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ECONOMICS

EU Fiscal Mechanisms to Face the COVID-19 Economic Crisis – Characterization and Assessment

Daniel José Reis Loureiro

M

2021

U.PORTO

FEP FACULDADE DE ECONOMIA UNIVERSIDADE DO PORTO

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Daniel José Reis Loureiro

Dissertation

Master in Economics

Supervised by
Ana Paula Ribeiro
Vítor Carvalho

June 2021

Pela minha mãe,

Que nunca deixou de me guiar, mesmo nos momentos mais ingratos da vida.

Pelo meu pai,

Que sempre acreditou em mim e sempre me apoiou até ao limite.

Pela minha namorada,

Que sempre me desafiou e me segurou nas horas mais difíceis.

Biography

I was born in 1998, in the beautiful city of Braga. Through my youth, I have always dedicated a lot of attention to the studies, either by my own willingness or by my parents' encouragement, for which I will always be grateful. However, some subjects have always motivated me more than others, with mathematics and economics being a good example.

Hence, doing the bachelor's degree in Economics was an obvious choice and that is why I ended up applying for the Faculty of Economics of the University of Porto. In 2019, I received the Professor Jacinto Nunes Award, given by Bank of Portugal, for being the student with the highest grade.

After the bachelor's, I applied to the master's degree in Economics, at the same Faculty, to which this dissertation is the final the step before it is completed.

Since the Economic science have become more interesting as I have been studying more, I applied to the PhD in Economics at FEP, which I will start in September 2021.

Regarding the professional path, my first experience was a summer internship at the Department of Statistics of Bank of Portugal. After an interruption for the first year of the master's, I resumed the professional word and I have been working at the Cabinet of Information and Strategic Studies of the Department of Economics of Porto City Council.

The passion to serve the public and to use my knowledge for the common well-being motivates me to study, investigate and have an active role in the public policy making.

Acknowledgements

To Professor Ana Paula Ribeiro and Professor Vítor Carvalho, my supervisors.

One can only understand the true challenge of doing a master's dissertation when it has to do it. The challenges, the deadlocks and the doubts can only be successfully surpassed with brilliant recommendations and constant availability, something the Professors have brought me. I will always be grateful for their dedication, commitment and passion for the academy and its students.

To Rui Monteiro, the Director of the Department of Economics of Porto City Council.

My first hierarchical superior and a brilliant leader. I will always remember the availability to adjust my professional calendar to my academic occupation and, most important, to give me precious advices about how to overcome the challenges of this dissertation.

The willingness to help the others without expecting something in return is something I urge him to maintain, since it is one of the best characteristics a person can have.

To the Faculty of Economics of the University of Porto.

All the Universities have their downsides, and FEP is not an exception. However, for the past five years, I have grown academically and personally in a way I could not predict and counting with the support of the Professors, the staff and all of my brilliant colleagues.

Abstract

The COVID-19 pandemic and the measures imposed to face it caused a major economic shock. Even though this crisis would have to be tackled, not all countries in the EU had the fiscal space to do it. Thus, the EU decided to implement a common fiscal response.

Therefore, our dissertation intended to study how to perform a centralized intervention and what would be its impacts on the most vulnerable economies. First, it was necessary to understand the rationale for a common policy and, subsequently, to study which mechanisms were pointed out in the literature to do it.

The literature review highlighted the provision of ESM loans and the distribution of grants financed by the emission of Eurobonds as the most adequate mechanisms. Besides, an analysis of the actually implemented policies was also conducted.

Afterwards, we performed estimations of three VAR models, to analyse which would be the best design for a common instrument, from the Portuguese perspective, by calculating the average fiscal multiplier. Although some of the results were not statistically different from zero, according to models considering the total government expenditure, the issuance of Eurobonds with the provision of grants would be the best possible mechanism. The implemented policy would be the second-best, while the distribution of loans without conditionality would be the worst mechanism, because of the public debt overload. ESM loans would perform better than this last option.

Regarding the model disentangling the expenditures per its categories, according to the weights predicted in the Portuguese Recovery and Resilience Plan published for public discussion of February 15th, 2021, the issuance of Eurobonds with the provision of grants would also be the best mechanism, although the average multiplier would be similar between all the instruments.

JEL codes: C32 E61 E62 E63 F55

Keywords: COVID-19; Eurobonds; European Stability Mechanism; European Union; Fiscal Policy; VAR model

Resumo

A pandemia COVID-19 e as medidas impostas para a enfrentar provocaram um intenso choque económico. Apesar de esta crise ter de ser combatida, nem todos os países da União Europeia dispõem da capacidade orçamental para o fazer. Como tal, a União Europeia decidiu implementar uma resposta orçamental comum.

Assim, esta dissertação pretendeu estudar como implementar uma intervenção centralizada e quais seriam os seus impactos nas economias mais vulneráveis. Primeiramente, foi necessário entender qual o racional para uma política comum e, posteriormente, estudar que mecanismos eram apontados na literatura para o fazer.

A revisão de literatura evidenciou a concessão de empréstimos pelo Mecanismo Europeu de Estabilidade e a distribuição de subsídios financiados com a emissão de *Eurobonds* como os mecanismos mais adequados. Ademais, foi realizada uma análise da política efetivamente implementada.

De seguida, três modelos VAR foram estimados, de modo a analisar qual seria a melhor estrutura para um instrumento comum, do ponto de vista português, calculando o multiplicador orçamental médio. Apesar de alguns dos resultados não serem estatisticamente diferentes de zero, de acordo com os modelos que consideravam a despesa pública total, a emissão de *Eurobonds* com a concessão de subsídios seria o melhor mecanismo possível. A política efetivamente implementada seria a segunda melhor hipótese, ao passo que a distribuição de empréstimos sem condicionalidade seria o pior mecanismo, devido à sobrecarga da dívida. Empréstimos do Mecanismo Europeu de Estabilidade seriam preferíveis a esta última opção.

Quanto ao modelo desagregador das despesas públicas, considerando o Plano de Recuperação e Resiliência publicado para discussão pública no dia 15 de fevereiro de 2021, a emissão de *Eurobonds* com a concessão de subsídios seria também o melhor mecanismo, ainda que o multiplicador orçamental fosse semelhante para todos os instrumentos.

Códigos JEL: C32 E61 E62 E63 F55

Palavras-chave: COVID-19; Eurobonds; Mecanismo Europeu de Estabilidade; Modelo VAR; Política Orçamental União Europeia

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Abbreviations

EA: Euro Area

ECB: European Central Bank

ERDF: European Rainy-Day Fund

ESM: European Stability Mechanism

EU: European Union

GDP: Gross Domestic Product

IRF: Impulse Response Functions

OMT: Outright Monetary Transactions

PEPP: Pandemic Emergency Purchase Program

SPV: Special Purpose Vehicle

UK: United Kingdom

USA: United States of America

WHO: World Health Organization

1. Introduction

On December 31, 2019, the Chinese health authorities warned the World Health Organization (WHO) of an outbreak of cases of pneumonia of unknown cause. Even though, initially, there was some hesitation while assessing the potential for contagion of the virus, on March 11, 2020, the WHO declared COVID-19 as a pandemic. Because of the evolution of the disease, several countries started to impose restrictive measures, to slowdown the propagation of the virus. On March 18, 2020, in Portugal, the President of the Republic declared the state of emergency, leading to the lockdown of the population.

Although current technology allows, nowadays, to perform numerous activities from home, this lockdown had, inevitability, significant economic impacts. On the second quarter of 2020, the Gross Domestic Product (GDP) of the European Union (EU) fell 14.4% when compared with homologous period (Eurostat, 2020). These economic damages happened in all the economies; in Portugal, the GDP plunged, in the same quarter, 16.3% when compared to the same period in the previous year (Banco de Portugal, 2020).

The negative effects were registered across 2020, with the GDP falling, in that year, 6.1% in the EU and 7.6% in Portugal (Eurostat, 2021a). A second severe wave of infections, particularly in Portugal, in the beginning of 2021, and measures put in place to tackled it (particularly a new generalized lockdown) caused a fall of the Portuguese GDP in the first quarter of 2021 by 5.4%, when compared to the homologous period. The GDP of the EU plunged 1.7% in that same period (Eurostat, 2021b).

These severe damages required strong public support measures during the lockdown, particularly through employment protection programs (the simplified lay-off program, in Portugal, was the measure with the greatest fiscal impact, representing a monthly expenditure of more than 500 million euros[1]). Besides, during the recovery stage it will be necessary a contracyclical fiscal policy, not only to speed up the recovery, but also to promote a quicker stabilization of the public deficit and debt in the future (Boone & Pereira, 2020).

While it is necessary to finance these interventions, the financial capacity varies across the EU countries. Even though some Member-States have a strong financial capacity, and thus a much larger fiscal power to support their economy, other states are in a more vulnerable position. The latter, still recovering from the sovereign debt crisis, fearing debt sustain-

[1] Source: https://www.tsf.pt/portugal/economia/lay-off-custa-563-milhoes-por-mes-e-a-maior-fatia-da-despesa-de-combate-a-covid-12168551.html (accessed on November 6th, 2020).

ability problems, may not, without appropriate support, implement a sufficiently expansionary fiscal policy, worsening the recession and the economic and social impacts of the pandemic (Grund, Guttenberg & Odendahl, 2020).

Hence, and since the EU decided to implement an active block-intervention in the fight against this economic crisis, it is important to assess which are the main fiscal mechanisms that can be used and what is their applicability to the more vulnerable economies, particularly to the Portuguese economy.

Therefore, this dissertation intends to answer the following investigation questions: i) Is there a rationale for a common EU policy to cope with this economic crisis? ii) If the EU intends to draw a common answer to the crisis, which fiscal mechanisms does It have at its disposal and what are the main advantages and disadvantages of each one? iii) Considering the solutions described in the literature and the effective policies in place, what is the best design for an EU fiscal mechanism?

These questions are certainly not new in the Economic Science. Since the creation of the European Monetary Union (EMU), with which Member-States lost their monetary policy autonomy and began to face a more limited fiscal policy, several authors have been debating about what are the best solutions so that EU can have at its disposal fiscal mechanisms to face significant exogenous, and possibly asymmetric, shocks (De Grauwe & Moesen, 2009; De La Dehesa, 2011; Delpla & Weizsäcker, 2011). The onset of the pandemic and its evolution led to the intensification of this debate, and, thus, new arguments for each instrument emerged.

However, even if these mechanisms are already significantly studied in the literature, this dissertation, for the systematization that promotes, but also for the specific study of the feasibility of these mechanisms during a pandemic circumstance, that is, during a severely adverse economic situation, will seek to add value to the literature. A significant portion of this value will come from the confrontation between advantages, disadvantages, and optimal institutional design of these instruments. Besides, the concrete study of the applicability of the main mechanisms in a vulnerable economy, particularly the Portuguese economy, will contribute to that value added. This will add to the debate that already exists in the literature, contributing to a decision-making process based on the choice of the most appropriate instrument to be implemented.

In order to answer the questions previously mentioned, the study will focus on two major steps. On the one hand, a comprehensive review of the existent literature will allow a

systematization of key contributions, clarifying what is the rationale for a common intervention at the European level and what are the comparative advantages of each mechanism potentially available to proceed with that intervention. On the other hand, the development of an empirical study, applied to the Portuguese economy, will allow to assess the feasibility of common mechanisms to the EU as well as the potential impacts of the alternative mechanisms as an expansionary policy.

This dissertation is organized in seven main sections. After the introduction, the second section summarizes the contributions of the literature to understand the rationale for the common intervention. In section three, the main fiscal mechanisms to perform a centralized intervention are presented and compared. In section four, the actually implemented instruments are described. In section five the empirical methodology is described and in section six the results of the application of that methodology are discussed. Finally, in section seven, a brief conclusion is presented.

2. Rationale for a common intervention

The pandemic and the measures imposed to slow down the propagation of the virus, particularly the lockdown, caused a severe and historic economic crisis. On the second quarter of 2020, the GDP of the EU fell 14.4% when compared to the homologous period (Eurostat, 2020). These damages happened in all the economies; in Portugal, the GDP fell, in the same quarter 16.3% when compared to the homologous period (Banco de Portugal, 2020). These impacts affected the entire year, with the GDP of EU falling 6.1% in 2020 and with the GDP of Portugal plunging 7.6% in the same period (Eurostat, 2021a).

A second severe wave of infections, particularly in Portugal, in the beginning of 2021, and measures put in place to tackled it extended the negative impacts to the first quarter of 2021, causing a fall of the GDP of Portugal by 5.4%, when compared to the homologous period. The GDP of the EU plunged 1.7% in that same period (Eurostat, 2021b).

Bonardi, Brulhart, Danthine, Jondeau and Rohner (2020) referred that these brutal economic impacts of the pandemic, particularly of the lockdown, had to be tackled by the governments. Among others, liquidity support measures to reduce the increase in the unemployment (Faria-e-Castro, 2021) are essential policies to implement. Müller (2020) also draws attention to the fact that the adverse expectations about the future might ended up reducing the investment and the consumption. So, governments should consider that avoid bankruptcies, preserve the supply and the demand, and avoid an extremely high burden of debt for consumers and companies was essential to prepare the recovery (Bonardi *et al.*, 2020).

Supporting this effort, the European Central Bank (ECB) created the PEPP [2] (*Pandemic Emergency Purchase Programme*), to buy public and private sector securities. However, this program does not prevent the increase of the public debt, that is, does not prevent debt sustainability problems, though it helps reducing liquidity issues that governments may face (De Grauwe & Diessner, 2020).

Thus, the dimension and the intensity of the economic crisis caused by the COVID-19 pandemic led many authors to consider a scenario in which the EU would implement common fiscal mechanisms to face the crisis. The rationale for this implementation will now be scrutinized in the current section.

Bénassy-Quéré *et al.* (2020b) highlighted that the fight against the economic crisis demands from the governments the capacity to finance their expenses, because, even though

[2] Source: https://www.ecb.europa.eu/mopo/implement/pepp/html/index.en.html (accessed on October 1st, 2020)

the ECB intervention is helpful, the Central Bank cannot implement asymmetric interventions in a large scale, without being helped by a common fiscal policy.

This asymmetry results, according to Gros (2020), from the fact that the economic impacts of the pandemic are different across countries, with the most affected being the ones with less capacity to fight the crisis in an autonomous way. Particularly, countries from the periphery, which will be the most affected ones, had not yet recovered in full from the economic downfall caused by the global financial crisis of 2007/08 (Buti, 2020).

Hence, although no Member-State was able to avoid the economic crisis:

> "The crisis is likely to affect European countries very differently for at least two reasons. First, it visits them in very different economic contexts. In some European countries, such as the Netherlands, the crisis follows years of relatively stable economic growth. In others, such as Germany, it hits home at the beginning of a downturn that's already been priced in. Yet more countries, such as Italy or France, are facing the Corona crisis in the midst of a prolonged period of economic weakness. Second, the economic costs of shutdowns differ across sectors, firms and occupations." (Hainbach & Redeker, 2020; p.1)

Alesina and Giavazzi (2020) disagreed with this idea of asymmetry and defend, on the date of the writing (one month prior to the article written by Gros (2020)), that the shock is symmetrical. Despite this difference, the authors justify the creation of a European program based on this symmetry. Besides, since countries were being hit by an historically intense symmetric shock, that would be the best moment to create a European safe asset.

However, even if we assume that the shock is symmetric, countries will still have different capacities to deal with the crisis that results from the shock. That disparity, pointed out by Gros (2020), can be demonstrated, for instance, by the fact that countries do not have the same financing capacity. Notwithstanding, regardless the financial condition of each country, it would be on the interest of all that all of them implement the restrictive measures adequate to slow the pandemic down (Bénassy-Quéré *et al.*, 2020a). Given the different economic and financial conditions of each country, these measures, that worsen the economic downturn, require European solidarity.

Mota and Peitz (2020) agreed it would be desirable that certain support measures would be implemented by the EU. The authors exemplified that the provision of liquidity to

firms should have been made by a European fund, to guarantee a level playing field.

If liquidity support measures are designed and implemented by each Member-State individually, companies from the same market, but based in different countries, would have access to different amounts of support. Furthermore, in such a profound and exceptional crisis, the support given to companies is broader than mere support for liquidity or employment and so, the absence of a European program could harm the integrity of the single market, by undermining the level playing field (Mota & Peitz 2020). Companies based in the most affected countries would face a reduction in its competitiveness and investment capacity in the single market (Verwey, Langedijk & Kuenzel, 2020).

These concerns about the integrity of the single market were also highlighted by Celi, Guarascio and Simonazzi (2020; p. 411-412):

> "(…) not all the countries of the Union have the resources needed to intervene in support of their economy, prompting concern that countries with the deepest pockets might be getting an unfair advantage in the EU's single market."

Moreover, the intensity of the economic uncertainty that results from the pandemic is so significant that governments should avoid being themselves a source of uncertainty. Naturally, the unpredictability of the situation meant that governments were unable to eliminate the uncertainty associated to their policies. Nevertheless, some measures, like disclosing the policies that they were willing to implement and promoting an international cooperation could be applied to reduce that uncertainty (Müller, 2020). Thus, drawing a common answer, agreeing policies and instruments that could be implemented contributes to the reduction of uncertainty and, by this way, to soften the economic recession and to speed up the recovery:

> "(…) a joint signal of demand support would still be effective to boost confidence and support the economy also in its recovery phase, when the epidemic recedes." (Demertzis, Sapir, Tagliapietra & Wolf, 2020; p. 8)

Suspending the Stability and Growth Pact Rules[3], particularly deficit rules, could be

[3] The Stability and Growth Pact comprises a diversity of rules to ensure that Member-States have sound public finances. Source: https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/eu-economic-governance-monitoring-prevention-correction/stability-and-growth-pact_en (accessed on November 28th, 2020).

one of the first implemented measures (Bénassy-Quéré *et al.*, 2020b).[4] Alesina and Giavazzi (2020), agreeing with this idea, argued that promising larger expenditures might eventually lead to lower expenditures. However, even if Member-States had the permission to run significant deficits, many of them, particularly the most indebted ones, might experience difficulties obtaining such a high level of funding. Since the mere authorization for spending would not lead to a sufficiently expansionary fiscal policy, broader instruments would be required to implement a common response (Bénassy-Quéré *et al.*, 2020b).

Grund, Guttenberg and Odendahl (2020) added that, in the absence of a common intervention, a strong divergence would occur. Countries, without any help, would adopt economic support measures according to their economic and fiscal capacity. The most vulnerable ones, given their reduced economic and financing capacity, would only implement the most urgent policies, because, as Garicano (2020a) stated, sufficiently expansionary policies to reduce unemployment and bankruptcies could provoke debt sustainability problems.

On the other hand, the most robust countries would implement more generous policies for their companies and workers and would better stimulate the economy for the recovery. Therefore, a significant divergence would happen (Grund *et al.*, 2020; Hainbach & Redeker, 2020), with the strongest states being able to limit the economic downturn and to promote a quicker recovery, while in the weaker states a substantial portion of the private sector would go bankrupt, the unemployment would raise considerably, and severely negative long term economic impacts would also arise.

Additionally, the fact that a Member-State implements the appropriate measures to tackle the crisis would end up influencing many other Member-States:

> "(…) in Europe's integrated economies, measures will spillover between Member-States. Therefore, governments should have a keen interest in ensuring that their neighbours and trading partners also deliver a forceful response to avoid a deeper recession." (Guttenberg & Johannes, 2020; p. 3).

Regarding these spillovers, while in normal circumstances they may be positive, but with low intensity, if all the Euro Area (EA) countries adopted, simultaneously, expansionary fiscal policies, they would increase considerably (Alloza, Ferdinandusse, Jacquinot & Schmidt, 2020). We can, thus, conclude that, given the necessity of expansionary policies to

[4] As described in section 4, these rules were in fact suspended, as suggested.

tackle the crisis provoked by the pandemic, spillovers were of particular importance.

Likewise, regardless its precise dimension, since the measures adopted by a country would affect the situation of the countries around, policy coordination would naturally lead to the increase of the efficiency of the implemented measures (Demertzis *et al.*, 2020).

Not only the kind of response would be important, but also the timing of implementation of that reaction would be crucial. A common response should be implemented as quickly as possible because the time is fundamental to determine the effectiveness of a policy to prevent the economic collapse (Giavazzi & Tabellini, 2020).

The speed of the action of the European institutions would also be fundamental, to avoid that populist parties leverage on the panic and uncertainty created by the pandemic to harm the citizens' perception of the EU (Alesina & Giavazzi, 2020).

Additionally, with the time passing by, policy recriminations might increase because of policy errors or moral hazard concerns, making an agreement for a common response more challenging to accomplished (Giavazzi & Tabellini, 2020). Moral hazard is based on the risk that countries that receive the funds would not apply sufficient fiscal discipline, waiting for the other countries to pay the bill in the future (Gourinchas, 2020).

This argument about moral hazard is one of the most frequent to justify the position against risk sharing or a common fiscal policy (Garicano, 2020a), because a European fiscal capacity would, supposedly, reward the reckless countries. Garicano (2020a) disagreed with this idea because, at least in the status provoked by the pandemic, it is not possible to argue that countries did not act while waiting for supranational intervention.

Although the kind, the dimension and the timing of the common intervention are of great importance, the duration of that response cannot be neglected. Boone and Pereira (2020) underlined that countries that invest more in the recovery stage, than the ones that reverse the policies too soon, not only can recover their economy more quickly, but can also stabilize their finances more rapidly in the future. These authors argued that the fiscal consolidation applied by some Member-States immediately after a brief expansionary fiscal policy in response to the 2008 financial crisis weakened the EA, resulting in higher unemployment, lower investment, lower inflation and incapacity to promote structural reforms.

Therefore, the absence of cooperation and the reduced expansionary fiscal policy that results from that absence would threat the social, political, economic, and financial stability of the EU, with negative consequences for the European project in the long-term (Giavazzi & Tabellini, 2020; Gostyńska-Jakubowska & Scazzieri, 2020; Verwey *et al.*, 2020).

Moreover, these negative impacts could become politically unsustainable, leading to economic nationalisms and, possibly, to the exit of the EU (Grund *et al.*, 2020).

Regarding these concerns about the long-run, Beck (2020) pointed out that the ones referring that debt mutualization and the sharing of fiscal costs would cause the increase of the political populism ignore that, in case of a new sovereign debt crisis, populism would increase even more, with all the underlying risks for the European project.

