The asymmetric impact of the pandemic crisis on interest rates on public debt: some evidence from the Eurozone

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Abstract

The outbreak of Covid-19 has played the role of a 'game changer' in the way countries of the Eurozone have faced the economic consequences of the pandemic crisis. This paper investigates what has happened to the interest rates of the sovereign bond in selected countries of the Eurozone during the first six months of 2020. While the pandemic crisis can be interpreted as a symmetric shock, we found some important asymmetric consequences both in the sovereign bond market and the credit default swap market. Even though the European Central Bank (ECB) has played a fundamental role in easening tensions, especially with the announce of the Pandemic Emergency Purchase Programme (PEPP), countries with a higher pre-Covid level of the debt-to-GDP ratio have been found to undergo a significant jump in interest rates and a greater perceived risks of default, which may have long lasting consequences. Important policies implications emerge in relation to the future role of the ECB.

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1. Introduction

From a historical perspective, the sovereign bond market of the countries of the European Monetary Union (EMU) has been characterised by two different periods. The first period involves the years after the adoption of the single currency (1999), where a rapid convergence of the interest rates within the euro-area is observed for most countries. This outcome has been considered a natural consequence of the adoption of the Euro, as on the one hand, it prevented devaluation risks at single-country level, and on the other hand, it benefited from the direct control of inflation and price stability assigned to the European Central Bank (ECB). As a consequence, since the beginning of the EMU and until the first half of 2008, sovereign bond yields have not changed significantly, with an average bond spread over the German bund close to zero. Frömmel and Kruse (2015), for example, gives support to the convergence hypothesis for countries highly involved in the European integration policies (Belgium, France, the Netherlands and Italy) in the period from August 1983 to August 2007.

The beginning of the second period, to some extent, can be dated back to the bankruptcy of Lehman Brothers in September 2008. Indeed, from mid-2010 onwards, a non-negligible divergence of the yields started to emerge, with debt markets experiencing a severe stress in Greece and in other financially vulnerable euro-area countries, in particular in Ireland, Portugal, Cyprus, Spain and Italy, which has been only partially compensated by policy tools.[1]

[1] See Kilponen *et al.* (2015) who focus on the impact of a wide range of policy announcements on the long-term sovereign bond yields of seven European countries (Germany, France, Spain, Italy, Portugal, Ireland, Greece) in the period from January 2007 to September 2013.

In this framework, the outbreak of the Covid-19 pandemic is playing the role of a 'game changer'; while affecting the global economic activity since early 2020, it introduces new and unpredictable elements in the market of sovereign bonds. Indeed, even though the long-term socio-economic effects of Covid-19 outbreak cannot be known, significant economic slowdowns of national economies around the world are already observable (Fernandes, 2020).[2] The Eurozone is not an exception, as the spread of the virus has required severe measures that may undermine the economic and financial stability at least of some member states. In order to face this symmetric shock and to avoid even harder consequences, the ECB has been massively involved in shielding national economies, especially those of the most indebted countries. In particular, on the evening of 18 March 2020, the ECB has decided to implement the Pandemic Emergency Purchase Programme (PEPP), i.e. a new temporary asset purchase programme of public (and private) sector securities, with an initial endowment of 750 billion of euros, later increased to 1,350 billion on 4 June 2020, and thought to last until the coronavirus crisis will be over, in any case not before the end of March 2022.[3]

The intervention of the ECB, among others objectives, is aimed at easening the tensions on the interest rates on the public debt that member states has to issue to face the economic crisis. To some extent, this program would benefit more countries where the ratio between public debt and GDP was already at critical levels before the pandemic crisis. But the pandemic crisis, in its own, may harden the situation of those same countries notwithstanding the intervention of the ECB, as such a massive intervention will not last forever. In this respect, easening tensions may be a palliative; higher level of

[2] For more details about the socio-economic implications of the Covid-19, see Nicola *et al.* (2020).
[3] The maturing principal payments from securities purchased under the PEPP will be reinvested at least until the end of 2023, without interfering with the monetary stance of the ECB.

public debts that will emerge at the end of the pandemic crisis will almost certainly require the reverse to restrictive fiscal policies and will leave the most indebtd countries with an increasing difficulty to issue public debt because of possibly increasing interest rates.

In order to understand whether the public policy is moving towards this scenario, the paper will address some fundamental policy questions raised by the intervention of the ECB. In particular, has the involvement of the ECB been effective until now? Has its impact been symmetric across European countries? Is there any signal that the most indebted countries may face increasing tensions and can we expect long-run differential responses of bond yields in different countries?

The analysis performed in this paper considers the changes that have occurred in the government bond markets of selected Eurozone countries by comparing 2019 with the first six months of 2020 (from 31 December 2019 to 30 June 2020), which basically corresponds to the "first wave" of the pandemic crisis. To this purpose, both the 10-year government bond market and the related Credit Default Swap (CDS) market have been considered, in order to investigate the presence of a different path of two strongly related markets before and after the crisis. In fact, the link between CDS and government bond markets is complex, and in times of crisis it can be made even more complex by the different degrees of liquidity associated to government bonds of different countries, by market imperfections and by speculative movements. Yet, the evolution of the difference between the CDS premium and the bond yields might provide additional information on possible asymmetric consequences of the pandemic symmetric shock in the medium-run, especially because of their different reaction to the information available in times of economic distress.

The rest of the paper is structured as follows. Section 2 describes the issue. Section 3 shows the empirical methodology to estimate trend dynamics in the period that follows the spread of the disease and to assess the relationship between the sovereign debt market and the CDS market, testing for structural breaks at several points in time corresponding to different announcements from the ECB. Section 4 provides and discusses the main results. Section 5 concludes and provides some important policy implications driven by the results.

