. In the first panel, each graph plots two lines: the red line represents the median difference for low-debt countries, whereas the blue line represents the difference for the high-debt countries.

The second panel of graphs presents the differences in the median difference between the two groups of countries, which allows for assessing the significance of the difference across groups of countries of the impact that the monetary policy regimes have on the effects of the shock on each variable. For example, the graph in the second row represents the difference in the marginal gain in GDP, which was plotted in the low-right graph in Figure 9.

The distinct marginal gain from unconventional monetary policies across the two groups of countries can be justified by several reasons observable in Figure 10. On the one hand, in the very short- term, the most indebted countries were able to increase more their persistence in government spending than the low-debt countries, which may justify the marginal gain of high-debt countries in the first quarters. On the other hand, because of the ELB, low-debt countries felt less need to raise taxes and, consequently, were able to take on more debt and gained some relief in relation to the more indebted countries. This relief may have contributed to a positive marginal gain in the medium-term.

In sum, all these effects have allowed unconventional monetary policy to increase fiscal multipliers in both groups of countries, but the benefit is greater for the more indebted countries in the short-term, whereas it is greater for the less indebted in the medium-term.

Figure 10 Impulse Responses Functions to a Government Spending Shock in countries with low debt and in countries with high debt, in normal times and at ELB



This figure plots the differences between Impulse Responses Functions to a Government Spending Shock in Normal Times and at the ELB for the key endogenous variables in low and high-debt countries. The IRFs are in percent to a shock of size one standard deviation. Bold lines represent median responses. Shadowed areas represent 90 percent credible sets.