A common fiscal policy to tackle the crisis provoked by the pandemic would also be significantly important for the geoeconomic position of the EU. Since some states have a lower capacity to intervene than others, the EU could lag behind the United States of America (USA) and the United Kingdom (UK) in its fiscal response (Bénassy-Quéré et al, 2020a), harming the competitiveness of its firms.

Finally, Gostyńska-Jakubowska and Scazzieri (2020) recognized that arguing that this crisis would lead to the rupture of the EU would be an overstatement. Nevertheless, the way the Union as whole responds to the crisis provoked by the COVID-19 pandemic will shape the future of the EU, particularly of the EA, and will profoundly influence the citizens' perception of the project. If the EU failed to overcome this adversity, it would become weaker and it could lose legitimacy in the opinion of its citizens. On the other hand, if the EU implements a robust and determined action, by coordinating the action of all Member-States and increasing the value of those efforts, has the chance to become stronger and sounder.

Even though the arguments mentioned before were clearly in favor of a common intervention, Perotti (2020) seemed to be against this common action. The author argued that a common answer to the crisis would increase the survival risk for the EU in the long term. The most vulnerable countries would be capacitated to tackle the crisis by themselves, as long as the ECB kept his asset purchase program, though the debt sustainability problems would always be present. To reduce this risk this author suggests that these countries should behave prudently, negotiating their policies with their partners, so that the other countries would not oppose to an extension of the accommodative monetary policy.

Despite this argument against a centralized intervention to tackle the economic crisis provoked by the COVID-19 pandemic, most of the authors analyzed in this dissertation agreed that, as stated before, that intervention is not only necessary, but also urgent.

3. Common intervention mechanisms

Assuming, from the literature analyzed in the previous section, that there is indeed a rationale for a common intervention, it is necessary to consider the way that intervention could be materialized, that is, it is necessary to study what fiscal mechanisms are available and what are their advantages and disadvantages. Naturally, and as it will be proven in this section, there are several mechanisms that can be used for that purpose and their advantages and disadvantages may vary according to their design and to other policy decisions.

In fact, even if the countries agree on the necessity of a common intervention to face the economic and financial demands of the pandemic, agreeing on the implementation of that assistance requires a better negotiating capacity by the Member-States:

> "In April 2020, a consensus emerged in the Eurogroup to offer financial support to Member-States that are hit severely by the corona crisis, so that those who do not have sufficient fiscal space can take appropriate action to fight this crisis. However, there is no consensus as of yet regarding the instrument to provide financial support. Two options are being considered for crisis relief funding: (1) namely provide funding through existing institutions, such as the European Investment Bank (EIB) or the European Stability Mechanism (ESM); or (2) create what is essentially a new institution, namely Eurobonds." (D'Erman, Schure & Verdun, 2020; p. 270 - 271)

Hence, in this section the main instruments that could be used to implement an EU fiscal response to the crisis will be explored by analyzing their advantages and disadvantages, but also operational issues related to the implementation of these mechanisms. From the literature review carried out during this dissertation, the use of the European Stability Mechanism assistance, detailed in sub-section 3.1., and the emission of common debt (usually known as Eurobonds), explained in sub-section 3.2, stand out as the main fiscal mechanisms to support a centralized response.[5]

[5] The creation of a European Rainy-Day Fund (ERDF) was also studied and considered, because of its disadvantages, inadequate to face the COVID-19 crisis. Nevertheless, this mechanism and its advantages and disadvantages are explored in the Appendix.

3.1. The European Stability Mechanism

In the absence of a fiscal policy coordination instrument in the EA or in the EU, the reaction would have to be implemented by Member-States (Guttenberg & Hemker, 2020). However, in case of an individual response by each Member-State, the brutal impacts on the deficit and on the public debt might force the countries to seek for the help of the ESM, in order to obtain funding under the best possible conditions (Garicano, 2020a).

The ESM was founded during the sovereign debt crisis, in 2012, to provide financial aid to EA Member-States with difficulties accessing the financial markets. To overcome this problem, the ESM would provide loans, conditional to the implementation of a macroeconomic adjustment programs.[6]

3.1.1. Advantages of the European Stability Mechanism in its current version

The ESM in its current version would function as a safeguard, that would guarantee that, if Member-States implemented the adequate fiscal policies, they would not face pressures and speculative attacks in the financial markets that could, in the limit, cut the access to financing (Guttenberg & Hemker, 2020).

Guttenberg and Hemker (2020) even argued that the EU current capacity to guarantee the access of all Member-States to the markets is a major improvement when compared to the 2008 financial crisis. Not only the ECB and the ESM have the necessary resources to keep the financing costs low (Odendahl & Springford, 2020), as the ESM could easily increase those resources (Erce, Pascual & Monés, 2020b).

Besides, since the ECB has already purchased more sovereign bonds of a Member-State than what it should have according to the capital key[7], the fiscal policy should keep up with this effort. To ensure that countries have the necessary resources to execute that fiscal policy, the ESM could assist by providing loans, to guarantee liquidity assistance to companies and to pay salaries to workers. Ideally, these loans would be granted to all Member-States, and not only the most vulnerable ones (Odendahl & Springford, 2020).

Precisely with this idea of ensuring the necessary financial security for the countries to implement the expansionary fiscal policies, Guttenberg and Hemker (2020; p.3) proposed

[6] Source: https://www.esm.europa.eu/assistance/lending-toolkit (accessed on December 20th, 2020).
[7] Capital key guides the ECB in its unconventional monetary policy, since assets from each Member-State are purchased according to the share of each one in the ECB's capital structure. Source: https://www.ecb.europa.eu/mopo/implement/pepp/html/index.en.html and https://www.ecb.europa.eu/press/pr/date/2018/html/ecb.pr181203.en.html (accessed on December 12th, 2020).

a safety net, according to which:

> "Member-States should send a clear and unequivocal message that they want all governments to deliver a forceful fiscal policy response regardless of their current fiscal situation, and that they are ready to use all available ESM instruments to ensure the necessary market access".

On the other hand, using the ESM would give the ECB the legal basis to activate its OMT[8] program, purchasing unlimited amounts of sovereign debt, further reducing the risk premia. Thus, the ESM would contribute to significantly reduce the fiscal effort necessary to reduce or stabilize the debt-to-GDP ratio after the crisis (Erce, Pascual & Marimon, 2020a).

3.1.2. Advantages of the European Stability Mechanism with rewritten rules

The ESM was created based on considerations regarding fiscal discipline and moral hazard, which do not make sense in the pandemic situation (Garicano, 2020a; Gourinchas, 2020). The propagation of the virus has nothing to do with incentives, borders or fiscal discipline, that is, it has nothing to do with the underlying motivations of the mechanism (Gourinchas, 2020). Consequently, the rules of this mechanism would have to be rewritten to make it a good instrument to be used in an EU common response (Garicano, 2020a).

A first point to considerer is the maturity of the loans. Though Odendahl and Springford (2020) argued that the current credit lines with a maturity of one year, renewable every year, would be enough, Bénassy-Quéré *et al.* (2020b) rejected this idea. The fact that the ESM can only lend with a maturity of one year is one of the malfunctions of this mechanism.

Thus, loans given to countries should have the longest maturity possible. Precisely to ensure that, Corsetti and Erce (2020) proposed that the ESM borrows with the lowest duration possible, taking advantage of the extraordinary low short term interest rates environment, at the time, but then lends those resources to Member-States with a very long maturity. In reality, the ESM would perform a maturity transformation, just as banks do in their normal activities.

However, even among those who support rewriting of the rules, opinions diverge.

[8] Outright Monetary Transactions is a program, announced in 2012, according to which the ECB would buy, without any limits, short-term debt from Member-States receiving ESM loans. Source: https://www.ecb.europa.eu/press/pr/date/2012/html/pr120906_1.en.html (accessed on December 20th, 2020).

Garicano (2020a) argued that the European Commission proposal, from 2017, to create a European Monetary Fund would be enough and it would allow an ambitious response. For that to be possible, a new instrument would have to be added to the ESM and the conditionality usually required (essential to satisfy the "no-bailout" clause in the Treaty) could be related to the investment in critical areas affected by COVID-19.

This conditionality is one the big dilemmas when considering the use of the ESM. The loans provided by this mechanism should not require any loss of sovereignty, that is, should not have associated any kind of conditionality (Guttenberg & Hemker, 2020), or should be linked to the minimal possible ex-post conditionality (Bénassy-Quéré *et al.*, 2020b; Smaghi, 2020). The imposition of austerity and reforms as an ex-ante condition to access the program would cause divisions among Member-States (Marimon, 2018) and it would hamper the recovery phase (Corsetti & Erce, 2020).

Besides, using the ESM to tackle the crisis would not have problems related to stigma if the conditionality required to receive the loans was specifically related to the COVID-19 crisis and its resolution. Still, to allow this minimal conditionality, countries should be prepared to accept reinforced surveillance (Erce *et al.*, 2020b).

The stigma associated to these loans is comprised not only by the signal sent to the financial markets, but also by the political stigma. To overcome the last one, which is also a concern, all Member-States would have to participate in an eventual program (Beck, 2020; Bénassy-Quéré *et al.*, 2020b) and the conditionality should be reduced to a mere ex-post monitoring of the use given to the resources (Smaghi, 2020).

Finally, since ESM support (which would allow the ECB to activate its OMT program, as mentioned before) usually requires the analysis of a macroeconomic framework and the performance of risk assessments, the rewriting of the rules should take into account not only that these assessments should be expedite, but also that controversial assessments, like the debt sustainability, should be avoided (Erce *et al.*, 2020b).

3.1.3. Disadvantages of the European Stability Mechanism

Despite the advantages mentioned above, Giavazzi and Tabellini (2020) underlined that rewriting the rules, as proposed by Bénassy-Quéré *et al.* (2020b), though it might be a step in the right path, would have numerous disadvantages. One of those weaknesses, recognized by Bénassy-Quéré *et al.* (2020b), is the fact that this solution would require little coordination and solidarity among Member-States.

Besides, since this is an historical crisis, not only because of its dimension, but also due to its cause, which required a strong and fast response from the governments, the resources available at the ESM would be insufficient to cover the needs, which constitutes another disadvantage of this mechanism (Giavazzi & Tabellini, 2020). Still, these authors pointed out that these resources could be expanded, by increasing the capital of the ESM.

Nevertheless, the dimension is not the only fundamental variable to analyze the utility of the ESM credit lines. The maturity of those loans is also, as mentioned before in this dissertation, a crucial issue. Multi-generation maturities would not be possible with the current credit lines and, thus, the threat that a sovereign debt crisis would only be postponed instead of avoided is a major issue in the current design of the mechanism. If countries wanted to avoid this risk, they might end up implementing an insufficiently expansionary fiscal policy (Giavazzi & Tabellini, 2020).

One can then argue that rewriting the credit line rules, establishing an adequate maturity, would be enough to solve this limitation. However, even in that case, ESM loans would still contribute to the expansion of the national public debt and debt sustainability would remain a problem and, hence, the risk of a sovereign debt crisis would still be present (Beck, 2020). Therefore, it is easy to understand that the fact that the ESM support is implemented through loans is a strong disadvantage, since giving loans to severely indebted countries would contribute to increase their fiscal constraints, to provoke the escalation of the interest rates and to worsening debt sustainability (Delatte & Guillaume, 2020).

Moreover, the ex-post conditionality proposed by Bénassy-Quéré *et al.* (2020b), even if its minimal, could restrict the effective use of the funds (Giavazzi & Tabellini, 2020). During the pandemic, countries must get funding, not only to strengthen the healthcare, but also to provide liquidity and capital, avoiding bankruptcies and unemployment. These expenses would have to be included in the loans, that is, they could not be limited by conditionality.

Despite its negative effects, credit lines without conditionality contradicts the initial idea of the ESM. This mechanism aims to stop financial instability situations, by providing loans with tough conditionality and so it would not be appropriate to face the COVID-19 crisis (Vihriälä, 2020). The funds should remain at the accessible for its original purpose, in the event of a financial crisis (Giavazzi & Tabellini, 2020).

Another limitation is related to the national parliaments' role in this mechanism, especially in a minimal conditionality scenario. Since this is an intergovernmental institution, all the loans would have to be approved by all the national parliaments and, even worse, each

one of them could veto the loan (Garicano, 2020a; Giavazzi & Tabellini, 2020). To overcome this issue, that can be aggravated by the fact that the lockdown could lead to the (at least partial) closure of many parliaments, Garicano (2020a) proposed that each loan would only have to be approved by a qualified majority of 85%.

On the other hand, Erce *et al.* (2020b) had a different perception because, even though they recognized that the need for approval by all the national parliaments might delay the process, especially because of the political tensions expected in these periods, they argued that trying to create new loan instruments, even if in the ESM framework, or rewriting the rules of the existent ones, would further delay the process. Thus, either for the delay in the approval of the loans or for time consuming process of implementing new procedures, national parliaments constitute another disadvantage of this mechanism.

The seniority associated to ESM loans, that is, the fact that they would be the firsts to get refunded in the event of default, would undermine the effectiveness of a program that uses this instrument, as it would hamper the access to the market. This is precisely the reason why Perotti (2020) opposed to the use of the ESM to implement a common response to the crisis. He argued that the support would be of little use, not only because the decrease of the financing costs would be small, but also since the seniority would make the rest of the debt riskier. Although this problem could be reduced by extending the maturities of these loans, the best solution for this issue would be the removal of the seniority from the credit lines used during the pandemic (Corsetti & Erce, 2020).

Even though Erce *et al.* (2020a) recognized that the seniority could constitute a problem, they argued that the risk would be manageable. According to them, the fact that ESM loans would represent a small portion of a country total debt stock, the fact that seniority could be removed in case of necessity and the fact that the proposed loans (for instance in Bénassy-Quéré *et al.* (2020b) proposal) would have a long maturity would reduce the market anxiety regarding this issue.

Despite the disadvantages mentioned in this topic, Giavazzi and Tabellini (2020) recognized that the ESM rules could be rewritten, as it was already detailed during this section, and the mechanism could become a first-best to implement a common intervention. This rewriting could not happen, however, without many negotiations, uncertainty and a very long period of waiting.

3.2. Issuance of common debt - Eurobonds

Boone and Pereira (2020) referred that an alternative to the usage of the ESM would be the creation of financial instruments to mutualize a great portion of the fiscal costs of facing the crisis. Even though this proposal is an example of a solution often pointed out in the literature to tackle the pandemic crisis (which involves the emission of debt common to all Member-States of the EU, usually known as "Eurobonds" or, in this specific case sometimes called "Coronabonds"), the idea of issue "Eurobonds" started prior to this crisis, particularly since the Great Recession of 2008/09 (De Grauwe & Moesen, 2009; De La Dehesa, 2011; Delpla & Weizsäcker, 2011).

The main difference between the common debt ("Eurobonds") and the individual national debt is due to the risk sharing. This mutualization of risks allows all Member-States to have an equal level of risk, which is now calculated based on the debt level of the EU as whole (Aarle, Engwerda & Weeren, 2018). Eurobonds can be issued by a common institution (Corsetti, Erce & Pascual, 2020; Mota & Peitz, 2020) or by each Member-State but guaranteed by all the Member-States (Giavazzi & Tabellini, 2020; Gros, 2020).

According to Gourinchas (2020), a common shock should trigger a common reaction, with the best response being the issuance of Eurobonds. The main goals of this emission would be funding healthcare expenditures, prevent the economic collapse of the most affected countries and recover from the lockdown of the economy (Boone & Pereira, 2020; Gourinchas, 2020). However, even though the issuance of Eurobonds was defended by many authors as the most appropriate mechanism to implement a common response, its implementation method, especially regarding the design and the timing, it is not consensual, that is, it varies according to the author.

Therefore, in the present section, the advantages and disadvantages of the issuance of Eurobonds is analyzed, especially comparing different alternatives for the implementation of this solution. While the advantages (sub-section 3.2.1) are divided according to the responsibility for the emission and to the distribution method, the disadvantages (sub-section 3.2.2.) are focused on the distinction between individual or joint emission. The different methods of issuing common bonds were also briefly targeted by the analysis.

3.2.1. Advantages of the issuance of Eurobonds

In this sub-section, different solutions for the emission of common debt are compared, particularly in what concerns to the advantages of each alternative. Although some advantages can be generalized for more than one of the solutions that will be presented, each one of these scenarios has its own advantages.

Besides, the different issuance and distribution methods are associated to different degrees of integration (within a solution that is already very integrative) and commitment from the Member-States. Hence, this sub-section is organized from the solution that would require a softer degree of economic and political integration to the solution requiring higher levels of integration and risk sharing.

3.2.1.1. Eurobonds individually issued by Member-States

Giavazzi and Tabellini (2020) proposed that all Member-States should issue a large volume of Eurobonds. Even though the bonds were all identical, each country would be responsible for the issuance of its part. The common rating would result from the fact that these bonds would be guaranteed by the joint fiscal capacity of all the participants, which would also result in the lowest interest rates possible (Gros, 2020).

These bonds would have an exceptionally long maturity or could even be perpetuities, which would be essential because, in a shock with the dimension of that provoked by the COVID-19 pandemic, the financing of the response would be optimally distributed across several generations (Giavazzi & Tabellini, 2020).

Furthermore, by allowing a rapid emission, these bonds would minimize the risk of a new sovereign debt crisis. This risk would be reduced even more in the event of an ECB support, because that aid would contribute to lower interest rates and to a limited solvency risk. Since inflation was not a problem at the time of the pandemic, debt monetization would contribute to the optimal response and it would not undermine ECB's independence, as long as it remained free to reduce its balance whenever necessary (Giavazzi & Tabellini, 2020).

Even though this instrument could represent an additional step in the European fiscal integration, the disadvantages associated to this solution, that will be analyzed in this dissertation, led Gros (2020) to abandon this option.

3.2.1.2. Eurobonds jointly issued and funds provided by loans

Naturally, an alternative to the individual emission of common debt is the joint issuance of that common debt. However, a joint emission would raise the question of how to distribute the funds raised in the markets. The provision of loans to the Member-States that wish to receive these funds is one of the solutions to the allocation problem.

In this solution, not only access to the financial markets would be guaranteed, but the main advantage would be the savings in financing costs (Giavazzi & Tabellini, 2020). This savings would result from the risk sharing, but mainly from the maturity transformation that the EU would do, as it will be explained bellow.

Reinforcing this idea, Corsetti *et al.* (2020) stated that issuing long term bonds would be crucial to allow effective recovery fiscal policies. Notwithstanding, doing that would be contrary to what countries with excellent financing capacity, like USA or Germany, have been doing when confronted with large necessities of funding. The problem with long term bonds (or, in the extreme case, perpetuities) is that, in a context of ultra-accommodative monetary policy, it would not take advantage of the support of the Central Bank.

Thus, although the ECB would be working to reduce the short-term interest rates, Member-States, by issuing long-term bonds and not taking advantage of the low shot-term rates, would be running against that effort:

> "Why would AAA-rated treasuries that can issue debt at negative interest all the way up to 10 years want to pay comparatively higher coupons by issuing consols?" (Corsetti *et al.*, 2020; p. 223)

ECB's Quantitative Easing and the negative interest rates means that issuers with strong access to the market and low roll-over risk would not have any justification to issue long-term bonds because they would miss the opportunity to benefit from low interest rates. These strong issuers could borrow with low maturities and very low interest rates and then roll-over the debt as the bonds reached maturity, reducing the premia paid. Yet, the same cannot be said about weaker issuers, which face higher financing costs and higher levels of uncertainty about the access to the capital markets in the future. For these countries, long-term debt is more appropriated (Corsetti *et al.*, 2020).

However, Corsetti *et al.* (2020) argued that it is possible, in context of the European project, that all Member-States benefit from long-term investments financed with short-term

bonds. In this proposal, the EU would be a strong issuer and could use its assets, on one hand, and its liabilities, on the other hand, as two separate policy instruments. On one hand, the loans that the EU would provide to Member-States would have long maturities, improving debt sustainability and reducing the necessity for funding. On the other hand, those loans would be financed by the issuance of short-term Eurobonds, taking the most of the ECB's monetary policy.

Therefore, the EU could perform maturity transformation for its Member-States. Besides, since this transformation proposed by Corsetti *et al.* (2020) would be financed by Member-States that would take the loans (by repaying them, in the future), transfers between Member-States would not be necessary.

It is important to highlight that this solution would not be innovative, since the European Commission, with the program SURE[9], has already issued European bonds. This program aimed to finance national employment protection programs, as in the case of the "simplified lay-off" in Portugal, and the funds raised with this program might amount to 100 million Euros and were distributed with loans. In practice, the European Commission has implemented a financial assistance program, with the distribution of the funds being conditional on the usage of the resources in the agreed measures.

Similar approach was also implemented in the USA, during the pandemic, with the CARES Act, with the federal government purchasing a large amount of public debt, which was already issued or that was going to be issued by the states (Leachman, Marshall & McNichol, 2020). In practice, with this program the federal government issued common debt (through the U.S. Department of the Treasury) and distributed those resources to the states by providing loans.

Nevertheless, as Leachman *et al.* (2020) underlined, although these loans may be useful for the local American governments to deal with the immediate fall in the revenues and increase in the expenses, they were not useful to face the medium and long-term economic impacts. This inadequacy results from the fact that many states might not want to raise funding, to avoid worsening the future fiscal situation. Precisely because of this limitation, the authors propose to distribute the resources by providing grants.

[9] Source: https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/financial-assistance-eu/funding-mechanisms-and-facilities/sure_en (accessed on October 18th, 2020).

3.2.1.3. Eurobonds jointly issued and funds provided by grants

Either the individual or the joint issuance with the funds provided by loans have some disadvantages that will be analyzed further on in this dissertation. One of the most important limitations results from the fact that those loans would add to the national public debt and so solvency risk would not be eliminated (Beck, 2020).

Given these problems, Gros (2020) proposed that the EU itself issued Eurobonds and then provided grants to the most affected countries to distribute the funds raised. Since these funds would be allocated by providing grants instead of loans, the risk of a rapid and significant increase of the public debt would be minimized.

By providing grants, that is, by financing at the European level programs designed at the national level, the problem mentioned before in this dissertation related to the fact that different Member-States would implement support measures with different volumes would be reduced, although moral hazard could become an issue (Mota & Peitz, 2020).