2. Setting the issue

In the European monetary union, member countries issue debt without having direct control over the relative currency. Thus, at the country level, the management of public debt is disjoint from the conduct of the monetary policy: debts are "national", while the monetary policy is "supranational". This also implies that governments may lose the option of monetary financing. The loss of a lender of last resort, which by definition can provide liquidity by printing money, makes the monetary union very sensitive to changing market sentiments. This can undermine the ability of governments to issue bonds, giving rise to a dangerous vicious circle between liquidity and solvency crisis (De Grauwe, 2011). The economic literature identifies three different channels through which a central bank could impact the yields of bonds when the public finance is under stress (Ghysels *et al.*, 2016). First, the purchases of government bonds may heighten the liquidity and the functioning of specific market segments, lowering the related premium. Second, by creating scarcity in specific segments with large-scale asset purchases, a central bank can lift the price of the related securities that are therefore interpreted as imperfect substitutes.

Third, central bank measures may affect market sentiments, increasing the overall confidence mostly when the dynamics of bond yields are driven not only by fundamentals but also by financial contagion, interpreted as a significant change in the reaction of financial markets.

The financial and economic crisis of 2008 in the Euro area has represented an important watershed in relation to sovereign bond yields' dynamics. After a period of convergence, which has characterized the initial stages of the monetary union, the relative spreads have increased significantly, and differences among member states have become increasingly pronounced especially during periods of financial turmoil. That crisis was an example of how a basically symmetric shock may have caused asymmetric long-run consequences. As a matter of fact, the European Central Bank (ECB) has in fact provided wide support to the issuance of national debts, in order to prevent tensions and to assure the stability of the Euro area through the implementation of the Securities Markets Programme (SMP) and of the Outright Monetary Transactions (OMT). These tools have actually been successful in lowering the interest rates of the more exposed countries (Krishnamurthy *et al.*, 2018) and in reducing the risk premium arising from liquidity concerns (De Pooter *et al.*, 2015). Furthermore, in 2015, the ECB announced the beginning of the Public Sector Purchase Programme (PSPP), which made the ECB and the participating National Central Banks (NCBs) the dominant investors in the European sovereign bond market (Boermans and Keshkov, 2018).[4] This measure had a beneficial impact on long-term sovereign bond, whose yields significantly lowered especially as maturity and riskiness increased (Altavilla *et al.*, 2015).

[4] The bond purchases have been implemented by NCBs at their own risk. From this perspective, it is misleading to state that the ECB directly bought government bonds (Belke and Gros, 2019).

In the recent pandemic crisis, the ECB seems to have played an analogous role in facing tensions on the bond market, especially after the announce of the monetary support provided by the Pandemic Emergency Purchase Programme (PEPP). Thus, a natural question to ask is whether this involvement of the ECB has been effective and, more importantly, whether its impact has been symmetric across European countries despite the different initial conditions. Or, alternatively, whether a symmetric pandemic shock has left different countries with asymmetric effects that may undermine the sustainability of public finances in a medium-term perspective.

3. Empirical methodology

In order to address this issue, we investigate the sovereign bond market of eight Eurozone member states (France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain) in the aftermath of the outbreak of Covid-19 (31/12/2019 – 30/06/2020), with particular reference to the impact of the ECB monetary policies that have been progressively adopted during the worsening of the health crisis. Following Agiakloglou and Deligiannakis (2020), we consider two different but strictly related markets: the 10-year sovereign bond market, which is considered as the benchmark in the bond market, and the 10-year sovereign CDS market denominated in U.S. dollars.[5] Looking at the CDS prices is particularly useful in times of economic distress, and even more when investigating the impact of economic policies on government bonds. In theory, CDS represents an alternative way to assess the default risk of a sovereign issuer, as it entails

[5] A premium of 100 basis points on the CDS market means it costs about 100,000 dollars to buy protection on 10 million dollars in government debt.

a transfer of sovereign credit risk between two parties through the purchase of a contract with protection against a negative credit event, such as the outright default, rating downgrade or delayed coupon payments. To some extent, the CDS price reflects both the expected loss of purchasing bonds (which depends on the probability of default and the recovery rate on the nominal value of the bonds) and the risk premium (where risk aversion and volatility play a fundamental role). As we will see below, particularly important, especially in times of economic crisis and financial distress, is the possibility that price variations of CDS may anticipate changes in the bond spread, leaving to the CDS a leading role in the price discovery process, i.e. in the process by which bond markets attempt to identify permanent changes in the equilibrium transaction prices (Harris *et al*., 2002), or – alternatively – by focusing attention on the speed component of the process (Hasbrouck, 1995).

The first step of the empirical analysis is to estimate an Ordinary Least Squares (OLS) multiple regression, where the dependent variable y_t is, in turn, the interest rate on 10-year sovereign bonds and the 10-year CDS premium on the same bond, and explanatory variables are the intercept β_0 and a linear time trend t (with β_1 representing the angular coefficient):

$$y_t = \beta_0 + \beta_1 t + \varepsilon_t \tag{1}$$

We then run two different tests: a Quandt Likelihood Ratio (QLR) test in order to identify the unkown structural break, that generally coincides with one of the days around the World Health Organization (WHO)'s pandemic declaration (March 11); a Chow test in order to verify whether a structural break exists corresponding to the outbreak of the disease. To this regard, we take as a benchmark date the day when the increase in the new

cases of Covid-19 became constant; obviously, this day is different for each country depending on the spread of the disease (see Table A.1 or A.2). Once the structural break has been identified, we estimate the following model:

$$y_t = \beta_0 + \beta_1 D_1 + \beta_2 t + \beta_3 t D_1 + \varepsilon_t \quad (2)$$

where D_1 is a dummy variable which is equal to 0 for the values prior to the structural break and to 1 for the values after it; β_0 and β_1 are the two different intercepts; β_2 and β_3 the angular coefficients and ε_t represents the error. Once again, we run a Chow test validating the significance of the unknown structural break and we replicate this step-by-step procedure by progressively adding four known possible structural breaks for each of the eight countries analysed: a) March 19, which represents the day after the first announce of the PEPP; b) March 30, which corresponds to the actual beginning of the purchases on the sovereign secondary market; c) a date between the end of April and the middle of May to consider the easing of quarantine measures (this day is different for each country, following the national trend of the epidemiological curve, see Table A.1 or A.2); d) June 4, when the ECB announces the reinforcement of the programme.