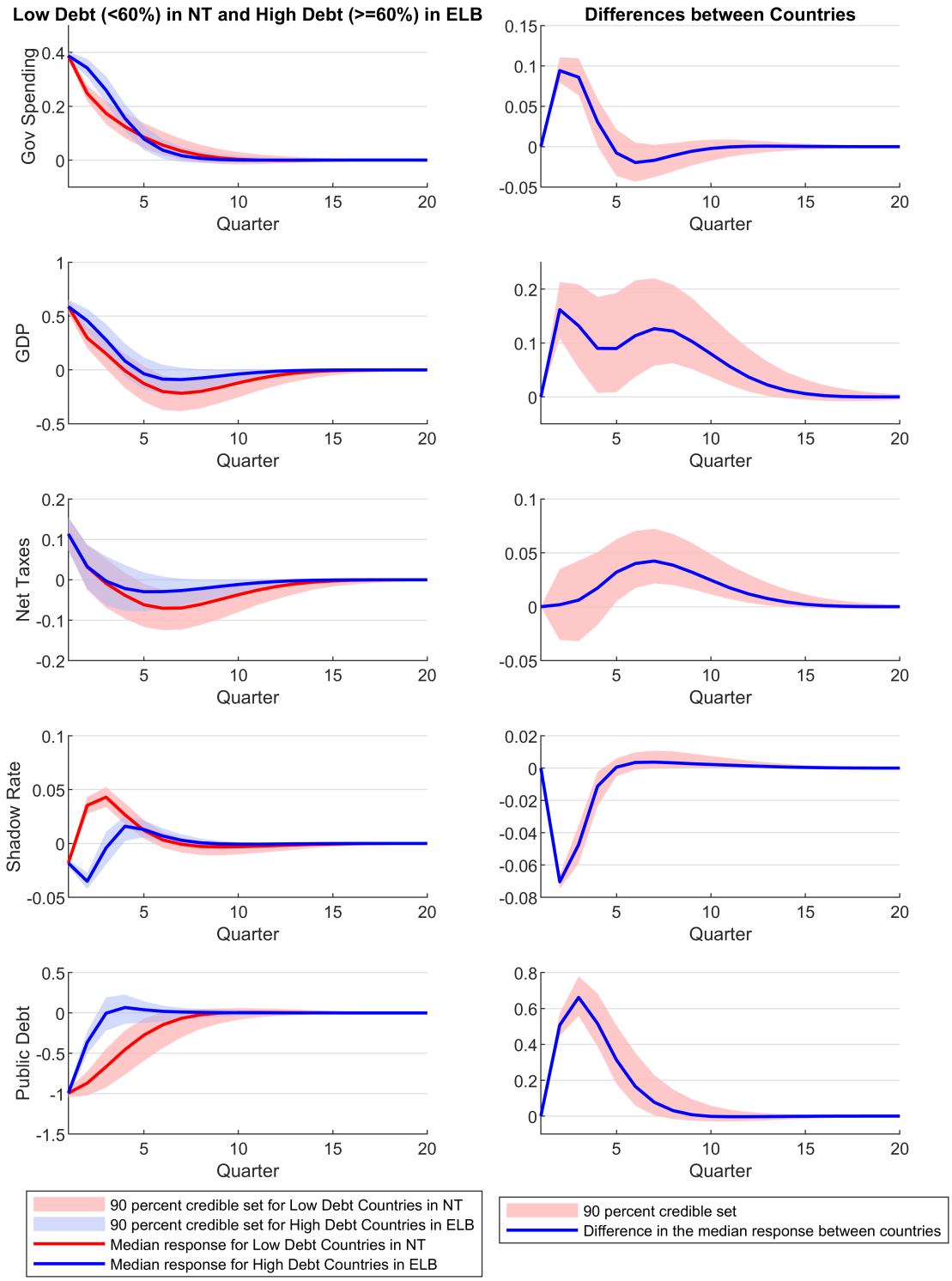
6. Policy Implications

Facing huge spikes in inflation across the EA, the ECB has recently announced the end of the net asset purchases under its asset purchase programme (APP) (ECB, 2022a). Consequently, since the southern European countries have very high debt levels in the aftermath of the pandemic, investors have reacted with a galloped increase in public debt interest rates. This reaction has increased spreads across the EA sovereign debt market, creating fear of a new sovereign debt crisis and the possibility of a fragmentation of the EA. In reaction to this, the ECB is currently designing an anti-fragmentation instrument, which may imply two different monetary policy regimes, one for countries with high debt levels and another for countries with low debt levels.

Assuming that public debt influences the impact of monetary policy on fiscal multipliers, how will the implementation of this monetary policy influence fiscal policy and will it reduce the fragmentation within the EA?

To answer this question, in this section, I compare the fiscal behavior of countries with high debt in a monetary policy regime under ELB (assuming the continuation of debt purchases for these countries) and countries with low debt under normal times. Figure 11 follows the same presentation strategy as Figures 5 and 7, but now the red line represents the median response of a low-debt country in normal times, and the blue line represents the response of a high-debt country in the ELB. The second panel of graphs shows the difference between these two scenarios.

Figure 11 Impulse Responses Functions to a Government Spending Shock in countries with low debt in normal and in countries with high debt at ELB



The Impulse Responses Functions to a Government Spending Shock in countries with low debt in normal times and in countries with high at ELB for the key endogenous variables. The IRFs in percent to a shock of size one standard deviation. Bold lines represent median responses. Shadowed areas represent 90 percent credible sets.

According to Figure 11, the difference in the shadow rate (which is intuitively much lower in high debt countries than in low debt countries) gives room to greater persistence of expenditures and greater relief of the tax burden in high debt countries. Consequently, there is a significant public debt increase, extending over the first eight quarters. Moreover, Figure 11 also shows that the countries with high debt would enjoy a significantly higher multiplier than the less indebted countries.

These dynamics could generate serious policy implications. In terms of fiscal policy decisions, it can provide incentives for high-debt countries to become more spendthrift. On top of this, the risk of recession (ECB, 2022c) reinforces the need for fiscal policy intervention (recall that high-debt countries would enjoy a higher fiscal multiplier) and the need to increase countries' debt.

This anti-fragmentation instrument may increase the fragmentation within the EA because it may create a situation with two converging equilibriums. On the one hand, countries with sufficiently high debt have incentives to increase debt because the gains from this instrument may exceed the gains from complying with European fiscal rules. This instrument may create disincentives for countries to comply with the European fiscal rules, weakening their credibility. On the other hand, countries with sufficiently low debt have incentives to lower their debt and comply with European fiscal rules because they have a debt level far enough to gain from the new anti-fragmentation instrument. Thus, the anti-fragmentation instrument may create an even more pronounced increase in debt in the most indebted countries and containment in the least indebted, which could generate even greater fragmentation within the EA.

For all these reasons, the new anti-fragmentation instrument will probably require greater coordination between the European Commission and the ECB so that these monetary measures can be combined with greater control and supervision of spending, namely more persistent government spending. Thus, an instrument that separates two distinct monetary policy regimes applied to countries with differentiated debt levels cannot be isolated from other fiscal control measures; for example, mechanisms such as the Excessive Deficit Procedure should be reinforced by the European Commission.

7. Conclusion

This dissertation has studied how the debt level of each country affects the impact of unconventional monetary policy on fiscal multipliers. To this end, the previous literature was analyzed both for the effect of monetary policy on multipliers and the effect of debt on multipliers. Then, I estimated fiscal multipliers using an I-VAR methodology. This methodology allows - through the three interaction terms: between the government spending and shadow rate; shadow rate and public debt and, the last, between government spending, shadow rate and public debt - to derive IRFs to an unexpected government spending shock for the different macroeconomic variables and for different levels of debt and monetary policy regimes at different percentiles of the interactive variables' distribution. Thus, the monetary policy period characterized by unconventional monetary policy is identified by the ELB regime, and the differentiation between low and high-debt countries is made through the 60% threshold as defined in the Maastricht criteria as the reference value to which countries should orient themselves when setting the target.