However, in an economic crisis caused by a pandemic, the joint issuance of debt by the EU, with funds distributed by grants, cannot be denied based on moral hazard. The propagation of the virus has nothing to do with incentives or borders. Besides, the restrictive measures to face the pandemic, for instance adopted by Italy, which caused significant economic damages, benefited several countries from that region (Gourinchas, 2020).

Furthermore, the issuance of Eurobonds associated with the distribution of grants would signal the support that the EU guarantees to its most vulnerable states, it would be more effective than non-conventional monetary policy restoring the confidence and it would give health authorities the necessary conditions to focus on the essential (Gourinchas, 2020). To perform this issuance, the bonds would have to be guaranteed by the community budget and irreversibly and unconditionally by all Member-States (Grund *et al.*, 2020).

This joint emission of debt, with long maturities, would not only help to finance, at low costs, the needs of all Member-States, but it would also not directly overload national debts because these funds would be provided by grants and because the EU is an institution with its own capacity to act (which means that the guarantees that Member-States would grant would not add to the national debt). This advantage would be essential to avoid a new sovereign debt crisis in the EA, to increase the fiscal space of the most vulnerable states, and to accelerate the recovery in all Member-States (Boone & Pereira, 2020).

The joint issuance of debt still had the advantage of increasing the volume of supranational safe assets that the ECB could purchase in its program or that banks can offer as

collateral, improving the effectiveness of the monetary policy (Claessens, Mody & Vallée, 2012). Besides, this advantage would be more evident in a severely adverse situation, such as the one provoked by the pandemic, because the Zero Lower Bond restriction and the necessity to stimulate the economy and to ensure financial stability led the Central Banks to continue and reinforce its non-conventional policies (Emmons, Haas & Neely, 2020).

Finally, the fact that Eurobonds may become a safe asset (which represents an advantage of Eurobonds, regardless of how the funds are distributed) could contribute to strengthen the role of the Euro as an international reserve currency, especially if this market reached the dimension of the American sovereign bonds market (Favero & Missale, 2010). This role of international reserve currency would be essential to ensure that an increase of the uncertainty would not translate into an increase of the spreads.

3.2.1.4. Eurobonds jointly issued and European program

Although the joint emission of debt with the funds being provided by grants has several advantages, many authors are even more ambitious in what concerns to the degree of integration required by the EU response.

Garicano (2020b) and Mota and Peitz (2020) defended the implementation of a European program designed by the EU and financed with European borrowing. The EU would borrow in the markets to spend according to its priorities and not to lend or provide subsidies to Member-States. Moreover, the financing costs should be supported by new own revenues and not by the increase of the Member-States contributions.

Even if authors like Gourinchas (2020) argued that in the crisis caused by the pandemic the moral hazard could not be the justification to deny centralized support, Mota and Peitz (2020) suggested that a European program, financed with EU debt and managed by the European Commission, would be the best option to overcome the issue of moral hazard. It would be up to the European Commission to design a program for the EU as a whole, and not to each Member-State to design its own national plan.

Therefore, Mota and Peitz (2020) proposed a European program, designed and financed by the European Commission, to ensure a level playing field and, simultaneously, to reduce moral hazard problems.

3.2.2. Disadvantages of the issuance of Eurobonds

Although the solutions mentioned above regarding the issuance of common debt and the distribution of the funds raised have many advantages, they also have disadvantages that cannot be ignored.

Therefore, as the main differences concerning the disadvantages are focused on the distinction between individual or joint emission, this topic was structured based on that distinction, highlighting the main disadvantages for each one. The disadvantages of the common issuance are present regardless of how the funds are distributed.

3.2.2.1. Disadvantages of the individual issuance of Eurobonds

In what concerns to the individual emission, Gros (2020), that studied the scenario in which Member-States would issue, individually, common debt, rejected this solution, because this design would not contribute to solve the problems of the most volatile and highly indebted countries. The author explained that, with this option, a Member-State could face lower financing costs, but its public debt would keep increasing rapidly.

In addition, the interests saved by the individual emission could, eventually, be suppressed by the increase of the costs of the remaining debt. Not only the debt-to-GDP ratio would rise, but that expansion could trigger the increase of the risk premia and, consequently, of the interest rates. Higher interest rates would mean higher deficits and so new debt increase (Gros, 2020). This public debt increase would hamper economic growth even more, especially in the most vulnerable countries (Garicano, 2020b).

Besides, the individual issuance of Eurobonds by Member-States would lead to different dimensions of the support and recovery plan, which could undermine the level playing field of the single market. If each Member-State designed and financed its own recovery program, EU companies in the same market would receive different support only because of the state where they were located, which would have harmful consequences for the integrity of the single market (Mota & Peitz, 2020).

Although the disadvantages associated to the individual issuance are not numerous, they are significantly and sufficiently negative to reject this option, since they could be ineffective, risky and even counterproductive, according to the literature analyzes.

3.2.2.2. Disadvantages of the joint issuance of Eurobonds

The joint issuance of common debt appears to be, at least in theory and according to Smaghi (2020), a good solution. It would allow Member-States to receive the necessary funding to boost their support, increasing the expenditures and decreasing the revenues, without raising the public national debt (if funds were distributed by grants).

Smaghi (2020) argued, however, that in practice this solution would be much more complicated. Its implementation would require, more than a technical choice, a significant political will, because of the sovereign transfers involved in this solution.

Furthermore, the absence of an EU fiscal capacity to guarantee the issued bonds could lead to higher risk levels, and so higher interest rates for the Eurobonds, when compared to the sovereign bonds of some Member-States (Smaghi, 2020). This idea is shared by Erce *et al.* (2020a), who argued that even though the common debt could have a good rating, it is not sure that it would be as safe as the bonds issued by the ESM, for instance, which means that it is not sure that it would allow such low financing costs. Even if the Eurobonds had AAA rating, they would not have the liquidity of a well-established market, such as the ESM bonds, which would translate into higher financing costs.

Another problem with the joint issuance of Eurobonds, even with the funds being provided by grants, is due to the fact that the treaty stipulates that the EU must have a balanced budget. To overcome this problem, it could be agreed that the countries with the biggest needs would contribute less to the next budget and the stronger countries would contribute more. In practice, the weaker countries would be receiving grants, that could amount to significant levels (Gros, 2020).

In addition, even with the provision of grants, since the transfers would be periodical, in the short-term the public debt of the most affected countries would rise (Gros, 2020). Yet, as this increase would be transitory and as the financial markets should react properly to the announcement of this solution, there should be no problem with this delay.

The inexistence of a vehicle ready to issue common debt would also be a severe limitation (Bénassy-Quéré *et al.*, 2020b). To worsen this problem, there is no budget for the EA (which is where the integration is more advanced); the ESM is not a budgetary institution and can only lend individually to Member-States; and the issuance of common debt would require taxes to pay it, which contradicts with the absence of European fiscal capacity. In addition, countries have different strategies to face crisis and line up those strategies would require long political negotiations.

Although Bénassy-Quéré *et al.* (2020b) admitted that, if these problems were solved, this solution could become a first-best, they referred that, because of the limited temporal horizon, the Eurobonds would not be possible to issue in useful time.

Besides, even though Perotti (2020) considered that the Eurobonds would help the periphery countries to reduced (although very little) their financing costs, he did not consider that this solution would make the access to the market easier, since these countries were not, on the writing day, with problems accessing the capital markets.

Additionally, this proposal would benefit more the periphery countries, since they would receive a bigger portion of the resources, increasing the risk for the remain Member-States. The remain countries would have a responsibility proportional to the dimension of their economy in the EU's and not proportional to the resources they would get (Perotti, 2020). This idea of disproportional benefit was also defended by Herzog (2020), who argued that the cause of the failure of all monetary unions was not lack of solidarity, but rather its excess. Excessive solidarity would encourage the over-indebtedness of Member-States and an attempt to externalize the costs of that debt to the remaining countries.

A similar idea of excessive risk was suggested by Vihriälä (2020), according to whom the issuance of Eurobonds, even if specifically to tackle the pandemic crisis, would be the start of a permanent program, which would increase the mutualization of the risks associated to the public debt of countries that implemented reckless fiscal policies. Some countries could argue that, even if the initial shock was not the result of bad policies, the fiscal vulnerability of some countries is the result of poor and irresponsible fiscal policies in the past.

This idea that the risk sharing and the issuance of common debt would trigger imprudent fiscal policies is justified by the logic that the Eurobonds would prevent the market from exercising its discipline (Favero & Missale, 2010). Particularly, if a country started to have remarkably high levels of debt, the yields should increase, forcing a fiscal consolidation. Conversely, Favero and Missale (2010) argued that market signals can remain calm and weak during a long period (even with a country incurring in unsustainable debt levels) and then vary abruptly, without giving the necessary time for a fiscal adjustment.

While authors like Verwey *et al.* (2020), Giavazzi and Tabellini (2020) and Gostyńska-Jakubowska and Scazzieri (2020) defended that the absence of cooperation to face the severe pandemic crisis would have negative impacts, Herzog (2020; p. 4) stated that:

> "The EU and eurozone is a voluntary union of democratic states, structured as a 'stability community' (…). Thus, each Member-State must support the common rules. Eurobonds destroy the general principle of liability and control of the eurozone – even as an exceptional instrument in an unprecedented pandemic. The long-term fiscal and economic damage of eurobonds in a rule-based fiscal architecture – as history corroborates – would be greater than the historical challenge of the coronavirus pandemic, unless there is a political union in Europe.".

Moreover, Horn, Meyer and Trebesch (2020) when confronted with the argument that the issuance of Eurobonds would be an unparalleled step and it would break a dangerous taboo (Vihriälä, 2020), demonstrated that jointly issued and guaranteed bonds have already been used repeatedly in the past without any problem.

One of the examples of this joint issuance were the "European Community Bonds", issued, for the first time, after the 1973 oil crisis. This process was based on the "Community Loan Mechanism", according to which the European Commission borrowed in the financial markets and then lent those funds to the countries most affected by the crisis. These bonds were guaranteed by the European budget and, only if this budget was unable to repay the bonds, they would be guaranteed by Member-States (fixed quotas). Portugal, for instance, has received, in 1987, loans under this mechanism.

This mechanism was then merged, according to Horn *et al.* (2020), in 1998, into the EU Balance of Payments Facility (which is currently at the disposal of the non-Euro Member-States) and, in 2008/2009, was used to provide help to Hungry, Romania and Latvian.

This knowledge about the past allows three main conclusions about this crisis. First, the European budget has always played a central role in guaranteeing the bonds and so Member-States' guarantees have always played a secondary role. Besides, the common bonds issued in the past have always been repaid in full, on the scheduled and without having to activate the guarantees. Finally, according to Horn *et al.* (2020; p. 205):

> "During deep crises the European governments have repeatedly shown willingness to extend rescue funds along with substantial guarantees to other members in need. The necessary institutional arrangements were often set up flexibly and quickly. Coronabonds would thus stand in a long tradition of European financial cooperation and solidarity".

3.2.3. Joint issuance method

Assuming that the joint issuance of Eurobonds was the selected instrument to implement a common response to the crisis, it would be necessary to define how that issuance would take place. Particularly, it would be necessary to stipulate which entity would be responsible for the emission and stipulate the design of that issuance.

The use of a Special Purpose Vehicle[10] (SPV) would not be the desirable instrument. This SPV would not only have transparency, judicial and decision-making problems, but it would also face other fundamental implementation difficulties, as explained by Garicano (2020b): it would take an excessive time to create it, which contradicted with the necessity to design and implement a rapid response to the pandemic crisis; the debt issued, guaranteed by Member-States, would have to be consolidated in the national debt, causing the significant increase of this debt, jeopardizing the goal of the recovery fund; and as the SPV would have to be headquartered in some state, the law of that country would prevail and it could be changed unilaterally, having an impact on the fund governance.

Alternatively, as mentioned by De La Dehesa (2011), referring to a Juncker and Tremonti proposal in 2010, a European Debt Agency could be created. This Agency could not only issue Eurobonds, but it would also have the freedom to issue debt that represented up to 40% of the GDP of the EU and of each Member-State. To create a market with enough size and liquidity, it could finance 50% of the debt emissions of Member-States or, in exceptional cases, 100%. In addition, it could convert national debt into Eurobonds, by purchasing that debt at discount, incentivizing countries to reduce their deficits..

Finally, another proposal frequently mentioned, particularly by Boone and Pereira (2020), Garicano (2020b) and by the European Commission itself[11], would be the EU, especially the European Commission, and not an instrument specifically created for the purpose, to issue the Eurobonds that would finance the response to the economic crisis.

The EU would be responsible for the repayment of that debt, and it could use the guarantees or other means. Since the EU is an institution with its own capacity to act, the guarantees would not have to be consolidated in the national debt of Member-States, which represents a great advantage when compared to the use of SPVs.

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[10] A Special Purpose Vehicle is an entity with a concrete purpose, frequently to issue financial assets. Source: https://corporatefinanceinstitute.com/resources/knowledge/strategy/special-purpose-vehicle-spv/ (accessed on November 6th, 2020).

[11] Source: https://ec.europa.eu/info/sites/info/files/2020mff_covid_recovery_factsheet.pdf (accessed on October 25th, 2020).

On the other hand, it would be necessary to define the design of the issuance. Although authors like Giavazzi and Tabellini (2020) and Mota and Peitz (2020) disagreed, the issuance of Eurobonds, that is, the issuance of common debt could trigger moral hazard problems (Garicano, 2020a; Gourinchas, 2020).

Therefore, a specific design could be implemented to overcome this issue. The division of the issuance in two tranches is one of the approaches suggested in the literature (Delpa & Weizsäcker, 2011). On one hand, a blue bond, in which countries with a debt-to-GDP ratio below 60% would participate. On the other hand, a red bond, in which countries with higher levels of debt would participate and would be incentivized to adopt prudent fiscal policies because of the higher financing costs (Delpa & Weizsäcker, 2011).

The compliance with the no bail-out clause stablished on the Treaty of Lisbon, the reduction of moral hazard problems and the incentives to the reduction of the public debt would make this a good method to issue Eurobonds (Bengoechea & Garcia, 2020). However, since debt sustainability was one of the main issues to avoid (Garicano, 2020b), this proposal would be insufficient to tackle the economic crisis.

Trying to solve these issues, without splitting the issuance in two tranches, De Grauwe and Moesen (2009; p. 3-4) proposed that the following specifications:

> "First, each euro government would participate in the issue on the basis of its equity shares in the EIB. Second, the interest rate (coupon) on the Eurobond would be a weighed average of the yields observed in each government bond market at the moment of issue. The weights would also be given by the equity shares in the EIB. Third, the proceeds of the bond issue would be channelled to each government using the same weights. Fourth, each government would pay the yearly interest rate on its part of the bond, using the same national interest rates used to compute the average interest rate on the Eurobond.".

However, regarding this proposal, De La Dehesa (2011) underlined that, with the purpose of reducing moral hazard, the strongest economies were being benefited and the most volatile ones were being damaged. According to the author, the only real advantage of this proposal for a small Member-State would be the significant liquidity of this market. Notwithstanding, even with that liquidity, a volatile and small economy would only accept to integrate this proposal in the eminence of losing the access to the capital markets.

4. European Union – actually implemented solutions

With the spread of the COVID-19 pandemic, the European Union institutions implemented several policies to minimize the economic costs of fighting the public health crisis. Those policies ended up being a mixed use of the instruments mentioned in the previous section and, so, its study is important to compare and assess the EU fiscal mechanisms. Despite the fact that other actions might have been implemented, in this section it will only be detailed the policies that may be important for the purpose of the study.

In March 2020, the European Commission announced the flexibilization of the state aid rules, the looseness of the fiscal rules, the commitment of 1 billion Euros from the EU budget to provide liquidity to firms through the European Investment Fund and the creation of the Coranavirus Response Investment Initiative.[12] Particularly in what concerns to the last measure, under the Cohesion policy, Member-States were able to redirect unspent cohesion funds for other purposes. Portugal redirected over 1 billion Euros of cohesion funds to tackle the health and economic crisis, *e.g.* to purchase health materials, to provide financial support to Small and Medium Enterprises and to intervene in the labor market.[13]

Later, in April 2020, the EA finance ministers agreed to make the ESM available to support the effort of the Member-States. According to that decision, a 540 billion Euros credit line with minimal conditionality (countries were only required to use the resources in the fight against the health crisis) was stablished[14], as suggested by several authors previously analyzed (Bénassy-Quéré *et al.*, 2020b; Guttenberg & Hemker, 2020; Smaghi, 2020).

However, the ESM credit line was not the only to be established to help in the fight against the COVID-19 economic crisis. The European Council approved the European Commission proposal to provide more than 90 billion Euros in loans, based on a system of voluntary guarantees from Member-States, under the SURE initiative.[15] This program aimed to finance national employment protection programs, as in the case of the "simplified lay-off" in Portugal. These loans were financed by the issuance of common debt (social bonds, since funds were to be mobilized to a social purpose) and, thus, similar to the approached

[12] Source: https://ec.europa.eu/commission/presscorner/detail/en/ip_20_459 (accessed on January 10th, 2021).
[13] Source: https://ec.europa.eu/regional_policy/pt/newsroom/coronavirus-response/ (accessed on January 10th, 2021).
[14] Source: https://www.esm.europa.eu/content/europe-response-corona-crisis (accessed on January 10th, 2021).
[15] Source: https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/financial-assistance-eu/funding-mechanisms-and-facilities/sure_en (accessed on October 18th, 2020).

described in section 3.2.1.2. In practice, the European Commission has implemented a financial assistance program, with the distribution of the funds being conditional on the usage of the resources in the agreed measures.

Even though the previous responses highlighted, already, the Member-States will for a common intervention, the most significant response, the NextGenerationEU[16], was negotiated until December 2020. This solution dedicated 750 billion Euros to the recovery of the economy. Although some of these funds were allocated to projects like the ReactEU, Horizon Europe, InvestEU, Rural Development, Just Transition Funds and RescEU, the majority of the resources (672,5 billion Euros) were allocated to a Recovery and Resilience Facility.[17]

This instrument is divided in grants (312.5 billion Euros) and loans (360 billion Euros) and each Member-State must design, present and implement its recovery plan, while deciding how much of these funds it would use. In practice, this solution comprises the ones described in section 3.2.1.2. and in 3.2.1.3.

In spite of the fact that funds are divided by grants and loans, each Member-State can decide how much of these resources it wants to use and if it wants to receive both grants and loans. The Portuguese Prime Minister, for instance, has stated that Portugal would not want to take loans, fearing debt sustainability problems[18], as already predicted in the previous literature review (*e.g.* Beck, 2020; and Giavazzi and Tabellini, 2020). Although the Recovery and Resilience Plan published for public discussion[19] on February 15th, 2021, ended up proposing to use some of the loans available, the planned amount (almost 2.7 billion Euros) represented a small portion of what the country could ask for.[20]

Not only the importance of loans within the recovery fund is a disadvantaged of the implemented solution, but for Beetsma and Kopits (2020; p. 9):

> "The fund is nested in the MFF, lacking flexibility to be activated in the event of a sudden unanticipated shock. It resembles the Structural Funds or Cohesion Funds, failing to distinguish cyclical from structural indicators of unemployment, activity,

[16] Source: https://ec.europa.eu/info/strategy/recovery-plan-europe_pt (accessed on January 14th, 2020)
[17] Source: https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en (accessed on January 14th, 2020)
[18] Source: https://expresso.pt/politica/2020-09-29-Costa-Portugal-vai-usar-integralmente-subvencoes-mas-nao-vai-recorrer-aos-emprestimos (accessed on January 14th, 2020)
[19] Source: https://www.portugal2020.pt/content/plano-de-recuperacao-e-resiliencia-em-consulta-publica-ate-1-de-marco (accessed on February 19th, 2021)
[20] Annex 1 details the predicted grants and loans per Member-State, according to the agreed in the Recovery and Resilience Facility.

and income levels of member countries. In addition, it seems to borrow features from the ESM in terms of lending conditional on structural policy measures and, in a favorable respect, from the EIB in terms of bond financing.".

Notwithstanding the fact that Member-States must design, present and implement its recovery plan, the solution described in section 3.2.1.4. is partially present, since the national strategies must follow common EU priorities, particularly regarding the environment sustainability (according to the European Green Deal) and the digital transition.

Hence, Portugal, that will receive almost 14 billion Euros in grants, will invest them, according to the Recovery and Resilience Plan published for public discussion, around 2.9 billion Euros in climate transaction, 2.5 billion in digital transaction and the 8.5 billion Euros in social vulnerabilities, employment and productivity, and competitiveness and cohesion (the Resilience dimension). Regarding the loans, almost 2.4 billion Euros will be destined to the Resilience dimension and 300 million to the climate transaction. The proposed amounts per dimension and per component are detailed in Annex 2.

The Recovery and Resilience Plan was updated in the meanwhile and approved by the European Commission on June 16th, 2021. The calculations performed in this dissertation considered the Recovery and Resilience Plan published for public discussion on February 15th, 2021, because of the proximity of the due date and the unpredictability of the time the European Commission would take to approve the program. Nevertheless, the general values did not suffer significant adjustments, with the overall dimension of the program and of each dimension remaining almost the same.

According to the document sent to the European Commission[21], in the second semester of 2022, the Portuguese government will reassess the amount of loans, particularly if it borrows an additional 2.3 billion Euros to support companies. This evaluation will consider the demand for these funds and the situation of the public finances at the time.

[21] Source: https://www.portugal.gov.pt/download-ficheiros/ficheiro.aspx?v=%3d%3dBQAAAB%2bLCAAAAAAABAAzNDQzNgYA62SpeQUAAAA%3d (accessed on June 3rd, 2021)

5. Methodology and Data

From the previous literature review, it is possible to conclude that providing ESM loans or issuing Eurobonds are the main mechanisms available to implement a common response, though major differences persist between them.

Even though these are the mechanisms mostly underlined in the literature, the implemented solution ended up combining both in a single resolution, as mentioned before. Therefore, comparing estimated outcomes under the solutions described in the literature with those resulting from the effective policies put in place is important to assess which is the best design for an EU fiscal mechanism.

First, it is necessary to estimate, with a VAR model applied to the Portuguese economy, as used by, *e.g.*, Marvão Pereira and Roca-Sagalés (2011) and Bova and Klyviene (2020), several fiscal multipliers to government spending. Since the resources of the common EU mechanisms are to be invested in a diversity of areas, multipliers should also consider this diversity. Hence, highlighting the impacts of the government expenditures in health, education or housing is a crucial step to estimate the overall effectiveness of a common response.