Having been declared on the evening of 18 March 2020, the announce effect of the new programme of public purchases has been tested on the first following trading day. Despite the fact that the purchase programme has officially started on 26 March 2020, the ECB periodic bulletin records zero purchases in the week of 23-27 March. For this reason, 30 March 2020 has been considered as the actual beginning of the programme. We also took into account the reinforcement of the programme announced on 4 June 2020. The final model may thus be written in the following way:

$$y_t = \beta_0 + \beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \beta_4 D_4 + \beta_5 D_5 + \beta_6 D_6 + \beta_7 t + \beta_8 t D_1 + \beta_9 t D_2 + \beta_{10} t D_3 + \beta_{11} t D_4 + \beta_{11} t D_5 + \beta_{12} t D_6 + \varepsilon_t \quad (3)$$

where D_1 is the dummy variable relative to the outbreak, D_2 the dummy variable relative to the unknown structural break, D_3 the dummy variable relative to the PEPP's announce, D_4 the dummy variable relative to the day in which PEPP's actually started, D_5 the dummy variable relative to the easing of quarantine measures and D_6 the dummy variable relative to the PEPP's reinforcement. The results of the multiple regressions are then reported for each country in the Appendix (Table A.1 and A.2).

Since we use yields and price levels, we check the stationarity of the residuals of each regression with the augmented Dickey-Fuller test (ADF). As reported in Table 1, the whole sample of the residuals in any kind of specification for each country (without constant, with constant and with constant and trend) is stationary.

[Table 1 about here]

The strong link between the 10-year sovereign bond market and the 10-year sovereign CDS market has been explored in a three-fold way. First of all, we investigate the (Granger) causality (Granger, 1969) of the two series by estimating the order of integration – to ensure their stationarity within a VAR model – using the HQC criterion for selecting the optimal lag order. In this way, it is possibile to understand whether a linkage exists and what is the direction of causality.[6] Secondly, we run a simple linear regression between the two series by taking into consideration four different periods in

[6] It is important to recall that Granger causality refers to the ability of one variable to predict the other. In this sense, one variable is believed to be caused by another one in a particular meaning; Granger causality is in fact not necessarily a true causality taking only into consideration the temporal precedence of one variable over the other, but it provides useful information about the link between two variables.

order to find any differences between the last quarter of 2019 and the first six months of 2020, which have been in turn divided into two sub-periods with the PEPP's announce as a watershed. Finally, in order to test possible changes of the misalignment between CDS and bond spreads before and after the pandemic crisis, we use a Vector Error Correction Model (VECM), after having tested the presence of a long-term relationship of alignment (where CDS price is equal to bond spreads).

4. Estimation results

4.1. *The impact of 10-year interest rates*

Figure 1 graphically describes the possibility that a symmetric shock may have caused temporary asymmetric effects on the interest rates of 10-year sovereign bonds. There are some issue to note. First, in all countries there is a peak corresponding to the date of the unknown break, which is identified in the interval between March 12 and March 16.[7] Furthermore, in almost all countries, the significant upsurge breaks the previous decreasing trend (with the possible exception of Greece).

[Figure 1 about here]

It is worth noting that the impact does not depend on the reliability of member countries. The highest increase is recorded in Greece (about 2 percentage points), while intermediate increases (close to 1 percentage point) occurred in Italy, Portugal, Spain, and France, and the lowest increases (about half a percentage point) in Germany, Ireland, and Netherlands.

[7] In the Appendix, Table A.1 reports the statistical significances of the structural breaks in relation to the 10-year sovereign bond yields. From this point of view, the unknown structural break is significant for the whole sample and always falls a few days after the pandemic declaration.

Even though different in scale, these increases give some support to the symmetric nature of the shock among European countries, which is also confirmed by the positive variations in absolute terms of the "unknown breaks" reported in Table 2. Obviously, those same coefficients allow to appreciate the difference in scale of the estimated changes, with Italy experiencing the highest increase (0.47) and Ireland the lowest one (0.19).

[Table 2 about here]

The visual inspection of Figure 1, however, provides further information, as after the date of the symmetric shock, some differences emerge in the path of the interest rates across countries. While the end points of the graphs are very close to the pre-Covid level for all countries, interest rates have temporarily increased in Italy, Greece, Spain, and to a less extent in Portugal. In other words, those countries that are often defined as peripheral in the Euro area have experienced an increasing trend of interest rates before re-establishing a decreasing trend. This path does not emerge in the other countries, if one makes exception for Germany following the decision of the German Federal Constitutional Court's judgment (Table A.2 in Appendix).