The results found can be divided into three distinct groups. First, the results suggest that fiscal multipliers are larger in ELB than in normal times. Two critical effects may explain such result: (1) the interest rate responded differently in the face of an unexpected shock to government spending because, in normal times, the Central Bank tended, on average, to respond with a contractionary Monetary Policy, whereas in the ELB this did not happen; (2) the persistence of government spending is higher in ELB.

Second, I find that the multiplier is higher in high-debt countries relative to low-debt countries, which is not in accordance with the literature. Three reasons may justify this difference. First, the increase in public debt ratios coincided with the ELB, meaning that high-debt countries, on average, have benefited from a more favorable monetary policy. Second, countries with more debt tend to have more difficulty containing spending than less indebted countries, which consequently generates a higher multiplier. Finally, the methodology used in this dissertation (IVAR) is not the same as the one commonly used in the literature (SVAR). In the SVAR methodology, one has to estimate different models for observations with different characteristics, which may generate bias caused by other endogenous variables. The IVAR, however, is a safeguard to this problem because it is possible to estimate the model using all observations and then compute the multiplier for the case where a high public debt state coincides with unconventional monetary policies.

Regarding the last group of results, I find that both high and low-debt countries benefit from the ELB regime. In the short term, unconventional monetary policies benefit high-debt countries more than low-debt countries. However, it is not true that unconventional monetary policy benefited the most highly indebted countries in general since, when analyzed over the medium term, the higher benefit is transferred to the less indebted countries. Two reasons can justify this result. On the one hand, in the immediate term, the most indebted countries were able to increase persistence in government spending. On the other hand, the less indebted countries gained some relief from unconventional monetary policies, which allowed them to feel less need to raise taxes and to take on more debt relative to the more indebted countries.

The present dissertation has policy implications for designing the new anti-fragmentation policy for the ECB. The implementation of different regimes for high and low-debt countries can generate several policy problems. First, it may create a greater incentive for the more indebted countries to become more spendthrift. Second, it may lead to greater fragmentation of the EA, as the more indebted countries have incentives to become more indebted than the less indebted countries. Finally, the implementation of this instrument may require greater coordination between the ECB and the European Commission to increase the control and supervision of indebtedness by governments.

Finally, I highlight the broader research agenda associated with the impact of public debt in conditioning the effects of monetary policy on fiscal multipliers. For example, I argue that introducing the public debt interest rates, which naturally differ from country to country, may allow further conclusions on the subject, since the shadow rate could have caused a larger decrease in the interest rates of the most indebted countries and this effect is not being considered by the literature. Moreover, it might also be enriching to extend the study through a division between conventional and unconventional monetary policy to understand the effects of each one in a more isolated way. Finally, introducing the quadratic effect in the interaction terms allows for assessing the possibility of a turning point from which the increase in debt, under these conditions, changes its effect on the multiplier.

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9. Annexes

Annex 1: Variables for each country that were considered for the informational dataset used to extract common factors (250 series)

National Account: Domestic Demand; Export of Goods and Services; Imports of Goods and Services; Gross Capital Formation; Final Consumption Expenditure of Households.

Government Statistics: Government Consolidated Gross Debt: Central Govt.

Output and income: Industrial Production Index: Manufacturing; Industrial Production Index: Mig-Intermediate Goods; Nominal Unit Labor Cost based on persons; Production - Total Industry Excl. Construction; Production of Total Construction; Wages and Salaries; Change in Inventories.

Employment and hours: Early Estimates of Labor Productivity - Total Economy; Employees Domestic Concept; Unemployment: Total.

Stock prices: S&P BMI - Price Index.

Exchange rates: NEER: 28 Trading Partners; NEER: 37 Trading Partners.

Money and credit quantity aggregates: Money Supply: M1 - Contribution to Euro M1; Money Supply: M2 - Contribution to Euro M2; Money Supply: M3 - Contribution to Euro M3; Official Reserve Assets.

Interest Rate: Harmonized Government 10-Year Bond Yield.

The following series are converted from monthly to quarterly frequency: Harmonized Government 10-Year Bond Yield; Industrial Production Index: Manufacturing; Industrial Production Index: Mid-Intermediate Goods; Money Supply: M1 - Contribution to Euro M1; Money Supply: M2 - Contribution to Euro M2; Money Supply: M3 - Contribution to Euro M3; Official Reserve Assets. Moreover, the S&P BMI - Price Index series is converted from daily to quarterly frequency.