Besides disentangling government spending, it is important to define the variable we are measuring the impact on. Usually, fiscal multipliers refer to the impact of 1 unit of government spending on GDP, but since distinct instruments will have different impacts on different spending components, we will compute, in addition, multipliers on private investment and consumption.

Once these fiscal multipliers are estimated, the assessment of the distinct EU fiscal mechanisms can be made. For that to be possible, different scenarios will be considered.

First, we consider the agreed and implemented solution, that promotes a mixed use of the mechanisms. This requires the analysis of the distribution of the resources across expenditure categories to define exogenous shocks to the model, as to compute the effective (average) fiscal multiplier associated to the Portuguese Recovery and Resilience Plan.

Then, other scenarios, particularly the ones considered in the literature, have also to be assessed for setting comparative benchmarks. It can be assumed that funds are financed fully by loans, affecting also domestic debt and/or taxes or that they are non-refundable.

5.1. VAR model

VAR models became widely used in Macroeconomics, since they allow precise estimations without an excessive number of restrictions and, hence, without an excessive number of ex-ante assumptions. The reduced form of the VAR model takes the following configuration:

$$X_t = \sum_{i=1}^{k} M_i X_{t-i} + e_t \quad (5.1.1.)$$

where X is a *n*-dimensional vector comprising the endogenous variables relevant to assess the impacts of fiscal policy on the economy (public expenditures, taxes and output are variables typically used, *e.g.*, Blanchard and Perotti (2002) and Marvão Pereira Roca-Sagalés (2011)). M_i represents the *n* by *n* matrix of coefficients. Since VAR models must include lags, their optimal number, k, can be defined either by existent evidence on the performance of the variables or by information criteria, *e.g.* Schwarz, Akaike or Hannan-Quinn criteria. Finally, e_t is the *n*-dimensional vector of reduced form residuals.

The reduced form residuals comprises three elements: i) automatic stabilizers (some variables considered in the model react automatically, that is, without any discretionary policy decision, to changes in output); ii) discretionary fiscal policy responses (policy decisions of change the variables, *e.g.* tax rates or public expenditures, to promote the stabilization of the economy); iii) random discretionary fiscal policy responses (usually known as a structural fiscal shock, that is meant to be captured by the structural VAR model). Therefore, the structural VAR model takes the following form:

$$A_0 X_t = \sum_{i=1}^{k} A_i X_{t-i} + B v_t \quad (5.1.2.)$$

where A_0 captures the contemporaneous relationships between the variables considered in X_t. The matrix B captures the relation between the reduced form residuals, e_t, and the structural form residuals, v_t. Hence, the structural form residuals can be considered as:

$$A_0 e_t = B v_t \quad (5.1.3.)$$

$$<=> \; v_t = B^{-1} A_0 e_t \quad (5.1.3.)$$

Studying the behavior of the variables considered in the vector X, following a one-unit shock to a structural residual, keeping fixed the remaining residuals, allows the analysis of the impact of a fiscal policy instrument in the economy. Thus, *ceteris paribus*, the impact of a one-unit variation of the structural residual in the endogenous variables can be analyzed by their impulse responses, an approach also called multiplier analysis. Therefore, this impulse response analysis allows to study:

> "The response of one variable to an impulse in another variable in a system that involves a number of further variables as well. Thus, one would like to investigate the impulse response relationship between two variables in a higher dimensional system." (Lütkepohl, 2005, p. 51)

However, the VAR model can only be estimated after the identification of the structural fiscal policy shocks. Four main methods are usually discussed in the literature to recognize these structural fiscal policy shocks: i) the Cholesky decomposition or recursive approach (Sims, 1980); ii) the structural identification approach, which is divided in three steps (Blanchard & Perotti, 2002); iii) the narrative approach (Ramey & Shapiro, 1998); iv) the restrictive approach (Hebous, 2011; Uhlig, 2005). In this work we follow the recursive approach since it is of widespread use and followed, *e.g.*, by Collingro and Frenkel (2020), Marvão Pereira and Roca-Sagalés (2011) and Perry and Vernengo (2014).

According to the recursive approach, the first variable in the system responds, contemporaneously, only to its exogenous shock; the second variable responds, contemporaneously, to its own exogenous shock and to changes in the first variable, and so on. Assuming a three-dimensional VAR model, *e.g.*, Blanchard and Perotti (2002) consider the ordering: taxes, public expenditures, and output. The recursive approach relying on the chosen ordering means that taxes respond only to its own shocks and do not respond, contemporaneously, to other shocks in the economy; public expenditures respond, contemporaneously, to its own shock and to changes in taxes; finally, output reacts to its own shock and to shocks in taxes and public expenditures. This method can be represented by matrixes:

$$\begin{bmatrix} 1 & 0 & 0 \\ a_{21} & 1 & 0 \\ a_{31} & a_{32} & 1 \end{bmatrix} \begin{bmatrix} e^{taxes} \\ e^{public\ expenditures} \\ e^{output} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} v^{taxes} \\ v^{public\ expenditures} \\ v^{output} \end{bmatrix} \qquad (5.1.4.)$$

Hence, the order of the variables assumes, in this model, particular importance. Even though economic theory can and should be used to define the ordering of the variables and the fact that certain variables tend to respond slower to shocks than others, the assumptions in which the choice relies on can be disputable, since there is not a unique ordering for the endogenous variables. In fact, Khalid and Kawai (2003) referred that this approach has a significant degree of arbitrariness, and a change of the order can severely affect the results.

In this dissertation, three different main models are to be considered. First, in model A, government spending will be considered as whole, without any distinction between its different components. Then, in model B, public expenditures will be disentangled into four categories, considering government spending in health, education, housing and the remaining expenditures.

In what concerns model A, two different specifications are considered.[22] First, four endogenous variables are considered (in logarithmic difference form): government spending (g_spending), tax revenues (taxes), the public debt to GDP ratio (debt), output (gdp). Besides, a constant term (C) and long-term interest rate (real_interest_rate) will also be considered. This last endogenous variable was included to consider the debt service, since its absence might jeopardize the results (Burriel *et al.*, 2010). Finally, a dummy for the 2009 economic crisis and an exogenous variable to capture the trend (by the automatic process of Eviews) were also included. A different specification, considering, additionally, private consumption (consumption) and private investment (investment), in logarithmic differences, was also estimated. Comparing to the previous specification, this would allow to analyze the impacts of a government spending shock in some crucial GDP components.

We consider the recursive approach as adequate to this study. Thus, the model includes the endogenous variables in the following order: public expenditures, tax revenues, long term interest rate, output and public debt to GDP ratio, for the first specification, and public expenditures, tax revenues, long term interest rate, private consumption, private investment, output and public debt to GDP ratio, for the broader specification. The long-term interest rate was taken in levels. This ordering means that taxes respond to its own shocks

[22] Besides these two specifications, another one was considered, estimating the last specification with annual data for the interval 1996 – 2019. This estimation allows to perform comparations with model A.2 and with model B.

and to shocks in the government spending, as they are levied to finance expenditure. Repeating the same logic for the remaining variables, output, for instance, responds to its own shocks and to shocks in the government spending, real interest rates, private consumption and private investment.[23]

For these models, quarterly data for the period between 2000 and 2019 was retrieved from Eurostat.[24] The use of quarterly data allowed a significant larger dimension of the sample and, therefore, sounder estimation results.

Since quarterly data has been used and since all the models were estimated using growth rates, we had to decide if the first differences would apply between consecutive logarithms (in that case we would be comparing the value for a certain quarter with the immediately previous one) or if the difference between logarithms would apply between the same quarter of consecutive years. In order to reduce the influence of seasonality, all the models using quarterly data were estimated considering the last option.

Regarding to model B, the endogenous variables (listed in the following order for the recursive approach) - government spending in health (g_health), education (g_education), housing (g_housing), remaining government spending (g_remain), tax revenues (taxes), long-term interest rate (real_interest_rate), output (gdp) and public debt (debt) - were considered in first-difference logarithms, except for long-term interest rate defined in levels. Besides, an exogenous constant term (C), a dummy variable for the 2009 economic crisis and a time trend are also included, similar to specification of model A.

For model B, annual data for the period between 1996 and 2019 was included[25], given the unavailability of quarterly data for disaggregate public expenditure variables. Besides, the period was extended, considering data from 1996, instead of 2000. The reduced size of the sample lead us to exclude the specification with the private consumption and investment variables.

Although an effort to include the maximum data possible was made, the availability of that data was limited for the variables considered in the model and, thus, the reduced size of the samples is a limitation for estimation of and the analysis of the results, as it will be shown in the next chapter.

[23] In order to accommodate the critics regarding the arbitrariness of ordering, we also tested alternative ordering for robustness purposes. Results did not change considerably.
[24] Annex 3 presents a systematization of the endogenous variables considered in aggregate the model and its source.
[25] Annex 4 presents a systematization of the endogenous variables considered in the disaggregate the model and their data sources.

6. Estimation and Discussion of Results

In the present section, we estimate the models specified above and analyze the results. For that purpose, the section was divided into three sub-sections: i) in sub-section 6.1. we present and analyze the results for the estimation of the first specification of model A, *i.e.*, the aggregate model without including private consumption and investment; ii) in sub-section 6.2. we present and analyze the results for the estimation of the second specification of model A, *i.e.*, the aggregate model, considering private consumption and investment; iii) in sub-section 6.3. we present and analyze the estimation results for the model with the disaggregate government spending.

Since impulse-response functions (IRF) obtained from the estimation of the models allow to compute, directly, the elasticities of output (consumption or investment) relative to fiscal variables (*i.e.*, the impact of a shock on the growth rate of a variable on another's growth rate), they need to be transformed as to properly get fiscal multipliers. Elasticities are converted into multipliers by multiplying each elasticity by the ratio between the average of the sample of the response variable and the average of the sample of the impulse variable (Auerbach & Gorodnichenko, 2013).

Complementarily, in the present section, we conduct some tests to the models, in particular to assess the stationarity of the variables and the optimal number of lags; results are presented and explained.

By the end of section 6, we discuss the best design for an EU fiscal mechanism, from Portugal's perspective, as regards to if that mechanism should be based on grants or loans and if it should be subject to conditionality or not. Furthermore, an average multiplier of the Portuguese recovery plan is also computed, even though these results must be interpreted cautiously given the limitations of the model.

6.1. Model A.1. – Aggregate model without private consumption and investment

The first model to be estimated is the aggregate model without considering the private consumption and investment. This option allows, together with the use of quarterly data, to reduce the number of coefficients to estimate and, thus, to obtain sounder results.

Regarding the tests to the model, using the tools in *Eviews*, we first apply the Schwarz information criterion to select the optimal number of lags. Results are presented in Table 1.

Table 1: Schwarz information criterion, model A.1.

Lag	Schwarz information criterion
0	-9.964559
1	-12.57292*
2	-11.76811
3	-11.13020
4	-10.33281
5	-9.786028
6	-9.162406
7	-8.272827

The values presented in Table 1 allow us to conclude that that optimal number of lags is 1, thus up to the previous quarter.

Table 2: VAR stability condition test, model A.1.

Roots	Modulus
0.910542	0.910542
0.715384 - 0.065793i	0.718403
0.715384 + 0.065793i	0.718403
-0.270588	0.270588
-0.200236	0.200236

Regarding overall VAR stability test, results presented in Table 2 show that no roots lie outside the unit circle, thus the VAR model satisfies the stability condition.

Table 3: Unit-root tests on the variables, model A.1.

Variable	Level (*p-value*)	1st difference (*p-value*)
log(g_spending) - log(g_spending(-4))	0.0000	0.0000
log(taxes) - log(taxes(-4))	0.0002	0.0000
real_interest_rate	0.3472	0.0000
log(gdp) - log(gdp(-4))	0.0450	0.0000

log(debt) - log(debt(-4))	0.6410	0.0002

Finally, in regard to the stationarity of model variables, results presented in Table 3 show that all the variables included in the model are stationary in first differences.

Once the tests were conducted, the adequate model specification was estimated. Annex 5.1. presents the estimation output of the model, using *Eviews*, and Figures 1 to 3 exhibit the accumulated IRF for output, over 20 quarters, following a shock in fiscal variables.

Figure 1: Accumulated impulse response of log(gdp)-log(gdp(-4)) to shocks in log(g_spending)-log(g_spending(-4)), model A.1.

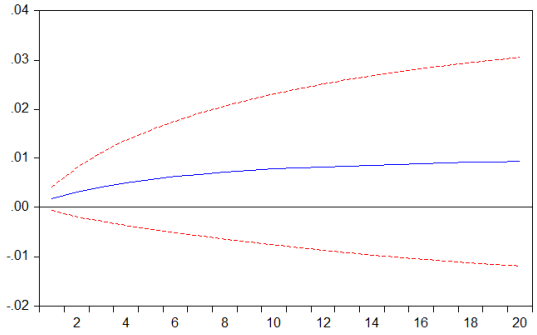


Figure 2: Accumulated impulse response of log(gdp)-log(gdp(-4)) to shocks in log(taxes)-log(taxes(-4)) , model A.1.

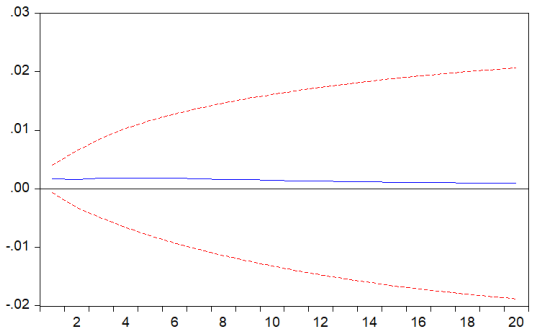
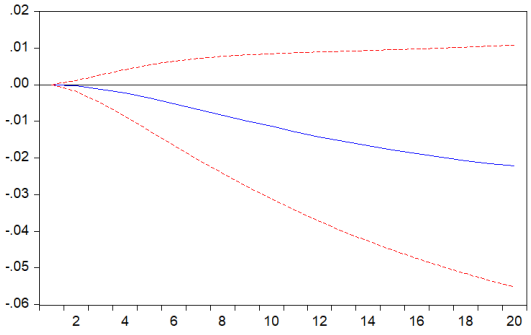


Figure 3: Accumulated impulse response of log(gdp)-log(gdp(-4)) to shocks in log(debt)-log(debt(-4)) , model A.1.



The first thing to notice is that the impulse response of the log(gdp)-log(gdp(-4)) to log(g_spending)-log(g_spending(-4)), log(taxes)-log(taxes(-4)) or to log(debt)-log(debt(-4)) shocks is not statistically significant. Since multiple configurations of the model were estimated, we assumed that this lack of significance is due to the reduced size of the sample. Nevertheless, further estimations with a larger sample should be conducted.

However, given that, except for taxes, confidence bands are quite asymmetric around 0, we still rely on the accumulated impulse responses[26] to compute the cumulative fiscal multipliers relevant to the analysis in Table 4.

Table 4: Cumulative fiscal multipliers on GDP over 20 quarters, model A.1

Variable	Fiscal multiplier on GDP[27]
Government expenditure	0.02[28]
Tax revenues	0.0026
Public debt	-0.0186[29]

Source: Own calculations

Analyzing the fiscal multipliers, one can conclude that an increase of the government spending has positive impact on GDP. An increase of one million Euros in public expenditure increases the GDP by 20000 Euros. The sign of the fiscal multiplier corresponds to the one estimated by Pereira and Wemans (2013), Marvão Pereira and Roca-Sagalés (2011) and Bova and Klyviene (2020), although the size of the multiplier appears to be considerably less.

Since we are considering the model using aggregate fiscal variables, these results are not sensible to the nature of the expenditure. Naturally, expenditures in defense or education are expected to have different economic impacts, as well as those impacts are different depending on if the expenditure is devoted to investment or to current spending. For instance, Pereira and Wemans (2013) estimated that the expenditures on salaries would have significant positive effects, while expenditures in goods and services would have negative impacts on the GDP.

On the other hand, the results appear to suggest that an increase in taxes leads to a non-significant variation of the output. Although a million of Euros increase in tax revenues,

[26] The tables with accumulated IRF are presented in Annex 5.2.

[27] Statistically, these fiscal multipliers cannot be considered different from zero, because of the lack of significance of the IFR.

[28] Fiscal multiplier of government spending was computed according to the following process: $0.0093 \times \frac{43935.94}{20404.06}$, being 0.0093 the accumulated IRF, 43935.94 the sample average of the GDP in millions of Euros and 20404.06 the sample average of the government expenditures in millions of Euros.

[29] For this analysis we considered the level of the GDP of the fourth quarter of 2019. One million Euros of additional public debt would represent an increase of 0.00181767p.p. on the debt ratio, which represents 0.181776% of a unitary increase. After calculating the fiscal multiplier for a unitary increase on the debt to GDP ratio (-10.2348), we calculated the fiscal multiplier of the public debt for an increase of one million Euros (0.181776%*(-10.2422)=-0.0186).

is estimated to increase Portuguese GDP by 2600 Euros, the confidence bands for IRF of taxes are quite symmetrical around 0. Indeed, this result shows that the increase of tax revenues to finance an expenditure program would be neutral (or, eventually, positive) for the return of the program on the output. However, this result contradicts the estimations of Marvão Pereira and Roca-Sagalés (2011), having these authors concluded that taxes have a negative impact on GDP.

Again, the model does not take into consideration the different taxes on the current tax wedge. Pereira and Wemans (2013) estimated that while direct taxes would have a negative multiplier, indirect taxes would have no effects and social transfers would verify a positive signal. Furthermore, the results that could be applied in general, may not be applied in severe economic situations, like the one caused by the COVID-19 pandemic.

Finally, and as expected, the increase of the public debt weight on GDP would have recessive economic results. The inclusion in the model of the public debt to GDP ratio, instead of considering it as real absolute change in Euros, makes the comparison and the discussion of the results more challenging. However, according to the economic rationale, the absolute value of the debt is not as relevant as the capacity of the country to produce enough to pay it; the consideration of the debt to GDP ratio allows for an assessment of its evolution across time in a more rigorous way to meaningfully affect other endogenous variables of the model such as risk premium (interest rate) and output.

Therefore, to compute the debt multiplier, we defined a one million Euros as a percentage of the GDP of the fourth quarter of 2019. An increase in one million Euros in public debt (*i.e.*, an increase in the debt to GDP ratio of 0.00181767p.p.) would reduce GDP by, approximately, 18600 Euros.

Naturally, this does not consider the variation of GDP across time and therefore is not a precise result. Notwithstanding, given the reduced weight of one million Euros in the GDP, even if the output increases considerably during the next 5 years, the results would not change significantly.

Having these fiscal multipliers, we can now analyze the average fiscal multiplier of alternative stylized EU programs designed to tackle the COVID-19 economic crisis.

Table 5: Average cumulative fiscal multiplier on GDP over 20 quarters, under alternative EU mechanisms, model A.1.

Design of the mechanism	Share of the fiscal multiplier considered			Average multiplier
	Government spending	Tax revenues	Public Debt	
i) Common debt; distribution of grants; no conditionality	100%	0%	0%	0.02
ii) Common debt; distribution of loans; no conditionality	100%	0%	100%	0.0014[30]
iii) Common debt; grants and loans; no conditionality	100%	0%	17,16%	0.0168
iv) Common debt; distribution of loans; with conditionality	100%	50%	50%	0.012

Source: Own calculations.

In order to perform the current analysis, four different EU mechanism designs were considered: i) a program financed through the issuance of a common debt, with the distribution of the resources through grants to the country and without any conditionality[31] (whose advantages are theoretically described in section 3.2.1.3.); ii) a program also financed by issuing a common debt, but with the distribution of the resources through loans[32] and without any conditionality (whose advantages are theoretically described in section 3.2.1.2); iii) a program with a distribution through both loans and grants, representing, respectively, 82.84% and 17.16% of total amount (a scenario similar to the actual implemented solution as described in section 4, mimicking the Portuguese Recovery and Resilience Plan published for public discussion on February 15th, 2021); iv) a program based on the presence of conditionality (described in section 3.1.). For the last program, we assume that during 5 years only 50% of the increase in the expenditure is compensated by an increase in tax revenues (since a full compensation could worsen the economic crisis).

[30] E.g. $100\% \times 0.02 + 100\% \times (-0.0186) = -0.0014$.

[31] As a simplifying assumption, it was considered that Portuguese tax payers would not contribute to the EU recovery program. However, even if the EU implements additional own resources, this assumption may not be correct. Further calculations should be performed once the repayment method of the common debt is agreed.

[32] For this assessment it was assumed that the public debt would have the same impacts, namely on risk premium, regardless of its financing source. In fact, this is a simplification since, among others, EU funding could contribute to reduce the spreads, decreasing the negative effects of public debt.

The results of the calculations and estimations conducted with this model appear to suggest that the best program would be the issuance of common debt with the distribution of the resources by grants (i). Besides the positive impact that an increase of the government spending has for the economy, the fact that this scheme prevents the increase of the public debt of a vulnerable country like Portugal is the core of the performance of the program. Boone and Pereira (2020) and Gros (2020) are some of the authors that have predicted this advantage, mainly due to its capacity to avoid an overload of the national debt.

On the other hand, the results appear to indicate that the worst common mechanism would be the issuance of common debt with the resources distributed by loans (ii). The negative effects of a significant overload of the Portuguese public debt would almost surpass the positive impacts of the public expenditure. This program would actually perform, according to our estimates, worse than the use of the ESM (iv). The latter, due to the conditionality, would allow a bigger GDP bust, mainly by partially avoiding the costly increase of the national debt.

However, not only a consolidation of 50% or more in the tax revenue in such a short period of time would be too aggressive for the economy, but, apart from other disadvantages described in section 3.1.3., this conditionality could restrict the effective use of the funds and the government spending might not increase as much as in the other scenarios (Bénassy-Quéré *et al.*, 2020b). Besides, by not preventing an increase of the public debt of a country already severely indebted, the overall perform would be worse (Delatte & Guillaume, 2020), as suggested by the results of the model.

Finally, alternative iii), similar to the actually implemented solution, appears to have an overall positive effect on the GDP, although the average fiscal multiplier would be lower than in the case of the distribution of the resources fully by grants, because of the increase in public debt. Hence, model A.1. results suggest that the Portuguese Recovery and Resilience Plan would have positive, but small, impacts in the GDP. The 16642 million Euros increase in the public expenditures would increase the GDP by almost 280 million Euros.