There are some factors that may have played a role in shaping the increasing trend of the interest rates after the break. First, a higher risk may be perceived in further emissions due either to the high level of public debt in relation to GDP or to the perceived lower ability to recover economic growth. To this purpose, a first estimate of the influence of the debt-to-GDP ratio on the 10-year sovereign bond yields can be carried out by analysing the relationship between the two variables in the last quarter of 2019. What we get is the expected outcome that a higher debt-to-GDP ratio is clearly associated with

higher bond yields (Figure 2).[8] The outbreak of Covid-19 has not only confirmed this tendency, but it has also changed the steepness of the relation. As reported in Figure 3, lower debt-to-GDP ratios are now associated with lower interest rates while higher ratios are now associated to higher sovereign bond yields (Figure 3). This amounts to say that after the pandemic crisis, the risk premium for the same level of debt-to-GDP ratio seems to have increased; furthermore, the shift becomes particulary significant after the second half of March, despite the ECB's intervention.[9]

[Figures 2 & 3 about here]

To some extent, as already happened in the crisis of 2008 (even though of different nature), long-term interest rates have increased more after the shock in those countries that accumulated deficits during normal times or that can be more exposed to international financial crises (Kilponen *et al*., 2015). To this respect, symmetric shocks – in Europe – tend to cumulate asymmetric impacts even when the deterioration of the public finances are not directly imputable to the fiscal misconduct of member states. In particular for Italy and Spain, it is likely that the level of long-term interest rates may be affected by the uncertainty about the sustainability of public debt, and the financing of their deficits at manageable rates in the next few years.

In similar scenarios, the role of the ECB may be fundamental in easening tensions in the bond markets. Our empirical investigation confirms that after the shock, this intervention has been effective. As reported in Table 2, indeed, the "PEPP's announce" has a clear impact on reducing interest rates, with the possible exception of Germany

[8] It is interesting to underline that public debt plays a significant role in influencing sovereign bond yields only when we consider its ratio to GDP. The same influence is not played if we consider it in absolute terms. See Figure A.1 in the Appendix.
[9] The same qualitative outcome is obtained when considering a logarithmic trend.

whose bonds are the benchmark for the whole European bond market. It is worth noting that the positive impact of the PEPP's announce is very strong in Italy, where the impact of the unknown break was also the highest; it is also significant in Portugal and Spain; and it is at its highest level in Greece, when the ECB declared to be available to purchase bonds of any European countries regardless of the bond rating provided by international agencies. Thus, as it should be, the role of the ECB has proved more effective in those countries that were already more financially exposed to the economic instability.

Yet, our empirical investigation also reveals that the positive impact of the announce rapidly declined. In other terms, the announce seems to have been more powerful than the actual purchases realised by the ECB and started in March 30. This happens any time that the markets discount in advance the impact of the measures, and it is in line with Attinasi *et al*. (2009) conclusions, who remark an important feature of the bank rescue packages during the 2008 financial crisis: government announcements of such packages have induced repricing of the sovereign risk, but this repricing has been independent of their actual amount.

Support to the power of the announce compared with the impact of the actual purchases can indeed be found in Table 2 (in the row "PEPP's purchases"), where there is evidence of only a very weak positive impact (i.e., reduction of interest rates) in Greece, while for all other countries this positive impact has rapidly vanished. In Italy, Portugal, and Spain, the PEPP's purchases are associated with a new upsurge of interest rates, which in Italy and Portugal is neutralised only at the "end of lockdown", i.e. in correspondence of the attempt to re-start the whole economic process. To some extent, this may be due to the perception of the end of lockdown as an effective new starting point for the functioning of markets in terms of expectations. This may also be the reason why the "PEPP's

reinforcement" has not any significant impact on the dynamic of the bond yields (again with the weak exception of Greece).

Is this temporary increase of the interest rates after the peak of the unknown break without costs? The answer is a mixed one, as in the period analysed the gross issues of debt securities have been not negligible in some countries, especially in France, Germany and Italy: in the period between April and June, they amounted in absolute terms to about 405, 246 and 195 billions, respectively (Table 3). If we look at the relative amount in relation to the level of gross debt at the end of 2019, the previous scenario slightly changes: during the same three months, the Netherlands issued 23.3% of its total debt, France 17%, and Germany 12%, and their ranking does not change when considering the whole period. The other countries, instead, issued public debt amounting to a share of less than 10% of the initial stock.

[Table 3 about here]

Since only part of these emissions have been purchased by the ECB under the PEPP (Table 4), this implies that the greatest part of the gross emissions have occurred at higher interest rates, even though for a small time interval, which may have caused a further asymmetry in response to the pandemic crisis.

[Table 4 about here]

4.2. *The relationship between interest rates and credit default swaps*

As previously noted, CDS represents an alternative way to assess the default risk of a sovereign issuer, as it entails a transfer of sovereign credit risk between two parties

through the purchase of a contract with protection against a negative credit event, such as outright default, rating downgrade or delayed coupon payments. After the financial crisis of 2008, sovereign risk has become a critical issue for many member states of the Eurozone. From that moment sovereign credit spreads raised rapidly, which represents a total novelty compared to the previous regime. Along with this progressive divergence, credit risk protection for sovereign debt begins to increase significantly in the form of CDS purchases, creating a strong link between CDS premiums and sovereign bond yields.

For this reason, some authors identify in the prices of CDS a more accurate estimate of government interest rates, due to the fact that government CDS markets are often more liquid than government bond markets (Longstaff *et al.*, 2011).[10] In order to investigate the link, if any, between the sovereign bond yields and the CDS premiums also in the present crisis, we perform a further empirical analysis. First of all, we run the Augmented Dickey-Fuller test in order to know the order of integration of our series and to avoid the presence of spurious correlations (Table 5). The whole sample is integrated of order 1, I(1), which means that first differences (in logs) are stationary processes. The corresponding correlations suggest the existence of a particular, but predictable, characterization, which is in line with the previous results: the most fragile countries in terms of public finance variables (Greece, Italy, Portugal and Spain) show a significant and higher correlation between sovereign bond and the related CDS markets with 10 years of maturity. At the same time, Germany and the Netherlands, whose bonds are considered safe-haven assets, does not display the same correlation. In any case, when we look at the

[10] For more information about the significative relationship between government bond yields and their associated CDS, see Agiakloglu and Deligiannakis (2020), who analyze sovereign risk for eight European countries before, during and after the financial crisis of 2008 and the subsequent 2011 European debt crisis in order to find the market that leads to price discovery process.