6.2. Model A.2. – Aggregate model with private consumption and investment

After estimating the model with aggregate fiscal variables and without private consumption and investment, we estimated that model considering, in addition, those variables. Although we expected similar fiscal multipliers on GDP as in the previous model, this model specification allows to analyze the average multipliers on consumption and investment.[33]

The estimation output of the model is presented in Annex 6.1. and, as in the previous sub-section, we started by performing several tests to the model, whose results are now detailed in Annex 6.2. According to those tests, the optimal number of lags is one; since no roots lie outside the unit circle, the model satisfies the stability condition; and all the variables in the model are stationary in first differences.

In what concerns to the accumulated IRFs, the tables are presented in Annex 6.3. and in Figures 4 to 12.

Figure 4: Accumulated impulse response of log(gdp)-log(gdp(-4)) to shocks in log(g_spending)-log(g_spending(-4)), model A.2.

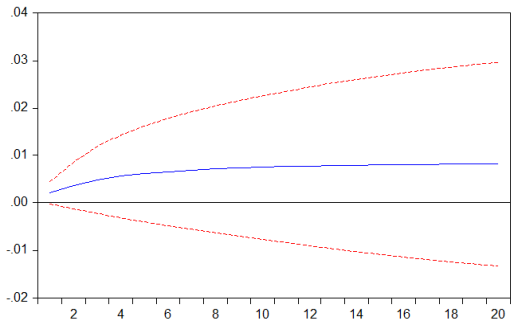


Figure 5: Accumulated impulse response of log(gdp)-log(gdp(-4)) to shocks in log(taxes)-log(taxes(-4)), model A.2.

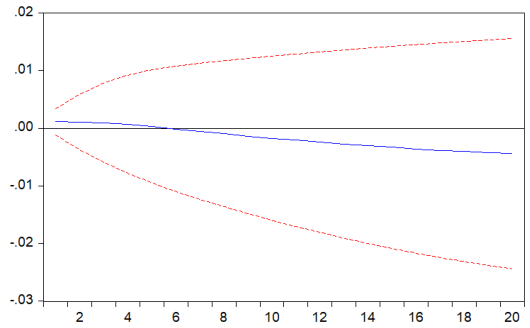


Figure 6: Accumulated impulse response of log(gdp)-log(gdp(-4)) to shocks in log(debt)-log(debt(-4)), model A.2.

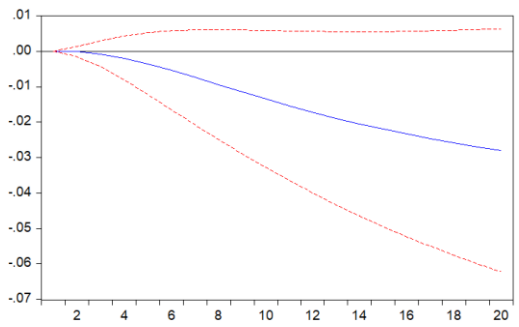
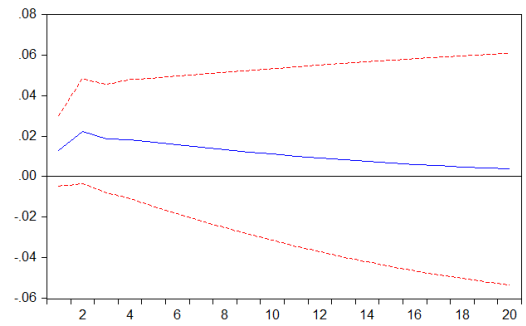


Figure 7: Accumulated impulse response of log(investment)-log(investment(-4)) to shocks in log(taxes)-log(taxes(-4)), model A.2.



[33] A model (model A.3.) considering the same variables, but with annual data for the period between 1996 and 2019, was also estimated and its results presented in Annex 7.

Figure 8: Accumulated impulse response of log(investment)-log(investment(-4)) to shocks in log(g_spending)-log(g_spending(-4)), model A.2.

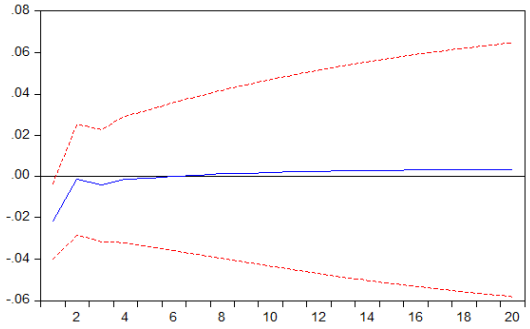


Figure 9: Accumulated impulse response of log(investment)-log(investment(-4)) to shocks in log(debt)-log(debt(-4)), model A.2.

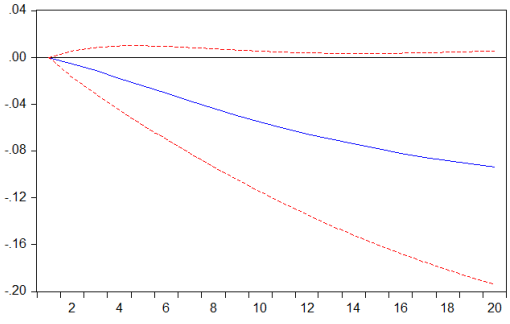


Figure 10: Accumulated impulse response of log(consumption)-log(consumption(-4)) to shocks in log(g_spending)-log(g_spending(-4)), model A.2.

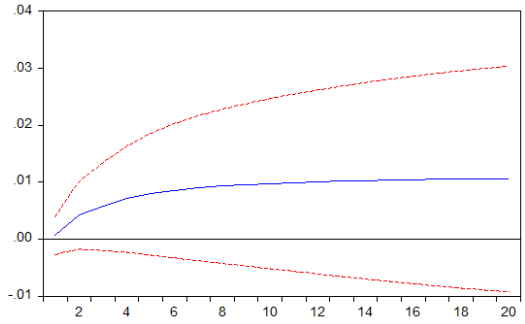


Figure 11: Accumulated impulse response of log(consumption)-log(consumption(-4)) to shocks in log(taxes)-log(taxes(-4)), model A.2.

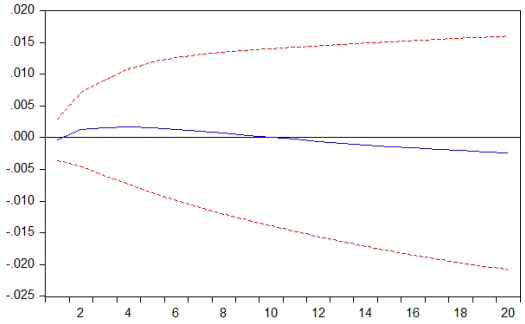
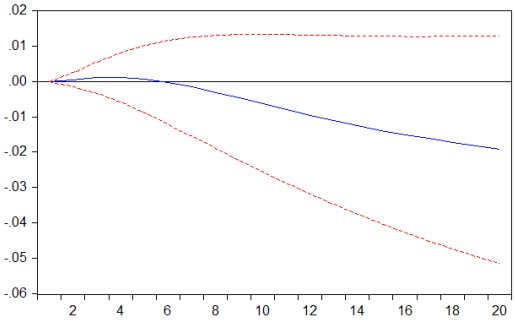


Figure 12: Accumulated impulse response of log(consumption)-log(consumption(-4)) to shocks in log(debt)-log(debt(-4)), model A.2.



Regarding the fiscal multipliers, calculated based on the IRFs, the results are presented in Table 6.

Table 6: Cumulative fiscal multipliers on GDP, private consumption, and private investment over 20 quarters, model A.2.

Variable	Fiscal multiplier on GDP[34]	Fiscal multiplier on private consumption[34]	Fiscal multiplier on private investment[34]
Government expenditure	0.0176	0.0146	0.0012
Tax revenues	-0.0127	-0.0045	0.0018
Public debt	-0.0234[35]	-0.0104	-0.0135

Source: Own calculations.

Previously to the analyzes of the fiscal multipliers, we must underline that the results are not statistically different from zero and they must be interpreted carefully. Although confidence bands are still strongly asymmetric in responses to spending and debt.

Notwithstanding, when we compare the results of model A.2. to the estimations performed for model A.1., we concluded that all fiscal multipliers to GDP are smaller, although similar, in this last model. The government spending multiplier has reduced from 0.02 to 0.0176. For each million Euros of public expenditure increase, the GDP increases by 17600 Euros.

On the other hand, tax revenues multiplier on GDP changed its signal, when compared to the one estimated under model A.1. Therefore, an increase of tax revenues by one million Euros leads to a decrease in GDP by 12700 Euros. This result, in spite of being contrary to the one estimated in model A.1., is according to the study performed by Marvão Pereira and Roca-Sagalés (2011).

Finally, public debt multiplier in GDP remained similar, although it has also decrease from -0.0186 to -0.0234. The fiscal multipliers associated to public debt remained with the same signal for the GDP, private consumption and private investment. However, the effects of public debt in private investment appear to be worse than its effects in consumption.

Regarding the government spending multipliers, the positive effect in private consumption (the consumption increases 14600 Euros for each million Euros increase in public expenditure) is considerably bigger than the positive impact on the private investment (that increases 1200 Euros for each million Euros increase in government expenditures).

[34] Statistically, these fiscal multipliers cannot be considered different from zero, because of the lack of significance of the IFR, except the multiplier of the public debt on the private investment.
[35] Calculated based on the method described in sub-section 6.1.

Conversely, although the fiscal multiplier of tax revenues in GDP and in private consumption have a negative signal, its fiscal multiplier in private investment register a positive signal. Since a one million Euros increase in tax revenues would provoke a decrease in private consumption of 4500 Euros and an increase of 1800 Euros in private investment, higher tax revenues would benefit private investment, while damaging the output and consumption.

Having analyzed the fiscal multipliers, we can know compare the average fiscal multiplier of alternative stylized EU programs designed to tackle the COVID-19 economic crisis:

Table 7: Average cumulative fiscal multipliers on GDP, private consumption and private investment over 20 quarters, under alternative EU mechanisms, model A.2.

Design of the mechanism	**Share of the fiscal multiplier considered**			**Average multiplier**		
	Government spending	**Tax revenues**	**Public debt**	**GDP**	**Private consumption**	**Private investment**
i) Common debt; distribution of grants; no conditionality	100%	0%	0%	0.0176	0.0146	0.0012
ii) Common debt; distribution of loans; no conditionality	100%	0%	100%	-0.0058	0.0042	-0.0123
iii) Common debt; grants and loans; no conditionality	100%	0%	17,16%	0.0136	0.0128	-0.0011
iv) Common debt; distribution of loans; with conditionality	100%	50%	50%	-0.0005	0.0072	-0.0047

Source: Own calculations

From a GDP point of view, the overall conclusions remain the same as in sub-section 6.1. A common mechanism that promotes the issuance of common debt, the distribution of those resources by grants and the absence of conditionality appears to be the best mechanism to implement a common fiscal policy, for the Portuguese economy. Naturally, since the fiscal multiplier of government spending in GDP is now lower than in model A.1., the overall benefit of the program is also reduced.

The novelty in this sub-section is that the previously mentioned mechanism appears to also be the best mechanism to promote private consumption and private investment (private investment falls in all the three remaining mechanisms). In really, the results suggest that private consumption would rise almost as much as the GDP, while the private investment would increase significantly less.

Besides, the conclusion in sub-section 6.1. that, in case of a distribution of loans, the presence of conditionality would be better for the GDP than its absence, appears to remain and can now be extended to the private consumption and the private investment. By limiting the increase of the public debt, this mechanism performs better both for private consumption and investment. In fact, in the case of private consumption, the distribution of loans with conditionality appears to have a positive effect (although the result is dependent on the weights associated to the tax revenues and to the public debt).

Furthermore, the average fiscal multiplier of the Portuguese Resilience and Recovery Plan in the GDP and in private consumption would be, according to model A.2., positive. The predicted 16642 million Euros in public spending would provoke an approximately 226 million Euros increase in GDP and 213 million Euros in private consumption. The program would also provoke a reduction in the private investment of about 18 million Euros.

In conclusion, although the results are not statistically significant and therefore must be interpreted carefully, the issuance of common debt and the distribution of the resources by grants would be the best EU mechanism with respect to GDP, private consumption and private investment. If the distribution of grants is to be rejected in favor of loans, the presence of conditionality would improve the outcomes. Finally, the Portuguese Recovery and Resilience Plan, analyzed in program iii), would perform, because of the grants, better than programs that consider the distribution fully by loans.

6.3. Model B – Disaggregate model

Once models with aggregate variables were analyzed, we estimated the model using detailed functional spending. This disaggregation is rather important since when governments design a fiscal mechanism to implement a counter-cyclical fiscal policy, it must take into account the different categories of expenditures and revenues that it has at its disposal. Even though the revenue categories are not being considered, the estimation exercise in this sub-section should allow to analyze what would be the best EU mechanism for the given categories of expenditure and what combination of categories that would result on a better outcome for the Portuguese economy.

In this model, private consumption and investment were not considered because of the small size of the sample, now relying on annual data. The estimation output of the model is presented in Annex 8.1. and, as in the previous sub-section, we started by performing several tests to the model, whose results are detailed in Annex 8.2. According to those tests, since no roots lie outside the unit circle, the model satisfies the stability condition; the optimal number of lags is one; and all the variables in the model are stationary in first differences.

The accumulated IRFs of GDP are detailed in Figures 13 to 18:

Figure 13: Accumulated impulse response of log(gdp)-log(gdp(-1)) to shocks in log(g_health)-log(g_health(-1)), model B

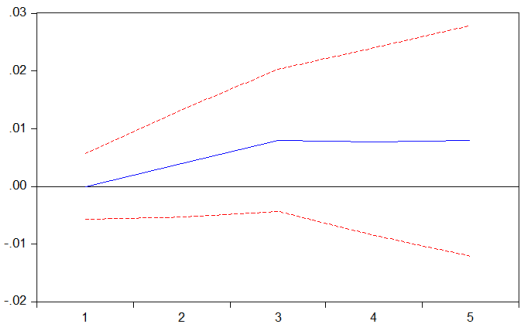


Figure 14: Accumulated impulse response of log(gdp)-log(gdp(-1)) to shocks in log(g_education)-log(g_education(-1)), model B

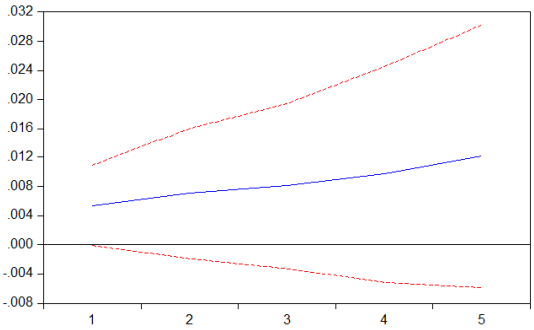


Figure 15: Accumulated impulse response of log(gdp)-log(gdp(-1)) to shocks in log(g_housing)-log(g_housing(-1)), model B

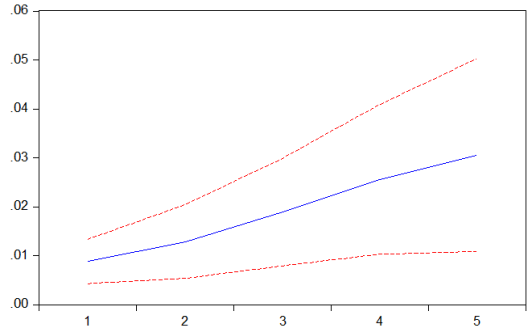


Figure 16: Accumulated impulse response of log(gdp)-log(gdp(-1)) to shocks in log(g_remain)-log(g_remain(-1)), model B

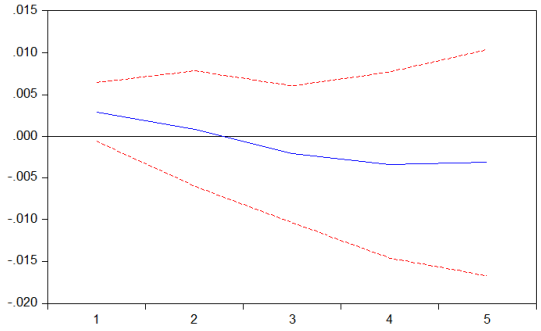


Figure 17: Accumulated impulse response of log(gdp)-log(gdp(-1)) to shocks in log(taxes)-log(taxes(-1)), model B

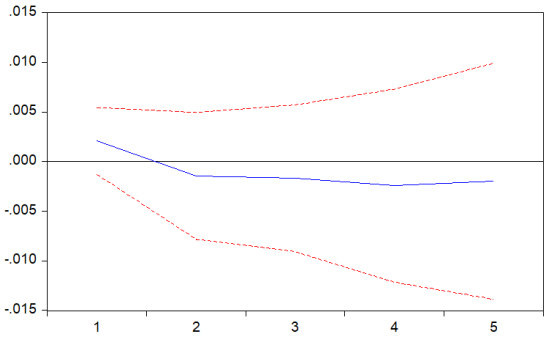
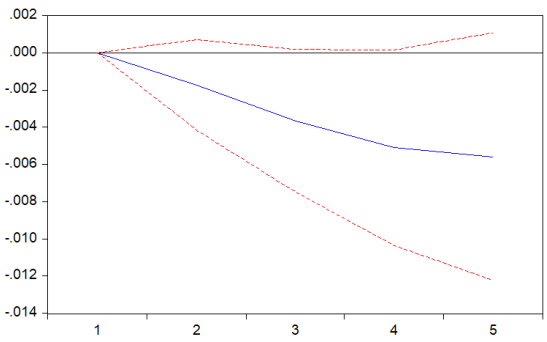


Figure 18: Accumulated impulse response of log(gdp)-log(gdp(-1)) to shocks in log(debt)-log(debt(-1)), model B



Regarding the fiscal multipliers, computed based on the accumulated IRFs, the results are presented in Table 8.

Table 8: Cumulative fiscal multipliers on GDP over 5 years, model B

Variable	Fiscal multiplier to GDP
Government expenditure in health	0.1186
Government expenditure in education	0.2087
Government expenditure in housing	4.4927
Remain government expenditure[36]	-0.0097
Tax revenues[36]	-0.0058
Public debt	-0.005[37]

Source: Own calculations.

The fiscal multiplier of the government expenditure in housing is not only positive, as it is also the largest multiplier estimated so far (and statistically significant). For each million Euros shock to this component, the GDP increases by almost 4.5 million Euros. Notice, however, that although the public spending in housing represents a small portion of the total government expenditure and around 11% of the government spending in education (own

[36] Statistically, these fiscal multipliers cannot be considered different from zero, because of the lack of significance of the IRF.

[37] For this analysis we considered the level of the GDP of 2019. One million Euros of additional public debt would represent an increase of 0.0004674p.p. on the debt ratio, which represents 0.04674% of a unitary increase. After calculating the fiscal multiplier for a unitary increase on the debt to GDP ratio (-10.695), we calculated the fiscal multiplier of the public debt for an increase of one million Euros (0.04674%*(-10.695)=-0.005).

calculation), the results suggest a potential for significant expansionary effects of the expenditures in housing. This is not surprising since most of these expenditures are composed of investment spending, which usually registers the largest fiscal multipliers according to the literature (Marvão Pereira & Roca-Sagalés, 2011)

Regarding the fiscal multiplier to the government expenditure in health and education, its signal is also positive. While a one million Euros shock in the public spending in health generates a 118600 Euros change in GDP, a similar increase of the expenditures in education leads to a rise of 208700 Euros in the GDP. Particularly concerning the fiscal multiplier of the spending in health, it would be interesting to analyze it during a pandemic period, in which public health measures and investment become crucial. Particularly, the preventive measures allow the continuation of the activities and, thus, minimize the downfall of the GDP.

Finally, the remain expenditure appears to have a negative fiscal multiplier, although for this variable the IRF and, therefore, the cumulative multiplier are not statistically different from zero.

Despite multiplier to tax revenues appears to have a negative signal, in contrast with the results of model A.1., but following the results in model A.2. and in Marvão Pereira and Roca-Sagalés (2011), in all models analysed, fiscal multipliers to tax revenues are not statistically different from zero.

Public debt multiplier registers in model B a smaller value than in the quarterly model A.1., with almost the absence of reaction of the GDP to a change in the public debt ratio. Notwithstanding, because of the negative signal, a rise in public debt would contribute to a fall of the GDP.

Having analyzed the fiscal multipliers, we can proceed to the analysis of the average cumulative multiplier on GDP of the alternative EU mechanisms. For that analysis, the Portuguese Recovery and Resilience Plan weights on disaggregate expenditure were computed as shown in Annex 2.

Table 9: Average cumulative fiscal multiplier on GDP over 5 years, under alternative EU mechanisms - model B with expenditure distribution as planned in the Portuguese Recovery and Resilience Plan

Design of the mechanism	Share of the fiscal multiplier considered						Average multiplier
	Health	Education	Housing	Remain G	Tax	Public debt	GDP
i) Common debt; distribution of grants; no conditionality	8.31%	11.53%	16.72%	63.44%	0%	0%	0.7789[38]
ii) Common debt; distribution of loans; no conditionality	8.31%	11.53%	16.72%	63.44%	0%	100%	0.7739
iii) Common debt; grants and loans; no conditionality	8.31%	11.53%	16.72%	63.44%	0%	17.16%	0.7780
iv) Common debt; distribution of loans; with conditionality	8.31%	11.53%	16.72%	63.44%	50%	50%	0.7735

Source: Own calculations.

The actually implement solution combined with the Portuguese Recovery and Resilience Plan appears to have a fiscal multiplier of 0.7780, which means that since the program for public discussion predicted a total amount above 16.6 billion Euros, the plan would promote an increase in the GDP by approximately 12.9 billion Euros over the next 5 years. According to our estimates of model B, investment in housing would represent the most important parcel of this effect.

If the mechanism was based on the distribution of loans without conditionality, the average multiplier in GDP would be similar to iv), but slightly smaller.

[38] $0.7789 = 0.0831 \times (-0.1186) + 0.1153 \times (-0.2087) + 0.1672 \times (4.4927) + 0.6344 \times (-0.0097) + 0 \times (0.0058) + 0 \times (-0.005)$

However, as mentioned in section 4, if the EU designed a mechanism combining loans and grants (which it did) and if Portugal would receive up to 13.9 billion Euros in grants and 14.2 billion Euros in loans, the Portuguese government could design a plan up to 28.1 billion Euros, with the loans representing 50.53% of this value. This plan, although computations not shown in the Table 9, would have, according to our estimates, a fiscal multiplier of 0.7764. Although this average multiplier is smaller than the one calculated for the actual solution, the fact that this would allow a significant larger program would cause a 21.81 billion Euros increase in the GDP over the next 5 years. Hence, if Portugal decided to use all the available resources and if it would keep the structure of the investments, it could strengthen the expansionary effects by almost 9 billion Euros.

Naturally, this last option would mean a 14.2 billion Euros increase in the public debt. The fact that the government did not want to take all the resources by borrowing this amount was predicted by Beck (2020) and Giavazzi and Tabellini (2020). Debt sustainability concerns the governments of the more volatile countries, particularly after the sovereign debt crisis.

If the mechanism approved by the EU was fully based on the distribution of grants, Portugal and other volatile countries would probably receive the entire amount. In that case, the average multiplier of the plan would be 0.7789 and it would have an accumulated effect of 21.89 billion Euros (considering a total expenditure of 28.1 billion Euros).

From the calculations conducted, and contrary to the previous models, a mechanism based only on the distribution of loans with conditionality would be the worst option to implement a common response. Even though the accumulated effect would still be positive, it would be lower than in the other alternatives, because it would combine the negative effects of public debt and tax revenues (contrary to models A, in model B the fiscal multiplier of the tax revenues is lower than the fiscal multiplier of the public debt). Besides, model B does not take into account the public debt overweight that could happen in this scenario or in the absence of a program (Delatte & Guillaume, 2020) and that this conditionality could restrict the effective use of the funds (Giavazzi & Tabellini, 2020).

Finally, different weights of the different categories could lead to distinct conclusions. According to the estimations performed in this section, if Portugal wanted to increase the overall impact of the recovery plan, it should increase the amount directed to housing. In

order to do it, it could maintain the investments predicted for the other categories and borrow from the Recovery and Resilience Facility[39] or it could reduce the investments in the other expenditures, keeping the total amount of the plan. If the last option was to be followed, model B suggests a reduction of the amount targeted to the expenditure categories not specified in the model.

In conclusion, the Recovery and Resilience Plan is expected to have positive accumulated effects in Portuguese GDP over the next five years and, though the average fiscal multiplier would be lower, the total effect could be larger if Portugal decided to receive in full both grants and loans available. Notwithstanding, a mechanism based only on the distribution of grants although it would not increase the expansionary effects significantly, it would incentive countries to implement larger programs.

[39] As presented in Annex 2, Portugal already predicted, in the plan published for public discussion, to borrow more than one billion to invest in housing, making this the second largest category benefiting from the loans.

7. Conclusion

The COVID-19 pandemic and the measures approved to tackle the health crisis caused a severe economic shock in the GDP of the EU, in general, and in the most vulnerable countries, like Portugal, in particular. Although the ECB extended its accommodative monetary policy, a diversity of authors argue that the Central Bank could not effectively counter the negative effects of this crisis by itself (*e.g.*, Bénassy-Quéré *et al.*, 2020b; Odendahl & Springford, 2020), with the fiscal policy playing, instead, a crucial role.

However, while the strongest economies of the EU had the chance to implement sound and robust fiscal policies, the most vulnerable countries were not able to do it, due to the small fiscal space to face the crisis (*e.g.*, Alesina & Giavazzi, 2020; Bénassy-Quéré *et al.*, 2020b; Gros, 2020). The lack of an adequate fiscal policy in response to the crisis would severely worsen the recession and hamper the recovery (Grund *et al.*, 2020).

Therefore, a common fiscal policy for the EU would be, according to most of the relevant literature, of a great importance to tackle the economic crisis caused by the pandemic. The need to safeguard a level playing field and the integrity of the single market (Mota & Peitz, 2020), to prevent debt sustainability problems (Garicano, 2020a), and to promote a sound, sustainable and convergent recovery (Boone & Pereira, 2020; *Grund et al., 2020*) are the main rationale for the implementation of a common policy.

Furthermore, a common action would prevent risks for the European project and the underlying economic, social and political costs (Beck, 2020; Giavazzi & Tabellini, 2020; Gostyńska-Jakubowska & Scazzieri, 2020; Grund *et al.*, 2020; Verwey *et al.*, 2020).

Once the rationale for a joint intervention is apprehended, we proceed to analyze what mechanisms could be at the disposal of Member-States to implement a common reaction. The use of the ESM and the issuance of Eurobonds were the main mechanisms highlighted in the literature.

Regarding the ESM, in its current version, it would function as a guarantee that the access to funding would not be cut (Guttenberg & Hemker, 2020) and that the financing costs would remain low (Odendahl & Springford, 2020). Besides, the rules of the mechanism could be rewritten, increasing the maturity of the loans (Bénassy-Quéré *et al.*, 2020b; Corsetti & Erce, 2020), reducing the conditionality to a minimum (Corsetti & Erce, 2020; Guttenberg & Hemker, 2020; Marimon, 2018), and avoiding controversial assessments (Erce *et al.*, 2020b), which would make the ESM a more appropriate instrument to the pandemic crisis.

However, the short maturity of the loans, if rules are not to be changed (Giavazzi & Tabellini, 2020), the fact that the loans would contribute to the expansion of the national public debts, and to the consequent debt sustainability problems (Beck, 2020; Delatte & Guillaume, 2020) and escalation of interest rates (Giavazzi & Tabellini, 2020), and the conditionality, even if reduced to a minimum, are constraints that reduce the adequacy of the ESM to smooth the crisis.

An alternative, identified in the literature, would be the issuance of common debt, *i.e.*, Eurobonds. On one hand, this common debt could be issued individually by Member-States and backed by all of them (Giavazzi & Tabellini, 2020), ensuring lower financing costs (Gros, 2020) and minimizing the risks of a new sovereign debt crisis (Giavazzi & Tabellini, 2020). On the other hand, Eurobonds could also be jointly issued, and the funds provided to each country through loans (Corsetti, *et al.*, 2020; Giavazzi & Tabellini, 2020), grants (Gros, 2020; Gourinchas, 2020) or even through a European program (Garicano, 2020b; Mota & Peitz, 2020).

While the distribution through loans would contribute, mainly, to the reduction of financing costs (Giavazzi & Tabellini, 2020), grants would reduce the differences between the dimensions of the national programs (Mota & Peitz, 2020), ensure low financing costs and reduce the sustainability risks of the public debt (Boone & Pereira, 2020). Finally, a European program, based on the EU own priorities (Garicano, 2020b), would not only ensure a level playing field, as it would also reduce moral hazard concerns (Mota & Peitz, 2020).

In spite of this advantages, both individual and common issuance of debt have disadvantages. The national public debt overload and the consequent debt sustainability concerns (Gros, 2020; Mota & Peitz, 2020) is the main problem of the country-level issuance. Notwithstanding, the sovereign transfers necessary to implement a common issuance, especially if funds are to be distributed by grants (Smaghi, 2020), the possible lower rating of the bonds (Erce *et al.*, 2020a), the inexistence of a vehicle ready to issue these bonds (Bénassy-Quéré *et al.*, 2020b) and the excessive risks for the richer countries (Perotti, 2020; Vihriälä, 2020) are some of the limitations associated to this option.

Before the assessment of the goodness of these theoretical alternatives, a brief description of the actually implemented policies is in order. Among others, the Recovery and Resilience Facility, framed within the Next Generation EU, was the most important fiscal mechanism to promote the recovery. This program is based on the issuance of common

debt, with the funds being partially distributed by grants and by loans to the member countries. Even though each country was kept independent in the design of its own recovery plan, the latter should respect the priorities stablished by the EU.

Once the main mechanisms to perform a centralized intervention were identified and the actually implemented solution analyzed, we had the necessary information to conduct econometric estimations to access the best design for an EU fiscal mechanism, from the Portuguese economy perspective, in terms of impacts on output, consumption and investment. For that purpose, we developed three VAR models of fiscal policy: a model with aggregate fiscal variables, without private consumption and investment; a model considering also the impacts on private consumption and investment; and a model with disaggregate government expenditures into health, education, housing and into an aggregator of the remain categories. While for the first two models quarterly data was used, for the latter only annual data was available.

Performing the VAR estimations enabled us to compute fiscal multipliers that were used to make a comparative assessment of four different, stylized, designs for EU fiscal support mechanisms: i) issuance of a common debt and distribution of the resources through grants free from conditionality, *i.e.*, similar to the issuance of Eurobonds with the resources distributed by grants; ii) issuance of common debt and distribution of the resources through loans and free from conditionality, *i.e.*, similar to the issuance of Eurobonds with the resources distributed by loans; iii) issuance of common debt and distribution of the resources by both grants and loans (the weights of the grants and loans used were calculated based on the Portuguese Recovery and Resilience Plan, published for public discussion on February 15th, 2021), also absent from conditionality, *i.e.*, similar to the actually implemented solution; iv) issuance of common debt followed by distribution of the resources through loans under conditionality, *i.e.*, similar to the use of the ESM.

A first thing to be noticed is that the results must be interpreted cautiously, since some of the IRFs, particularly those from the models using aggregate fiscal variables, were not statistically significant. Further estimations should be conducted in the future, as more data becomes available.

Both models with aggregate expenditure led to the same general conclusion regarding the impacts on GDP. The issuance of Eurobonds and the provision of grants would be the best possible mechanism, due to the positive spending multiplier and to the prevention of a public debt increase. This result was not a surprise since it was predicted by Boone and

Pereira (2020) and Gros (2020), analyzed in the literature review. Eurobonds with the distribution of loans would be the worst design (because of the public debt increase in a severely indebted country, as predicted by Delatte and Guillame (2020)). The actually implemented solution would be a second best (because of the small increase in public debt) and the ESM would perform better than the provision of loans without conditionality, because it would control over public debt increase.

Besides, regarding the impacts on private consumption, the overall conclusions would be the same. The main difference would be regarding private investment, since all the solutions, except the issuance of Eurobonds and the provision of grants, would provoke a negative impact on this variable. Because of the absence from public debt increases, the distribution of grants would be the best design from the private investment perspective.

Finally, the model with disaggregate expenditures led to slightly different conclusions. For the analysis of the fiscal multipliers, we considered the weights of the fiscal expenditure categories according to the Portuguese Recovery and Resilience Plan, published for public discussion on February 15th, 2021. First, we conclude that the estimated fiscal multiplier to the housing expenditures is the largest among the spending categories. This is not surprising since most of these expenditures are composed of investment spending which is standard to yield the largest fiscal multipliers according to the literature (Marvão Pereira & Roca-Sagalés, 2011). Second, although spending in education and housing would also have estimated positive impacts, the remain expenditures would register a negative effect. When comparing the alternative policy designs, we conclude that the issuance of Eurobonds and the provision of grants free from conditionality would still be the best mechanism, although the overall average multiplier in GDP would be similar across all the solutions. Nevertheless, the use of the ESM, providing loans under conditionality would be the mechanism with a smaller (but positive) multiplier and, thus, it would be the worst mechanism to implement a common response.

Hence, the investigation performed in this dissertation suggests that the issuance of Eurobonds and the distribution of the resources through grants would be the best common mechanism, from the Portuguese economy perspective, to tackle the COVID-19 economic crisis. Besides, although the average fiscal multiplier may be different, all the models suggest that the Portuguese Recovery and Resilience Plan published for public discussion on February 15th, 2021, will have a positive impact on the Portuguese GDP.

Notwithstanding, some questions remain, and further research should be carried regarding this theme. The use of a wider sample (specially to check if some of the lack of significance is due to the reduced size of the sample), the consideration of a model with further disaggregation regarding expenditure categories and also disentangling tax revenues, the assessment with similar models applied to other vulnerable economies – eventually, the use of panel data for several vulnerable economies -, and the assessment including data from the implementation of the Recovery and Resilience Plan onwards, are potential steps for improvements. Besides, one could also include in the study the economic impacts of the time lag necessary to negotiate and implement the common fiscal policy.

8. Appendix: European Rainy-Day Fund

An alternative to both mechanisms mentioned before would be the creation of an ERDF, designed to avoid permanent transfers between Member-States and appropriate to tackle major economic shocks (Lenarčič & Korhonen, 2018). Its advantages and disadvantages will be analyzed in this section.

This fund, according to Lenarčič and Korhonen (2018) proposal, would be designed to have a stabilizing function. During periods of positive output gap, countries would accumulate resources in their part of the fund, while in periods abnormally negative, they could use those resources or borrow funds from the savings of the others. This strategy would avoid the need of debt mutualization and the need of permanent transfers between countries.

Since countries would be able to withdraw the savings from the fund, one could argue that in a crisis like the one caused by COVID-19, all the countries would have the necessity to access their savings. Assuming that those savings would not be enough to face the significant shock, the stabilizing capacity of the fund would be threatened.

Precisely for this type of crisis, that affect many of the participants in the fund, Lenarčič and Korhonen (2018) proposed that the fund should be able to borrow on the financial markets. For that to be possible, the fund's debt would have to have a high rating, particularly through the creation of a capital structure, the granting of national guarantees, the issuance of bonds covered by future payments of the loans given by the fund or by future contributions, and, eventually, the power to collect taxes.

8.1. Advantages of the European Rainy-Day Fund

Lenarčič and Korhonen (2018; p. 6) defended that this ERDF has many advantages:

> "(…) it does not lead to permanent transfers, it minimizes the issue of moral hazard, it leads to limited borrowing needs and finally, inter-compartmental borrowing within the fund could be cheap. Higher costs would only apply if the fund would need to borrow on the market. The saving-borrowing nature provides a better incentive structure, improves political acceptance and it could also improve the fund's creditworthiness. In terms of governance, benefits of the European RDF could be derived from regular reporting about the countries' positions, which would increase transparency and confidence in sound conduct of public finances by participating countries. Finally, the access to the European RDF could be made ex-ante conditional on

the country complying with the European fiscal rules and with the Macroeconomic Imbalance Procedure, which would create incentives for running sound economic policies.".

Besides, the creation of this fund, at least in the EA, could contribute to improve the quality of the Member-States fiscal policy, during periods of economic expansion. By generating incentives to save and to accumulate resources for economic instability situations, the fund could not only reduce the procyclicality of the fiscal policy, but could also increase the stabilizing capacity of that policy (Buti, Eijffinger & Franco, 2003).

8.2. Disadvantages of the European Rainy-Day Fund

Lenarčič and Korhonen (2018; p. 6) defended that this ERDF has many advantages:

"(…) it does not lead to permanent transfers, it minimizes the issue of moral hazard, it leads to limited borrowing needs and finally, inter-compartmental borrowing within the fund could be cheap. Higher costs would only apply if the fund would need to borrow on the market. The saving-borrowing nature provides a better incentive structure, improves political acceptance and it could also improve the fund's creditworthiness. In terms of governance, benefits of the European RDF could be derived from regular reporting about the countries' positions, which would increase transparency and confidence in sound conduct of public finances by participating countries. Finally, the access to the European RDF could be made ex-ante conditional on the country complying with the European fiscal rules and with the Macroeconomic Imbalance Procedure, which would create incentives for running sound economic policies.".

Besides, the creation of this fund, at least in the EA, could contribute to improve the quality of the Member-States fiscal policy, during periods of economic expansion. By generating incentives to save and to accumulate resources for economic instability situations, the fund could not only reduce the procyclicality of the fiscal policy, but could also increase the stabilizing capacity of that policy (Buti, Eijffinger & Franco, 2003).

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10. Annexes

Annex 1: Recovery and Resilience Facility predicted grants and loans per Member-State (in billion Euros, current prices)

Member-State	Grants[40]	Loans[41]
Austria	3.5	27.1
Belgium	5.9	32.7
Bulgaria	6.3	4.1
Croatia	6.3	3.7
Cyprus	1.0	1.4
Czechia	7.1	14.3
Denmark	1.6	21.9
Estonia	1.0	1.9
Finland	2.1	16.4
France	39.4	168.4
Germany	25.6	240.9
Greece	17.8	12.7
Hungary	7.2	9.7
Ireland	1.0	18.7
Italy	68.9	122.7
Latvia	2.0	2.0
Lithuania	2.2	3.2
Luxembourg	0.1	N/A
Malta	0.3	0.8
Netherlands	6.0	55.3
Poland	23.9	34.7
Portugal	13.9	14.2
Romania	14.2	14.9
Slovakia	6.3	6.2
Slovenia	1.8	3.2

[40] Source: https://ec.europa.eu/info/sites/info/files/about_the_european_commission/eu_budget/recovery_and_resilience_facility_.pdf (accessed on February 13th, 2021).

[41] Source: Own Calculations based on the agreed rule that each Member-State could request a loan amounting up to 6.8% of its 2019 Gross National Income (GNI). The GNI data was retrieved from Eurostat.

Spain	69.5	84.8
Sweden	3.3	33.2
European Union	338[42]	360[43]

[42] The total amount of grants is bigger than the announced, because the announced amount (312.5 billion Euros) was in 2018 prices and the values considered in these table are in current prices.

[43] The total amount of loans distributed by Member-States cannot be bigger than 360 billion Euros. Hence, even though each Member-State can request a loan up to the value mentioned in this column, if all the countries did it, the loans would have to be adjusted according to the share of each country GNI in the EU's GNI.

Annex 2: Portuguese Recovery and Resilience Plan per component (million Euros)

Table 10: Matching between the Recovery and Resilience Plan components and the considered expenditure categories

RRP component		Structural Dimension	Predicted amount in grants	Predicted amount in loans	Considered expenditure category
C1 - National Health System		Resilience	1383	0	Government spending in health
C2 – Housing		Resilience	1633	1149	Government spending in housing
C3 – Social Responses		Resilience	583	0	Remaining government spending
C4 – Elimination of Poverty Areas from the Metropolitan Areas		Resilience	250	0	Remaining government spending
C5 – Investment and Innovation		Resilience	1396	1250	Remaining government spending
C6 – Qualifications and Skills		Resilience	1359	0	Government spending in education
C7 – Infrastructure	Business and Industrial Estates	Resilience	110	0	Remaining government spending
	Road Network	Resilience	723	0	Remaining government spending

C8 – Forest	Resilience	665	0	Remaining government spending
C9 – Water Management	Resilience	441	0	Remaining government spending
C10 – Sustainable Mobility	Climate Transaction	1032	300	Remaining government spending
C11 – Industry decarbonization	Climate Transaction	715	0	Remaining government spending
C12 – Sustainable Bioeconomy	Climate Transaction	150	0	Remaining government spending
C13 – Energetic Efficiency in Building	Climate Transaction	620	0	Remaining government spending
C14 – Hydrogen and Renewables	Climate Transaction	371	0	Remaining government spending
C15 – Digital School	Digital Transaction	559	0	Government spending in education
C16 – Companies 4.0	Digital Transaction	650	0	Remaining government spending
C17 – Quality and sustainability of public finances	Digital Transaction	406	0	Remaining government spending
C18 – Economic justice and Business Environment	Digital Transaction	267	0	Remaining government

				spending
C19 – Public Administration – Digitalization, Interoperability and Cybersecurity	Digital Transaction	631	0	Remaining government spending

Table 11: Total amount (million Euros) and weight of each considered expenditure category

Considered expenditure category	Total amount	Weight
Government spending in health	1383	8.31%
Government spending in education	1918	11.53%
Government spending in housing	2782	16.72%
Remain government spending	10559	63.44%
Total	16642	100%

Annex 3: Model A – endogenous variables and its source

Variable	Source	Time	Data considered[44]
G_SPENDING	Eurostat	2000Q1 – 2019Q4	Total general government expenditure
TAXES	Eurostat	2000Q1 – 2019Q4	Total tax revenue was computed by summing: taxes on production and imports, receivable; current taxes on income, wealth, etc., receivable; net social contributions, receivable; capital taxes, receivable. According to Eurostat glossary[45], taxes and social contributions assessed as unlikely to be collected would have to be deducted from this sum. However, since no data was found for Portugal, this step was not considered.
DEBT	Eurostat	2000Q1 – 2019Q4	General government consolidated gross debt as a percentage of GDP
REAL_INTEREST_RATE	Eurostat	2000Q1 – 2019Q4	Real Maastricht criterion interest rates[46]
CONSUMPTION	Eurostat	2000Q1 – 2019Q4	Household and NPISH final consumption expenditure
INVESTMENT	Eurostat	2000Q1 – 2019Q4	Gross fixed capital formation subtracting the general government gross fixed capital formation
GDP	Eurostat	2000Q1 – 2019Q4	Gross Domestic Product

[44] The real value of the variables was used, by deflating the nominal value by the implicit GDP deflator, considering 2010 as the base and national currency.
[45] Source: https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Tax_revenue (accessed on March 21st, 2021).
[46] Source: https://ec.europa.eu/eurostat/cache/metadata/en/irt_lt_mcby_esms.htm (accessed on March 21st, 2021).

Annex 4: Model B – endogenous variables and its source

Variable	Source	Time	Data considered[47]
G_HEALTH	Eurostat	1996 – 2019	General government expenditure by function – health
G_EDUCATION	Eurostat	1996 – 2019	General government expenditure by function – education
G_HOUSING	Eurostat	1996 – 2019	General government expenditure by function – housing and community amenities
G_REMAIN	Eurostat	1996 – 2019	Total general government expenditure deducted from the expenditures in health, education and housing.
TAXES	Eurostat	1996 – 2019	Total tax revenue was computed by summing: taxes on production and imports, receivable; current taxes on income, wealth, etc., receivable; net social contributions, receivable; capital taxes, receivable. According to Eurostat glossary[48], taxes and social contributions assessed as unlikely to be collected would have to be deducted from this sum. However, since no data was found for Portugal, this step was not considered.
DEBT	Eurostat	1996 – 2019	General government consolidated gross debt as a percentage of GDP
REAL_INTEREST_RATE	Eurostat	1996 – 2019	Real Maastricht criterion interest rates[49]

[47] The real value of the variables was used, by deflating the nominal value by the implicit GDP deflator, considering 2010 as the base and national currency.
[48] Source: https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Tax_revenue (accessed on March 21st, 2021).
[49] Source: https://ec.europa.eu/eurostat/cache/metadata/en/irt_lt_mcby_esms.htm (accessed on March 21st, 2021).

CONSUMPTION	Eurostat	1996 – 2019	Household and NPISH final consumption expenditure
INVESTMENT	Eurostat	1996 – 2019	Gross fixed capital formation subtracting the general government gross fixed capital formation
GDP	Eurostat	1996 – 2019	Gross Domestic Product

Annex 5: Model A.1.