Granger causality, the significant linkage between the two markets becomes clearer. Generally speaking, the movements in CDS market always seem to anticipate the dynamics in the sovereign bond market, which means that CDS play a leading role in the price discovery process. In any case, the fundamental question is whether we can extend this kind of reasoning to all countries and whether the price discovery process maintains its direction before and after the pandemic crisis.

[Table 5 about here]

A first simple way to show the close connection between 10-year sovereign bond yields and 10-year CDS premium is to run a linear regression between the two series (Figure 4). This analysis has been carried out by taking into consideration two different periods: the year 2019 as a whole – in order to verify if the outbreak caused by the Covid-19 has created any differences in the aforementioned relationship – and the first two quarters of 2020, which have been subsequently divided into two sub-periods with the PEPP's announce as a watershed. On the one hand, the close link between the two variables appears clear; on the other hand, it is worth noting that, despite the effort of the ECB, the health crisis has resulted in an increase in the perceived risk of default: the same interest rate is associated with a higher CDS premium, especially in the second quarter of 2020, as evident by the highest line in Figure 5.

[Figures 4 & 5 about here]

In the same vein, the underlying link between CDS and interest rates is further evident in Figure 6, where it is shown that the path of CDS even exacerbates the increasing path of interest rates previously highlighted in Figure 1 in Italy, Portugal, Greece, and Spain, and shows a slight increase even in countries like Germany and France. Furthermore, also

in this case, the significant upward movement following the unkown structural break is mitigated by the announcement of the PEPP; while the actual begininng of the purchases at the end of March is associated to increasing risk premiums, especially in Greece, Italy, Portugal and Spain. Differently from the 10-year interest bonds, in this case the end of lockdown and the PEPP's reinforcement significantly affect CDS dynamics, pushing them down.

[Figure 6 about here]

[Table 6 about here]

In order to have a more precise information about the relationship between bond spreads and CDS, in particular about which of the two may play a leading role in the price discovery process, we estimated a Vector Error Correction Model for each country (Coudert and Gex, 2010; Fontana and Sheicher, 2010). To this purpose, we exploit the stationarity of the first difference of both bond spreads and CDS prices.[11] As well known, this allows to use a two-variable Vector Error Correction (VEC) model in which the long-run equilibrium is given by a zero basis (i.e. no difference between CDS premia and bond spreads) in a context where both spreads and CDS premia evolve jointly over time.[12] In particular, for each country j, the model can be written as follows:

$$\Delta spr_{t,j} = \beta_0 + \beta_1 \Delta spr_{t-1,j} + \beta_2 \Delta cds_{t-1,j} + \lambda_1 (spr_{t-1} - \alpha_0 - \alpha_1 cds_{t-1}) + \varepsilon_t \qquad (4)$$

$$\Delta cds_{t,j} = \gamma_0 + \gamma_1 \Delta spr_{t-1,j} + \beta_2 \Delta cds_{t-1,j} + \lambda_2 (spr_{t-1} - \alpha_0 - \alpha_1 cds_{t-1}) + \mu_t \qquad (5)$$

[11] The test is not included but it is available from the authors upon request.

[12] Since a CDS premium can be interpreted as the spread between the government bond and the risk-free interest rate, CDS premia and bond spreads should have the same value. The presence of a diverging value is what motivates the analysis, to understand what "price" between the two is leading the other in the adjustment path (see Duffie, 1999; Coudert and Gex, 2010). Indeed, differences between the two can provide information on the potential existence and size of arbitrage opportunities which should typically be very small if credit markets are functioning normally (see Fontana and Schiecher, 2010).

where Δspr is the difference of bond spreads with the German bund with one lag, Δcds is the difference between CDS prices with the same lag, λ coefficients are the error-correction coefficients measuring the response of the dependent variable to the deviation from lon-run equilibrium, where it is assumed that $spr_{t-1} - \alpha_0 - \alpha_1 cds_{t-1} = 0$. In this model, we expect $\lambda_1 < 0$, because if $spr_{t-1,j}$ is above its long-run value, then $(spr_{t-1} - \alpha_0 - \alpha_1 cds_{t-1}) > 0$ and this should lead to a downward movement of $spr_{t,j}$. Thus, if $\lambda_1 < 0$ is statistically significant and λ_2 is not, the price discovery process is led by the bond market, a situation that should occur in the most reliable countries, also in terms of high ratings. Conversely, if λ_1 is not statistically significant, while λ_2 is positive and statistically significant, this would imply that the adjustment towards the long-run equilibrium is led by the CDS prices. It may occur, in the model, that both λ_1 and λ_2 are statistically significant, which means that both the market of bonds and the market of CDS may play a role in the price discovering process.[13] In this case, regardless of the signs of the coefficients, a normalization can be used (Schwarz and Szakmary, 1994) to get the information share driven by each series. In particular, the information share $S_k = \ 0 < \frac{|\lambda_k|}{|\lambda_1|+|\lambda_2|} < 1$ will provide the percentage of the total joint adjustment which is due either to the bond or to the CDS market. It means that if $S_1 > 0.5$, the price discovery process is mainly driven by the bond market, while the reverse is true for $S_1 < 0.5$. An opposite interpretation occurs when looking at S_2. Table 7 reports the results of the VECM, split in two sub-periods, the first from the beginning of 2019 until the last end of lockdown, and the second after the last lockdown until 30 June.[14] This choice helps to

[13] It is worth noting that the fact that both coefficients may be statistically significant does not imply an alternation of signs, as bond spreads may show negative signs for some countries.
[14] The countries which ended the lockdown in the lastest date (Ireland, Italy and Portugal: 18 May) have been taken as a benchmark for the choice of the watershed of the two sub-samples.