Annex 5.1.: Estimation output

Vector Autoregression Estimates
Date: 06/21/21 Time: 16:42
Sample (adjusted): 2001Q2 2019Q4
Included observations: 75 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	LOG(G_SP...	LOG(TAXE...	REAL_INT...	LOG(GDP)-...	LOG(DEBT)...
LOG(G_SPENDING(-1)...	-0.257403	-0.056629	-1.490002	-0.001733	-0.007600
	(0.11891)	(0.08496)	(1.28549)	(0.01825)	(0.04061)
	[-2.16472]	[-0.66650]	[-1.15909]	[-0.09496]	[-0.18712]
LOG(TAXES(-1))-LOG...	-0.065963	-0.269800	0.341557	-0.028807	0.104420
	(0.16097)	(0.11502)	(1.74026)	(0.02470)	(0.05498)
	[-0.40978]	[-2.34563]	[0.19627]	[-1.16609]	[1.89924]
REAL_INTEREST_RA...	0.004329	0.008386	0.796699	-0.000731	-0.001344
	(0.00649)	(0.00464)	(0.07015)	(0.00100)	(0.00222)
	[0.66707]	[1.80873]	[11.3569]	[-0.73368]	[-0.60661]
LOG(GDP(-1))-LOG(G...	1.334874	2.346617	-2.806615	0.806413	-0.469115
	(0.69463)	(0.49634)	(7.50952)	(0.10660)	(0.23725)
	[1.92170]	[4.72781]	[-0.37374]	[7.56481]	[-1.97732]
LOG(DEBT(-1))-LOG(...	-0.029664	0.175128	5.844504	-0.017020	0.794578
	(0.22221)	(0.15878)	(2.40223)	(0.03410)	(0.07589)
	[-0.13350]	[1.10299]	[2.43295]	[-0.49910]	[10.4696]
C	0.027364	-0.019965	0.122838	0.002355	0.023681
	(0.02346)	(0.01676)	(0.25358)	(0.00360)	(0.00801)
	[1.16662]	[-1.19123]	[0.48442]	[0.65410]	[2.95604]
CRISIS	0.120651	-0.041946	0.585348	-0.005947	0.030976
	(0.04082)	(0.02917)	(0.44130)	(0.00626)	(0.01394)
	[2.95567]	[-1.43809]	[1.32642]	[-0.94941]	[2.22178]
@TREND	-0.001035	-0.000208	0.004070	5.92E-05	-0.000260
	(0.00049)	(0.00035)	(0.00525)	(7.4E-05)	(0.00017)
	[-2.13301]	[-0.60068]	[0.77553]	[0.79510]	[-1.56736]
R-squared	0.181284	0.367381	0.901471	0.795855	0.866649
Adj. R-squared	0.095746	0.301287	0.891177	0.774526	0.852717
Sum sq. resids	0.313846	0.160240	36.68006	0.007391	0.036611
S.E. equation	0.068442	0.048904	0.739908	0.010503	0.023376
F-statistic	2.119345	5.558427	87.57147	37.31395	62.20500
Log likelihood	98.94242	124.1511	-79.59834	239.5145	179.5131
Akaike AIC	-2.425131	-3.097362	2.335956	-6.173719	-4.573682
Schwarz SC	-2.177932	-2.850163	2.583154	-5.926521	-4.326483
Mean dependent	0.007280	0.011690	2.679884	0.007140	0.041959
S.D. dependent	0.071974	0.058506	2.242933	0.022120	0.060911

Determinant resid covariance (dof adj.)	3.02E-13
Determinant resid covariance	1.72E-13
Log likelihood	570.1361
Akaike information criterion	-14.13696
Schwarz criterion	-12.90097
Number of coefficients	40

Annex 5.2.: Impulse Response Functions

IRF of log(gdp)-log(gdp(-4)) to shocks in log(g_spending) - log(g_spending(-4))

Period	
1	0.001753
	(0.00120)
2	0.003023
	(0.00249)
3	0.004133
	(0.00349)
4	0.004982
	(0.00435)
5	0.005683
	(0.00507)
6	0.006251
	(0.00570)
7	0.006724
	(0.00627)
8	0.007119
	(0.00678)
9	0.007455
	(0.00725)
10	0.007743
	(0.00769)
11	0.007993
	(0.00809)
12	0.008211
	(0.00846)
13	0.008405
	(0.00881)
14	0.008577
	(0.00913)
15	0.008731
	(0.00942)
16	0.008869
	(0.00970)
17	0.008993
	(0.00995)
18	0.009106
	(0.01019)
19	0.009208
	(0.01041)
20	0.009300
	(0.01061)

IRF of log(gdp)-log(gdp(-4)) to shocks in log(taxes) - log(taxes(-4))

Period	
1	0.001671
	(0.00119)
2	0.001624
	(0.00243)
3	0.001800
	(0.00341)
4	0.001818
	(0.00424)
5	0.001803
	(0.00493)
6	0.001752
	(0.00552)
7	0.001685
	(0.00605)
8	0.001608
	(0.00652)
9	0.001528
	(0.00694)
10	0.001449
	(0.00733)
11	0.001373
	(0.00769)
12	0.001302
	(0.00802)
13	0.001235
	(0.00832)
14	0.001173
	(0.00860)
15	0.001117
	(0.00886)
16	0.001065
	(0.00910)
17	0.001018
	(0.00932)
18	0.000975
	(0.00952)
19	0.000936
	(0.00970)
20	0.000901
	(0.00987)

IRF of log(gdp)-log(gdp(-4)) to shocks in log(debt) - log(debt(-4))

Period	
1	0.000000
	(0.00000)
2	-0.000378
	(0.00076)
3	-0.001190
	(0.00191)
4	-0.002308
	(0.00320)
5	-0.003649
	(0.00450)
6	-0.005131
	(0.00574)
7	-0.006688
	(0.00690)
8	-0.008269
	(0.00798)
9	-0.009833
	(0.00897)
10	-0.011353
	(0.00989)
11	-0.012808
	(0.01074)
12	-0.014187
	(0.01154)
13	-0.015482
	(0.01229)
14	-0.016690
	(0.01299)
15	-0.017812
	(0.01365)
16	-0.018847
	(0.01428)
17	-0.019801
	(0.01488)
18	-0.020678
	(0.01544)
19	-0.021481
	(0.01598)
20	-0.022216
	(0.01649)

Annex 6.: Model A.2.

Annex 6.1.: Estimation output

Vector Autoregression Estimates
Date: 06/21/21 Time: 18:28
Sample (adjusted): 2001Q2 2019Q4
Included observations: 75 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	LOG(G_SP...	LOG(TAXE...	REAL_INT...	LOG(CON...	LOG(INVE...	LOG(GDP)-...	LOG(DEBT)...
LOG(G_SPENDING(-1)...	-0.200478	-0.076994	-1.377621	0.033697	0.278369	0.000973	0.013330
	(0.12636)	(0.09018)	(1.38894)	(0.02611)	(0.14741)	(0.01885)	(0.04195)
	[-1.58658]	[-0.85380]	[-0.99185]	[1.29082]	[1.88842]	[0.05162]	[0.31778]
LOG(TAXES(-1))-LOG...	-0.087781	-0.259487	0.319048	0.019303	0.150342	-0.028459	0.095139
	(0.16116)	(0.11502)	(1.77154)	(0.03330)	(0.18801)	(0.02405)	(0.05350)
	[-0.54467]	[-2.25605]	[0.18010]	[0.57972]	[0.79963]	[-1.18347]	[1.77818]
REAL_INTEREST_RA...	0.005968	0.007032	0.793636	-7.82E-05	-0.007093	-0.001077	-0.000356
	(0.00658)	(0.00469)	(0.07229)	(0.00136)	(0.00767)	(0.00098)	(0.00218)
	[0.90741]	[1.49831]	[10.9787]	[-0.05759]	[-0.92452]	[-1.09744]	[-0.16318]
LOG(CONSUMPTION(...	0.507184	-0.596743	-2.404432	0.228471	-0.686479	-0.205262	0.394980
	(0.55904)	(0.39897)	(6.14499)	(0.11550)	(0.65217)	(0.08341)	(0.18559)
	[0.90725]	[-1.49572]	[-0.39128]	[1.97816]	[-1.05261]	[-2.46081]	[2.12824]
LOG(INVESTMENT(-1)...	0.128725	-0.030180	0.384271	0.011118	0.044991	0.014885	0.039360
	(0.11499)	(0.08206)	(1.26398)	(0.02376)	(0.13415)	(0.01716)	(0.03817)
	[1.11944]	[-0.36776]	[0.30402]	[0.46798]	[0.33539]	[0.86753]	[1.03107]
LOG(GDP(-1))-LOG(G...	0.743070	2.868781	-1.429078	0.635185	1.193950	0.949743	-0.842567
	(0.82856)	(0.59132)	(9.10762)	(0.17118)	(0.96659)	(0.12363)	(0.27507)
	[0.89682]	[4.85150]	[-0.15691]	[3.71063]	[1.23522]	[7.68229]	[-3.06314]
LOG(DEBT(-1))-LOG(...	0.005762	0.180573	6.063029	0.027496	-0.267903	-0.005328	0.798506
	(0.22701)	(0.16201)	(2.49526)	(0.04690)	(0.26482)	(0.03387)	(0.07536)
	[0.02538]	[1.11461]	[2.42982]	[0.58628]	[-1.01163]	[-0.15731]	[10.5957]
C	0.025492	-0.014777	0.156196	0.003162	-0.040841	0.004761	0.020725
	(0.02429)	(0.01734)	(0.26704)	(0.00502)	(0.02834)	(0.00362)	(0.00807)
	[1.04935]	[-0.85232]	[0.58492]	[0.62998]	[-1.44106]	[1.31348]	[2.56972]
CRISIS	0.131243	-0.054413	0.535091	-0.025373	-0.089600	-0.010237	0.039227
	(0.04234)	(0.03021)	(0.46536)	(0.00875)	(0.04939)	(0.00632)	(0.01405)
	[3.10003]	[-1.80093]	[1.14984]	[-2.90093]	[-1.81418]	[-1.62059]	[2.79103]
@TREND	-0.001102	-0.000224	0.003616	-4.53E-05	0.001358	3.43E-05	-0.000265
	(0.00049)	(0.00035)	(0.00543)	(0.00010)	(0.00058)	(7.4E-05)	(0.00016)
	[-2.22943]	[-0.63450]	[0.66542]	[-0.44355]	[2.35479]	[0.46552]	[-1.61245]
R-squared	0.210688	0.391588	0.901796	0.750784	0.450142	0.813951	0.878538
Adj. R-squared	0.101399	0.307347	0.888199	0.716277	0.374008	0.788190	0.861720
Sum sq. resids	0.302574	0.154108	36.55881	0.012915	0.411783	0.006736	0.033347
S.E. equation	0.068227	0.048692	0.749962	0.014096	0.079594	0.010180	0.022650
F-statistic	1.927799	4.648393	66.32109	21.75751	5.912491	31.59666	52.23852
Log likelihood	100.3140	125.6142	-79.47417	218.5872	88.75758	242.9953	183.0148
Akaike AIC	-2.408374	-3.083045	2.385978	-5.562326	-2.100202	-6.213207	-4.613729
Schwarz SC	-2.099375	-2.774046	2.694976	-5.253328	-1.791204	-5.904208	-4.304730
Mean dependent	0.007280	0.011690	2.679884	0.007339	-0.012290	0.007140	0.041959
S.D. dependent	0.071974	0.058506	2.242933	0.026463	0.100599	0.022120	0.060911

Determinant resid covariance (dof adj.)	2.00E-19
Determinant resid covariance	7.33E-20
Log likelihood	907.2722
Akaike information criterion	-22.32726
Schwarz criterion	-20.16427
Number of coefficients	70

Annex 6.2.: Tests to the model

Table 12: Schwarz information criterion, model A.2.

Lag	Schwarz information criterion
0	-18.05143
1	-20.04776*
2	-18.46781
3	-17.66328
4	-16.15123
5	-14.89666
6	-14.80762
7	-16.71992

Table 13: VAR stability condition test, model A.2.

Roots	Modulus
0.916586	0.916586
0.764723	0.764723
0.534404 - 0.213630i	0.575521
0.534404 + 0.213630i	0.575521
-0.323009	0.323009
-0.158906	0.158906
0.087181	0.087181

Table 14: Unit-root tests on the variables, model A.2.

Variable	Level (*p-value*)	1st differences (*p-value*)
log(g_spending) - log(g_spending(-4))	0.0000	0.0000
log(taxes) - log(taxes(-4))	0.0002	0.0000
real_interest_rate	0.3472	0.0000
log(consumption) - log(consumption(-4))	0.0007	0.0000
log(investment) - log(investment(-4))	0.0353	0.0001
log(gdp) - log(gdp(-4))	0.0450	0.0000
Log(debt)-log(debt(-4))	0.6410	0.0002

Annex 6.3.: Impulse Response Functions

IRF of log(gdp)-log(gdp(-4)) to shocks in log(g_spending) - log(g_spending(-4))

Period	
1	0.002060
	(0.00116)
2	0.003624
	(0.00246)
3	0.004779
	(0.00351)
4	0.005556
	(0.00439)
5	0.006111
	(0.00509)
6	0.006517
	(0.00568)
7	0.006831
	(0.00621)
8	0.007079
	(0.00669)
9	0.007282
	(0.00715)
10	0.007448
	(0.00758)
11	0.007587
	(0.00799)
12	0.007702
	(0.00838)
13	0.007799
	(0.00874)
14	0.007880
	(0.00909)
15	0.007948
	(0.00942)
16	0.008007
	(0.00972)
17	0.008057
	(0.01001)
18	0.008100
	(0.01027)
19	0.008137
	(0.01052)
20	0.008170
	(0.01075)

IRF of log(gdp)-log(gdp(-4)) to shocks in log(taxes) - log(taxes(-4))

Period	
1	0.001134
	(0.00115)
2	0.001051
	(0.00242)
3	0.000979
	(0.00345)
4	0.000683
	(0.00427)
5	0.000305
	(0.00491)
6	-0.000113
	(0.00545)
7	-0.000537
	(0.00591)
8	-0.000954
	(0.00634)
9	-0.001354
	(0.00674)
10	-0.001735
	(0.00712)
11	-0.002095
	(0.00749)
12	-0.002434
	(0.00784)
13	-0.002752
	(0.00817)
14	-0.003049
	(0.00848)
15	-0.003326
	(0.00878)
16	-0.003583
	(0.00905)
17	-0.003821
	(0.00931)
18	-0.004041
	(0.00956)
19	-0.004245
	(0.00978)
20	-0.004433
	(0.01000)

IRF of log(gdp)-log(gdp(-4)) to shocks in log(debt) - log(debt(-4))

Period	
1	0.000000
	(0.00000)
2	-0.000113
	(0.00072)
3	-0.000766
	(0.00184)
4	-0.001942
	(0.00310)
5	-0.003529
	(0.00437)
6	-0.005385
	(0.00557)
7	-0.007388
	(0.00670)
8	-0.009443
	(0.00774)
9	-0.011485
	(0.00872)
10	-0.013471
	(0.00964)
11	-0.015374
	(0.01052)
12	-0.017181
	(0.01137)
13	-0.018883
	(0.01219)
14	-0.020478
	(0.01298)
15	-0.021967
	(0.01374)
16	-0.023353
	(0.01447)
17	-0.024639
	(0.01518)
18	-0.025830
	(0.01587)
19	-0.026931
	(0.01652)
20	-0.027947
	(0.01716)

IRF of log(investment)-log(investment(-4)) to shocks in log(g_spending) - log(g_spending(-4))	
Period	
1	-0.021810
	(0.00902)
2	-0.001591
	(0.01346)
3	-0.004409
	(0.01361)
4	-0.001345
	(0.01540)
5	-0.000869
	(0.01663)
6	4.35E-05
	(0.01797)
7	0.000561
	(0.01920)
8	0.001040
	(0.02038)
9	0.001414
	(0.02152)
10	0.001735
	(0.02261)
11	0.002006
	(0.02366)
12	0.002237
	(0.02465)
13	0.002434
	(0.02559)
14	0.002604
	(0.02648)
15	0.002751
	(0.02731)
16	0.002879
	(0.02809)
17	0.002990
	(0.02882)
18	0.003088
	(0.02950)
19	0.003175
	(0.03014)
20	0.003251
	(0.03073)

IRF of log(investment)-log(investment(-4)) to shocks in log(taxes) - log(taxes(-4))	
Period	
1	0.012765
	(0.00878)
2	0.022414
	(0.01307)
3	0.018692
	(0.01340)
4	0.018559
	(0.01476)
5	0.016906
	(0.01593)
6	0.015700
	(0.01709)
7	0.014379
	(0.01819)
8	0.013168
	(0.01925)
9	0.012013
	(0.02027)
10	0.010938
	(0.02125)
11	0.009935
	(0.02219)
12	0.009002
	(0.02309)
13	0.008136
	(0.02394)
14	0.007334
	(0.02475)
15	0.006592
	(0.02551)
16	0.005907
	(0.02622)
17	0.005274
	(0.02689)
18	0.004691
	(0.02752)
19	0.004155
	(0.02811)
20	0.003661
	(0.02866)

IRF of log(investment)-log(investment(-4)) to shocks in log(debt) - log(debt(-4))	
Period	
1	0.000000
	(0.00000)
2	-0.005707
	(0.00566)
3	-0.011362
	(0.00992)
4	-0.017588
	(0.01366)
5	-0.024000
	(0.01694)
6	-0.030533
	(0.01993)
7	-0.037001
	(0.02270)
8	-0.043288
	(0.02530)
9	-0.049307
	(0.02777)
10	-0.055008
	(0.03014)
11	-0.060368
	(0.03243)
12	-0.065377
	(0.03465)
13	-0.070042
	(0.03680)
14	-0.074373
	(0.03888)
15	-0.078384
	(0.04089)
16	-0.082093
	(0.04284)
17	-0.085517
	(0.04472)
18	-0.088675
	(0.04654)
19	-0.091584
	(0.04829)
20	-0.094262
	(0.04997)

IRF of log(consumption)-log(consumption(-4)) to shocks in log(g_spending) - log(g_spending(-4))	
Period	
1	0.000530
	(0.00163)
2	0.004086
	(0.00296)
3	0.005624
	(0.00385)
4	0.006998
	(0.00469)
5	0.007840
	(0.00536)
6	0.008461
	(0.00592)
7	0.008897
	(0.00638)
8	0.009229
	(0.00679)
9	0.009485
	(0.00714)
10	0.009691
	(0.00748)
11	0.009858
	(0.00779)
12	0.009995
	(0.00809)
13	0.010108
	(0.00837)
14	0.010203
	(0.00863)
15	0.010281
	(0.00888)
16	0.010347
	(0.00912)
17	0.010403
	(0.00934)
18	0.010450
	(0.00955)
19	0.010491
	(0.00975)
20	0.010525
	(0.00993)

IRF of log(consumption)-log(consumption(-4)) to shocks in log(taxes) - log(taxes(-4))	
Period	
1	-0.000386
	(0.00163)
2	0.001272
	(0.00291)
3	0.001530
	(0.00378)
4	0.001711
	(0.00455)
5	0.001576
	(0.00516)
6	0.001343
	(0.00565)
7	0.001037
	(0.00605)
8	0.000708
	(0.00639)
9	0.000372
	(0.00670)
10	4.34E-05
	(0.00699)
11	-0.000274
	(0.00726)
12	-0.000576
	(0.00752)
13	-0.000863
	(0.00777)
14	-0.001134
	(0.00801)
15	-0.001387
	(0.00824)
16	-0.001625
	(0.00846)
17	-0.001846
	(0.00866)
18	-0.002051
	(0.00886)
19	-0.002242
	(0.00904)
20	-0.002418
	(0.00921)

IRF of log(consumption)-log(consumption(-4)) to shocks in log(debt) - log(debt(-4))	
Period	
1	0.000000
	(0.00000)
2	0.000586
	(0.00100)
3	0.001120
	(0.00221)
4	0.001181
	(0.00348)
5	0.000716
	(0.00473)
6	-0.000210
	(0.00592)
7	-0.001473
	(0.00702)
8	-0.002951
	(0.00802)
9	-0.004545
	(0.00893)
10	-0.006180
	(0.00976)
11	-0.007805
	(0.01054)
12	-0.009385
	(0.01127)
13	-0.010902
	(0.01196)
14	-0.012343
	(0.01262)
15	-0.013701
	(0.01326)
16	-0.014976
	(0.01387)
17	-0.016166
	(0.01447)
18	-0.017274
	(0.01504)
19	-0.018303
	(0.01559)
20	-0.019256
	(0.01612)

Annex 7.: Model A.3.: Aggregate model with annual data between 1996 and 2019

Annex 7.1.: Estimation output[50]