investigate whether the health crisis has changed the relationship between sovereign bond yields and the related CDS market once constraints on the re-starting of the economic activity were relaxed in all countries. To this regard, in the first period, the possibility of the CDS market as a leader in the price discovery process was estimated only in Greece and Spain. In all other countries, the bond market prevails in driving prices, with the exception of Italy, where the coefficients are not significant, as if a long-run equilibrium between bond spreads and CDS is not supported. When moving to the second period, the positions of only three countries are left invariant: France and Netherlands, as sufficiently reliable countries, had basically no impact on the price discovery process, with the bond market playing a leading role in both periods; also in Greece, with a lower rating, there is no evidence of a change, with the CDS premia again playing the leading role. However, the situation has changed for all remaining countries: in particular, there is a clear evidence of a deteriorated position for Italy, Portugal, and Ireland, with Spain being almost half-way with respect to the first period. Even though for Portugal and Spain both coefficients are statistically significant, the calculation of the information share $S_2 = \frac{|\lambda_2|}{|\lambda_1|+|\lambda_2|}$ reveals that the CDS market weights more in both countries (61.6 per cent in Portugal and 53.5 per cent in Spain). This estimation gives first evidence that Greece, Ireland, Italy, and Portugal, among the countries considered in this analysis, are the most exposed to the post-pandemic crisis, with a clear indication that the CDS market may affect the yields of the bonds more than what occurred in the past. Furhermore, by looking at the graphs in Appendix plotting the bond spread and the CDS premium, it is worth considering that among the previous four countries, a positive basis (i.e. a positive difference between CDS and bond spreads) is more pronounced for Italy and Greece, which means that these two countries are more at risk of an arbitrage strategy concerning

short selling of bonds and selling of the CDS protection. Since liquidity in government bonds and markets functioning are usually heterogeneous, the positive basis may persist as it may be rather costly to trade (Fontana and Scheicher, 2010). But the issue remains that a clear distinction among countries is marked by the crisis, giving further support to the hypothesis that a symmetric shock may have long-run asymmetric consequences even in the presence of a common ECB strategy to face the crisis.

[Table 7 about here]

5. Concluding remarks

This paper investigates the sovereign bond market of selected Eurozone countries since the outbreak of the disease during the first six months of 2020. Notwithstanding the fact that the crisis may be understood as a symmetric shock, asymmetric effects have occurred in different countries, with non-negligible consequences on the economic policies. In particular, the paper has shown that the interest rates on the 10-year bond – after the unknown break due to the health crisis – follows different paths across countries, with Greece, Italy, Portugal, and Spain being the most affected countries.

Even though temporary, the stocks of public debt issued in this interval, especially in Italy, are likely to generate additional future costs and stress on the public budget. This conclusion cannot hide the fundamental role played by the ECB in easening tensions in the bond markets during the crisis. However, we have shown that this intervention was more effective at the time it was announced, rather than when it was realised at the end of March. Thus, in order to forecast the policy consequences of what would be the long-term effects of the short-run asymmetric impacts of the crisis, the paper has found that a

positive link between the interest rates on bonds and the CDS premium is traceable. It means that, due to the huge increase of the ratio between public debt and GDP occurred in some countries, the health crisis has resulted not only in a temporary increase of interest rates, but also in an increase of the perceived risk of default, as the same interest rates seem now associated to a higher CDS premium, especially in the second quarter of 2020. This is particularly true and troubling for Ireland, Greece and Italy, an outcome that raises medium-term concerns about the possibility to implement public policies able to recover from the non-negligible increase of debt issuance.

We think that these results may convey important information for public policies both in the short-run and in the long-run, at least in two dimensions of the future economic policy. The first concerns the proper use of the Recovery and Resilience Fund (RRF), in particular the impulse that it will be able to provide to the growth of GDP. In particular, as shown in the paper, since some asymmetric consequences are expected in the medium-term, it would be a natural consequence that the RRF should help some countries more than others. But in order to be effective, RRF programmes should properly balance the share of expenditures devoted to resilience and the share spent on recovery. Both will be important to ensure that the cost of debt financing will be restored to the pre-Covid levels and will not be significantly affected by further shocks. To some extent, the opportunity of using the RRF might change both the path of GDP growth and the ability to resist economic shocks, which are critical points of some member States.

The second dimension is related to the policy that will be followed by the ECB when the public debt purchased until the end of the programme will go to maturity. Even though the paper has provided some evidence that the public debt has not been a major issue during the crisis, the stock of the public debt accumulated by the ECB could be at the

time of the maturity. The analysis carried out in this paper gives some preliminary support to this conclusion. On this ground, it is likely that the debate about what to do with the purchases of the public debt will re-emerge at the time of maturity. At that time, for some member States, the repayment of the whole stock of debt would provide a comparable shock, which could frustrate the efforts made and the impact of the money spent by the European Union on resilience and recovery provisions. This will pose new challenges on the monetary policy of the European Union, which is not likely to end at the end of the pandemic crisis; in fact, it could be necessary that at least part of the purchases will be re-issued with a new maturity, if a credible long-term exit strategy from the pandemic crisis has to be developed.

References

Agiakloglou, C. and Deligiannakis, E. (2020). Sovereign risk evaluation for European Union countries, Journal of International Money and Finance, 103.

Altavilla, C., Carboni, G. and Motto, R. (2015). Asset Purchase Programmes and Financial Markets: Lessons from the Euro Area, ECB Working Paper 1864, European Central Bank.

Attinasi, M., Checherita, C. and Nickel, C. (2009). What explains the surge in euro area sovereign spreads during the financial crisis of 2007-2009? Working Paper Series, European Central Bank, no. 1131.

Belke, A. and Gros, D. (2019). QE in the euro area: has the PSPP benefited peripheral bonds? CEPS Working Document, n. 1.

Boermans, M. and Keshkov, V. (2018). The impact of the ECB asset purchases on the European bond market structure: Granular evidence on ownership concentration. DNB Working Paper, n. 590.