Vector Autoregression Estimates
Date: 06/22/21 Time: 10:48
Sample (adjusted): 1998 2019
Included observations: 22 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	LOG(G_SP...	LOG(TAXE...	REAL_INT...	LOG(CON...	LOG(INVE...	LOG(GDP)-...	LOG(DEBT)...
LOG(G_SPENDING(-1)...	-0.004364	0.177686	-12.06463	0.189612	0.134692	0.120291	0.151424
	(0.24839)	(0.20881)	(6.77678)	(0.11346)	(0.37057)	(0.10013)	(0.25235)
	[-0.01757]	[0.85094]	[-1.78029]	[1.67115]	[0.36347]	[1.20133]	[0.60006]
LOG(TAXES(-1))-LOG...	-0.194347	-0.623882	5.069158	-0.057509	-0.281246	-0.230859	0.209357
	(0.32143)	(0.27021)	(8.76947)	(0.14683)	(0.47954)	(0.12957)	(0.32655)
	[-0.60463]	[-2.30887]	[0.57805]	[-0.39169]	[-0.58649]	[-1.78167]	[0.64111]
REAL_INTEREST_RA...	-0.000132	0.004012	0.782030	-0.003966	0.001487	-0.001517	0.001072
	(0.00535)	(0.00450)	(0.14594)	(0.00244)	(0.00798)	(0.00216)	(0.00543)
	[-0.02465]	[0.89218]	[5.35839]	[-1.62313]	[0.18632]	[-0.70367]	[0.19733]
LOG(CONSUMPTION(...	-0.730831	0.615418	-17.15465	-0.358968	0.723967	-0.117179	-0.783675
	(0.88031)	(0.74004)	(24.0172)	(0.40212)	(1.31333)	(0.35487)	(0.89434)
	[-0.83019]	[0.83161]	[-0.71426]	[-0.89270]	[0.55125]	[-0.33020]	[-0.87627]
LOG(INVESTMENT(-1)...	-0.334774	-0.100499	-5.620206	0.058748	0.002622	0.081084	-0.176164
	(0.27525)	(0.23139)	(7.50959)	(0.12573)	(0.41064)	(0.11096)	(0.27964)
	[-1.21625]	[-0.43432]	[-0.74840]	[0.46725]	[0.00639]	[0.73075]	[-0.62997]
LOG(GDP(-1))-LOG(G...	0.836637	0.157744	70.06991	-0.023116	-0.307208	0.059931	1.665712
	(1.59585)	(1.34155)	(43.5389)	(0.72896)	(2.38083)	(0.64332)	(1.62127)
	[0.52426]	[0.11758]	[1.60936]	[-0.03171]	[-0.12903]	[0.09316]	[1.02741]
LOG(DEBT(-1))-LOG(...	-0.492133	-0.300442	19.11105	-0.150050	-0.941438	-0.191956	0.840565
	(0.28502)	(0.23960)	(7.77609)	(0.13019)	(0.42522)	(0.11490)	(0.28956)
	[-1.72666]	[-1.25392]	[2.45767]	[-1.15252]	[-2.21402]	[-1.67068]	[2.90290]
C	0.057388	0.023949	-0.809524	0.035728	0.002645	0.027417	-0.007557
	(0.03153)	(0.02650)	(0.86019)	(0.01440)	(0.04704)	(0.01271)	(0.03203)
	[1.82016]	[0.90357]	[-0.94110]	[2.48075]	[0.05623]	[2.15711]	[-0.23593]
CRISIS	0.078911	-0.114081	4.323470	-0.069019	-0.161820	-0.047575	0.143053
	(0.04323)	(0.03634)	(1.17948)	(0.01975)	(0.06450)	(0.01743)	(0.04392)
	[1.82528]	[-3.13900]	[3.66556]	[-3.49502]	[-2.50894]	[-2.72986]	[3.25707]
@TREND	-0.002530	-0.000231	-0.005754	-0.000214	0.002281	-6.23E-05	-0.000888
	(0.00133)	(0.00112)	(0.03635)	(0.00061)	(0.00199)	(0.00054)	(0.00135)
	[-1.89899]	[-0.20639]	[-0.15828]	[-0.35195]	[1.14746]	[-0.11601]	[-0.65622]
R-squared	0.548915	0.631357	0.870968	0.754948	0.738519	0.761932	0.804915
Adj. R-squared	0.210601	0.354875	0.774194	0.571159	0.542408	0.583380	0.658601
Sum sq. resids	0.014690	0.010382	10.93460	0.003065	0.032697	0.002387	0.015162
S.E. equation	0.034988	0.029413	0.954577	0.015982	0.052199	0.014105	0.035546
F-statistic	1.622501	2.283539	9.000002	4.107687	3.765820	4.267297	5.501280
Log likelihood	49.21104	53.02978	-23.52644	66.44891	40.41014	69.19858	48.86337
Akaike AIC	-3.564640	-3.911798	3.047858	-5.131719	-2.764558	-5.381689	-3.533034
Schwarz SC	-3.068711	-3.415870	3.543786	-4.635791	-2.268630	-4.885761	-3.037105
Mean dependent	0.011477	0.017522	2.645431	0.011387	0.001081	0.011405	0.031429
S.D. dependent	0.039380	0.036620	2.008828	0.024406	0.077165	0.021852	0.060835

Determinant resid covariance (dof adj.)	9.78E-22
Determinant resid covariance	1.41E-23
Log likelihood	360.2944
Akaike information criterion	-26.39040
Schwarz criterion	-22.91890
Number of coefficients	70

Annex 7.2.: Impulse Response Functions

IRF of log(gdp)-log(gdp(-1)) to shocks in log(g_spending) - log(g_spending(-1))

Period	
1	0.006920
	(0.00282)
2	0.011380
	(0.00496)
3	0.009647
	(0.00676)
4	0.008379
	(0.00788)
5	0.007818
	(0.00879)

IRF of log(gdp)-log(gdp(-1)) to shocks in log(taxes) - log(taxes(-1))

Period	
1	0.008485
	(0.00229)
2	0.008897
	(0.00426)
3	0.013440
	(0.00562)
4	0.015692
	(0.00708)
5	0.018255
	(0.00819)

IRF of log(gdp)-log(gdp(-1)) to shocks in log(debt) - log(debt(-1))

Period	
1	0.000000
	(0.00000)
2	-0.004178
	(0.00258)
3	-0.009629
	(0.00458)
4	-0.013676
	(0.00611)
5	-0.016446
	(0.00742)

IRF of log(consumption)-log(consumption(-1)) to shocks in log(g_spending) - log(g_spending(-1))

Period	
1	0.008087
	(0.00318)
2	0.014512
	(0.00486)
3	0.013291
	(0.00594)
4	0.011723
	(0.00659)
5	0.011529
	(0.00725)

IRF of log(consumption)-log(consumption(-1)) to shocks in log(taxes) - log(taxes(-1))

Period	
1	0.005392
	(0.00282)
2	0.006497
	(0.00396)
3	0.007802
	(0.00475)
4	0.010340
	(0.00582)
5	0.012051
	(0.00681)

IRF of log(consumption)-log(consumption(-1)) to shocks in log(debt) - log(debt(-1))

Period	
1	0.000000
	(0.00000)
2	-0.003266
	(0.00288)
3	-0.009251
	(0.00447)
4	-0.012626
	(0.00546)
5	-0.015461
	(0.00645)

[50] Tests to the model are available under request to the author. The model satisfies the stability condition, and the variables are stationary for 1st differences.

IRF of log(investment)-log(investment(-1)) to shocks in log(g_spending) - log(g_spending(-1))

Period	
1	0.008509
	(0.01105)
2	0.018435
	(0.01975)
3	0.012974
	(0.02673)
4	0.006819
	(0.03126)
5	0.004670
	(0.03460)

Figure 19: Accumulated impulse response of log(gdp)-log(gdp(-1)) to shocks in log(g_spending)-log(g_spending(-1)), model A3

IRF of log(investment)-log(investment(-1)) to shocks in log(taxes) - log(taxes(-1))

Period	
1	0.036758
	(0.00948)
2	0.052250
	(0.01724)
3	0.064624
	(0.02232)
4	0.074583
	(0.02798)
5	0.081401
	(0.03228)

Figure 20: Accumulated impulse response of log(gdp)-log(gdp(-1)) to shocks in log(taxes)-log(taxes(-1)), model A3

IRF of log(investment)-log(investment(-1)) to shocks in log(debt) - log(debt(-1))

Period	
1	0.000000
	(0.00000)
2	-0.020491
	(0.00976)
3	-0.037836
	(0.01757)
4	-0.050544
	(0.02365)
5	-0.058350
	(0.02887)

Figure 21: Accumulated impulse response of log(gdp)-log(gdp(-1)) to shocks in log(debt)-log(debt(-1)), model A3

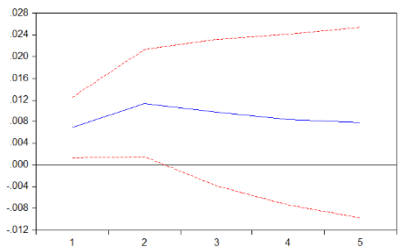


Figure 22: Accumulated impulse response of log(consumption)-log(consumption(-1)) to shocks in log(g_spending)-log(g_spending(-1)), model A3

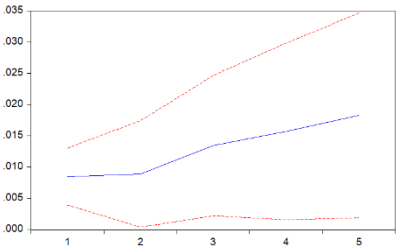


Figure 23: Accumulated impulse response of log(consumption)-log(consumption(-1)) to shocks in log(taxes)-log(taxes(-1)), model A3

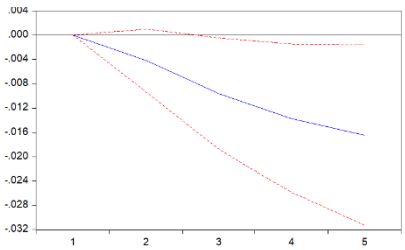


Figure 24: Accumulated impulse response of log(consumption)-log(consumption(-1)) to shocks in log(debt)-log(debt(-1)), model A3

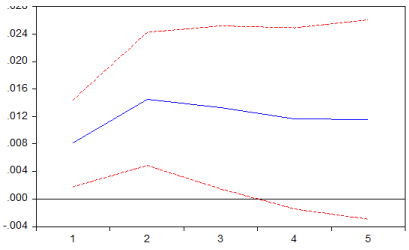


Figure 25: Accumulated impulse response of log(investment)-log(investment(-1)) to shocks in log(g_spending)-log(g_spending(-1)), model A3

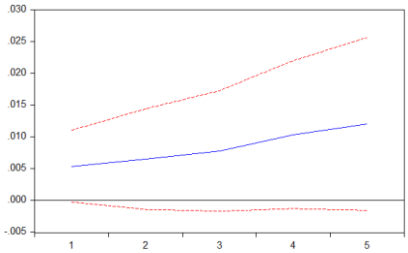


Figure 26: Accumulated impulse response of log(investment)-log(investment(-1)) to shocks in log(taxes)-log(taxes(-1)), model A3

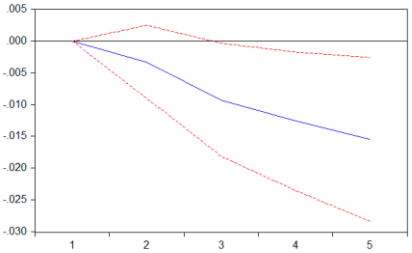
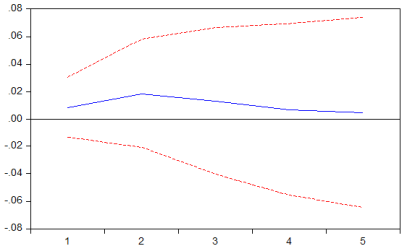
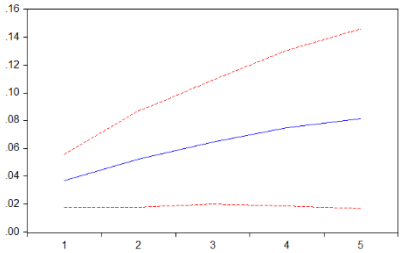
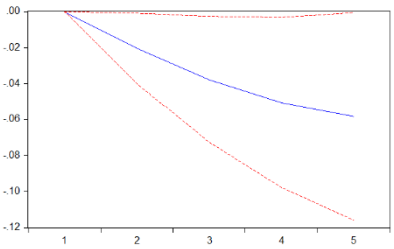


Figure 27: Accumulated impulse response of log(investment)-log(investment(-1)) to shocks in log(debt)-log(debt(-1)), model A3







Annex 7.3.: Fiscal multipliers

Table 15: Cumulative fiscal multipliers on GDP, private consumption, and private investment over 5 years, model A.3

Variable	Fiscal multiplier to GDP	Fiscal multiplier to private consumption	Fiscal multiplier to private investment
Government expenditure	0.017	0.0162	0.0018
Tax revenues	0.0528	0.0225	0.0417
Public debt	-0.0147[51]	-0.0089	-0.0092

Source: Own calculations

Table 16: Average cumulative fiscal multiplier on GDP, private consumption and private investment, under alternative EU mechanisms, model A.3.

Design of the mechanism	Share of the fiscal multiplier considered			Average multiplier		
	Government spending	Tax revenues	Public debt	GDP	Private consumption	Private investment
i) Common debt; distribution of grants; no conditionality	100%	0%	0%	0.017	0.0162	0.0018
ii) Common debt; distribution of loans; no conditionality	100%	0%	100%	0.0023	0.0073	-0.0074
iii) Common debt; grans and	100%	0%	17,16%	0.0145	0.0147	0.0002

[51] For this analysis we considered the level of the GDP of 2019. One million Euros of additional public debt would represent an increase of 0.0004674p.p. on the debt ratio, which represents 0.04674% of a unitary increase. After calculating the fiscal multiplier for a unitary increase on the debt to GDP ratio (-31.499), we calculated the fiscal multiplier of the public debt for an increase of one million Euros (0.04674%*(-31.499)=-0.0147).

loans; no conditionality						
iv) Common debt; distribution of loans; with conditionality	100%	50%	50%	0.0361	0.023	0.0181

Source: Own calculations

Annex 8.: Model B

Annex 8.1.: Estimation output

Vector Autoregression Estimates
Date: 06/22/21 Time: 17:21
Sample (adjusted): 1998 2019
Included observations: 22 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	LOG(G_HE...	LOG(G_E...	LOG(G_H...	LOG(G_R...	LOG(TAXE...	REAL_INT...	LOG(GDP)-...	LOG(DEBT)...
LOG(G_HEALTH(-1))-...	0.061974	0.780451	0.732728	0.678627	-0.134735	-9.544596	0.041850	0.467234
	(0.24704)	(0.28011)	(0.83137)	(0.37075)	(0.29867)	(9.16062)	(0.12862)	(0.31779)
	[0.25086]	[2.78620]	[0.88135]	[1.83043]	[-0.45111]	[-1.04192]	[0.32537]	[1.47025]
LOG(G_EDUCATION(-...	0.020581	-0.091249	-2.061292	0.087573	0.073268	2.896081	0.119761	-0.103085
	(0.18200)	(0.20636)	(0.61247)	(0.27313)	(0.22003)	(6.74857)	(0.09476)	(0.23412)
	[0.11308]	[-0.44219]	[-3.36556]	[0.32063]	[0.33299]	[0.42914]	[1.26389]	[-0.44032]
LOG(G_HOUSING(-1))...	-0.011281	0.044772	0.183517	0.036615	0.038330	-3.057811	0.021144	-0.109937
	(0.06729)	(0.07630)	(0.22645)	(0.10098)	(0.08135)	(2.49517)	(0.03503)	(0.08656)
	[-0.16765]	[0.58681]	[0.81041]	[0.36258]	[0.47116]	[-1.22549]	[0.60354]	[-1.27006]
LOG(G_REMAIN(-1))-...	-0.181350	0.111793	0.256834	-0.326937	0.127501	-4.113830	-0.025216	0.133049
	(0.18173)	(0.20605)	(0.61156)	(0.27272)	(0.21970)	(6.73856)	(0.09462)	(0.23377)
	[-0.99793]	[0.54255]	[0.41997]	[-1.19879]	[0.58033]	[-0.61049]	[-0.26651]	[0.56915]
LOG(TAXES(-1))-LOG...	-0.422997	-0.525592	1.771785	0.265105	-0.667699	-1.839956	-0.222395	0.339823
	(0.28062)	(0.31819)	(0.94438)	(0.42114)	(0.33927)	(10.4058)	(0.14611)	(0.36099)
	[-1.50734]	[-1.65182]	[1.87613]	[0.62949]	[-1.96805]	[-0.17682]	[-1.52214]	[0.94136]
REAL_INTEREST_RA...	-0.007004	0.004328	0.008516	0.008074	0.001223	0.715858	-0.000768	0.007017
	(0.00473)	(0.00536)	(0.01591)	(0.00709)	(0.00571)	(0.17526)	(0.00246)	(0.00608)
	[-1.48193]	[0.80767]	[0.53540]	[1.13823]	[0.21409]	[4.08454]	[-0.31223]	[1.15407]
LOG(GDP(-1))-LOG(G...	-0.075977	-0.434781	1.231026	-0.831958	0.752901	24.36681	0.049330	0.198295
	(0.67454)	(0.76483)	(2.27000)	(1.01230)	(0.81550)	(25.0125)	(0.35120)	(0.86771)
	[-0.11264]	[-0.56847]	[0.54230]	[-0.82185]	[0.92324]	[0.97419]	[0.14046]	[0.22853]
LOG(DEBT(-1))-LOG(...	-0.619681	-0.383794	-0.235127	0.160643	-0.139047	8.933015	-0.192664	0.764560
	(0.25313)	(0.28701)	(0.85184)	(0.37987)	(0.30602)	(9.38613)	(0.13179)	(0.32562)
	[-2.44812]	[-1.33722]	[-0.27602]	[0.42288]	[-0.45437]	[0.95173]	[-1.46191]	[2.34804]
C	0.089275	0.018016	-0.067832	7.49E-05	0.031766	0.382633	0.021023	-0.025523
	(0.03147)	(0.03568)	(0.10590)	(0.04723)	(0.03804)	(1.16689)	(0.01638)	(0.04048)
	[2.83694]	[0.50492]	[-0.64052]	[0.00159]	[0.83496]	[0.32791]	[1.28313]	[-0.63050]
CRISIS2009	0.041148	0.043262	0.134789	0.059046	-0.108350	3.948891	-0.052973	0.140578
	(0.02860)	(0.03243)	(0.09626)	(0.04293)	(0.03458)	(1.06067)	(0.01489)	(0.03680)
	[1.43855]	[1.33387]	[1.40025]	[1.37550]	[-3.13317]	[3.72303]	[-3.55700]	[3.82049]
@TREND	-0.002100	-0.001883	-0.003251	-0.001512	-0.000339	-0.021490	0.000320	-0.000919
	(0.00105)	(0.00119)	(0.00353)	(0.00157)	(0.00127)	(0.03888)	(0.00055)	(0.00135)
	[-2.00243]	[-1.58412]	[-0.92132]	[-0.96063]	[-0.26741]	[-0.55274]	[0.58577]	[-0.68164]
R-squared	0.862434	0.866413	0.732338	0.571114	0.620584	0.881387	0.802380	0.844352
Adj. R-squared	0.737374	0.744970	0.489009	0.181218	0.275660	0.773556	0.622725	0.702854
Sum sq. resids	0.007310	0.009398	0.082790	0.016464	0.010685	10.05168	0.001982	0.012097
S.E. equation	0.025779	0.029230	0.086755	0.038688	0.031167	0.955923	0.013422	0.033162
F-statistic	6.896165	7.134322	3.009660	1.464785	1.799189	8.173822	4.466229	5.967242
Log likelihood	56.88797	54.12412	30.19071	47.95691	52.71291	-22.60032	71.24690	51.34764
Akaike AIC	-4.171633	-3.920375	-1.744610	-3.359719	-3.792083	3.054574	-5.476991	-3.667967
Schwarz SC	-3.626112	-3.374853	-1.199089	-2.814198	-3.246561	3.600096	-4.931469	-3.122446
Mean dependent	0.017127	-0.002703	-0.024449	0.013552	0.017522	2.645431	0.011405	0.031429
S.D. dependent	0.050304	0.057881	0.121363	0.042756	0.036620	2.008828	0.021852	0.060835

Determinant resid covariance (dof adj.)	2.64E-24
Determinant resid covariance	1.03E-26
Log likelihood	408.4721
Akaike information criterion	-29.13383
Schwarz criterion	-24.76966
Number of coefficients	88

Annex 8.2.: Tests to the model

Table 17: Schwarz information criterion, model B

Lag	Schwarz information criterion
0	-22.73163
1	-24.76966*

Optimal number of lags: 1

Table 18: VAR stability condition test, model B

Roots	Modulus
0.692372	0.692372
-0.675994	0.675994
-0.172929 - 0.567759i	0.593510
-0.172929 + 0.567759i	0.593510
0.400021 - 0.397221i	0.563739
0.400021 + 0.397221i	0.563739
0.543967	0.543967
-0.325174	0.325174

Since no roots lies outside the unit circle, the VAR model satisfies the stability conditions.

Table 19: Unit-root tests on the variables, model B

Variable	Level (*p-value*)	1st differences (*p-value*)
log(g_health) - log(g_health(-1))	0.2648	0.0011
log(g_education) - log(g_education(-1))	0.0446	0.0007
log(g_housing) - log(g_housing(-1))	0.0339	0.0005
log(g_remain) – log(g_remain(-1))	0.0032	0.0000
log(taxes) - log(taxes(-1))	0.0006	0.0000
real_interest_rate	0.3894	0.0011
log(gdp) - log(gdp(-1))	0.1260	0.0002
log(debt) - log(debt(-1))	0.2698	0.0029

All the variables of the model are stationary in first differences.

Annex 8.3.: Impulse response functions

IRF of log(gdp)-log(gdp(-1)) to shocks in log(g_health) - log(g_health(-1))

Period	
1	-1.41E-06
	(0.00286)
2	0.003990
	(0.00466)
3	0.007983
	(0.00617)
4	0.007758
	(0.00813)
5	0.007912
	(0.00999)

IRF of log(gdp)-log(gdp(-1)) to shocks in log(g_education) - log(g_education(-1))

Period	
1	0.005378
	(0.00274)
2	0.007049
	(0.00449)
3	0.008080
	(0.00569)
4	0.009676
	(0.00742)
5	0.012156
	(0.00902)

IRF of log(gdp)-log(gdp(-1)) to shocks in log(g_housing) - log(g_housing(-1))

Period	
1	0.008809
	(0.00226)
2	0.012874
	(0.00378)
3	0.018915
	(0.00550)
4	0.025554
	(0.00764)
5	0.030540
	(0.00987)

IRF of log(gdp)-log(gdp(-1)) to shocks in log(g_remain) - log(g_remain(-1))

Period	
1	0.002869
	(0.00178)
2	0.000887
	(0.00347)
3	-0.002187
	(0.00411)
4	-0.003451
	(0.00557)
5	-0.003187
	(0.00678)

IRF of log(gdp)-log(gdp(-1)) to shocks in log(taxes) - log(taxes(-1))

Period	
1	0.002051
	(0.00170)
2	-0.001459
	(0.00320)
3	-0.001699
	(0.00370)
4	-0.002445
	(0.00486)
5	-0.002013
	(0.00595)

IRF of log(gdp)-log(gdp(-1)) to shocks in log(debt) - log(debt(-1))

Period	
1	0.000000
	(0.00000)
2	-0.001736
	(0.00122)
3	-0.003662
	(0.00192)
4	-0.005100
	(0.00263)
5	-0.005584
	(0.00332)

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