Coudert, V., and M. Gex (2010). Credit Default Swap and Bond Markets: Which Leads the Other?. Financial Stability Review, 14, 161-167.

De Grauwe, P. (2011). The Governance of a Fragile Eurozone. CEPS Working Documents, Economic Policy, May.

De Pooter, M., Martin., R. F. and Pruitt, S. (2015). The Liquidity Effects of Official Bond Market Intervention. International Finance Discussion Papers, 1138.

Duffie, D. (1999). Credit Swap Valuation. Financial Analysts' Journal, 83, 635–665.

Fernandes, N. (2020). Economic Effects of Coronavirus Outbreak (COVID-19) on the World Economy, SSRN.

Fontana, A., and M. Scheicher (2010). An Analysis of Euro Area Sovereign CDS and their Relation with Government Bonds. European Central Bank, Working Paper No. 1271.

Frömmel, M. and Kruse, R. (2015). Interest rate convergence in the EMS prior to European Monetary Union. Journal of Policy Modeling, Volume 37, Issue 6, November-December, pages 990-1004

Ghysels, E., Idier, J., Manganelli, S. and Vergote, O. (2017). A High-Frequency assessment of the ECB Securities Markets Programme. Journal of the European Economic Association, Volume 15, Issue 1, pages 218-243.

Granger, C.W.J. (1969). Investigating Causal Relations by Econometrics Models and Cross Spectral Methods. Econometrica, 35, pp. 424-38.

Harris, F., McInish, T. and Wood, R. (2002). Security price adjustment across exchanges: An investigation of common factor components in Dow stocks, Journal of Financial Markets 5, pages 277-308.

Hasbrouck, J. (1995). One security, many markets: Determining the contributions to price discovery, Journal of Finance 50, pages 1175-1199.

Kilponen, J., Laakkonen, H. and Vilmunen, J. (2015). Sovereign Risk, European Crisis-Resolution Policies, and Bond Spreads. International Journal of Central Banking, vol. 11(2), pages 285-323, March.

Krishnamurthy, A., Nagel, S. and Vissing-Jorgensen, A. (2018). ECB Policies Involving Government Bond Purchases: Impact and Channels, Review of Finance, 22, pages 1-44.

Longstaff, F.A., Pan, J., Pedersen, L.H. and Sigleton, K.J. (2011). How sovereign is sovereign credit risk. American Economic Journal: Macroeconomics, Vol.3, No.2, April.

MacKinnon, J. G. (1991). Critical Values for Cointegration Tests, in R.F. Engle and C.W.J. Granger (eds), Long-run Economic Relationship: Readings in Cointegration. Oxford: Oxford University Press.

Nicola, M., Alsafi, Z., Sohrabi, C., Kerwan, A., Al-Jabir, A., Iosifidis, C., Agha, M. and Agha, R. (2020). The socio-economic implications of the coronavirus pandemic (COVID-19): A review. International Journal of Surgery, 78.

Schwarz, T. and A. Szakmary A. (1994). Price Discovery in Petroleum Markets: Arbitrage, Cointegration, and the Time Interval of Analysis. Journal of Futures Markets, vol. 14, 147-167.

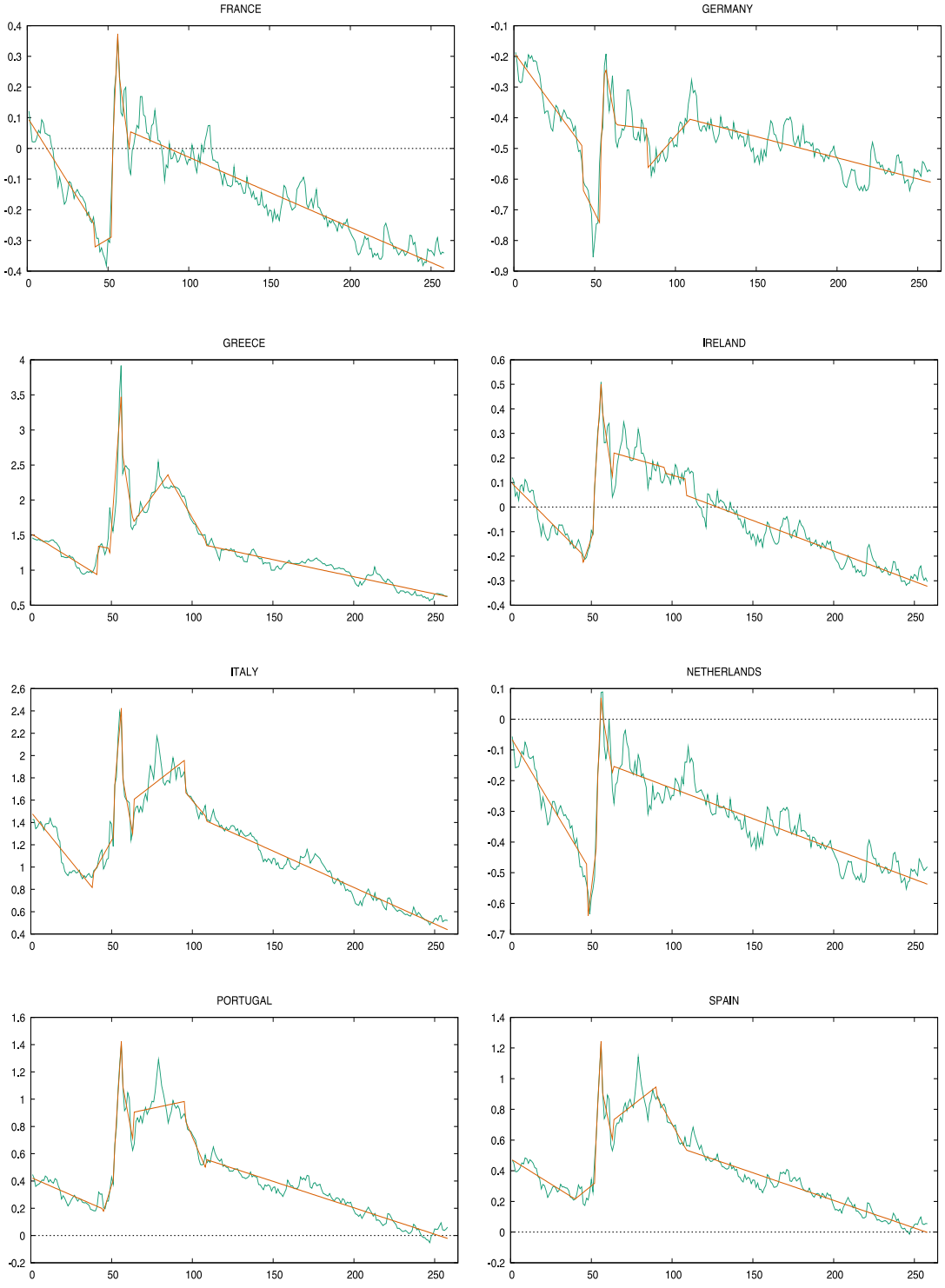
Tables and Figures

Table 1 – Augmented Dickey-Fuller test (ADF) for the residuals – Test statistic values

31/12/2019-30/06/2020

Note: p-values are represented in brackets. * means that the correlation is significative at 1% level, ** at 5% level and *** at 10% level. Critical values are taken from MacKinnon (1991).
Source: authors' elaborations on Thomson-Reuters data

Figure 1 – Interest rate: 10-year sovereign bond – Linear trend estimation



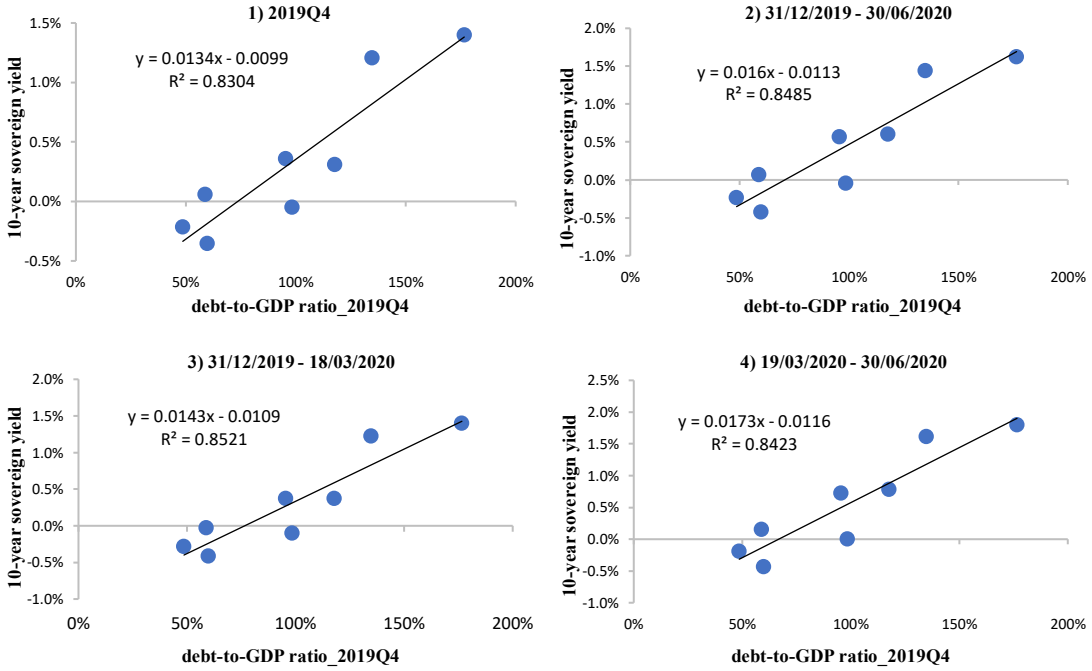
Note: each figure represents the daily trend starting from 31 December 2019 to 31 December 2020.
Source: authors' elaborations on *Thomson-Reuters* data

Table 2 – Interest rate: 10-year sovereign bond – Trend estimates

	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
	Variation in absolute terms							
Covid-19	-0.08	-0.15	0.40	-0.03	0.14	-0.17	-0.10	-0.01
Unknown break	0.31	0.25	-0.07	0.19	0.47	0.23	0.30	0.30
PEPP's announce	-0.14	0.01	-0.83	-0.12	-0.64	-0.06	-0.31	-0.34
PEPP's purchases	0.05	-0.01	-0.07	0.09	0.31	0.02	0.05	0.13
End of lockdown	-	-0.13	-0.05	-0.02	-0.29	-	-0.04	-0.07
PEPP's reinforcement	-	0.01	-0.08	-0.07	-0.05	-	-0.06	-0.02
	Coefficient							
Pre-Covid-19	-0.01	-0.01	-0.01	-0.01	-0.02	-0.01	-0.01	-0.01
Covid-19	0.00	-0.01	0.00	0.02	0.03	0.04	0.04	0.01
Unknown break	0.12	0.12	0.32	0.10	0.17	0.13	0.19	0.21
PEPP's announce	-0.04	-0.03	-0.15	-0.04	-0.08	-0.03	-0.06	-0.05
PEPP's purchases	0.00	0.00	0.03	0.00	0.01	0.00	0.00	0.01
End of lockdown	-	0.01	-0.04	-	-0.02	-	-0.03	-0.02
PEPP's reinforcement	-	0.00	0.00	0.00	-0.01	-	0.00	0.00
Adjusted R-squared	0.90	*0.81*	*0.95*	*0.93*	*0.96*	*0.88*	*0.96*	*0.95*

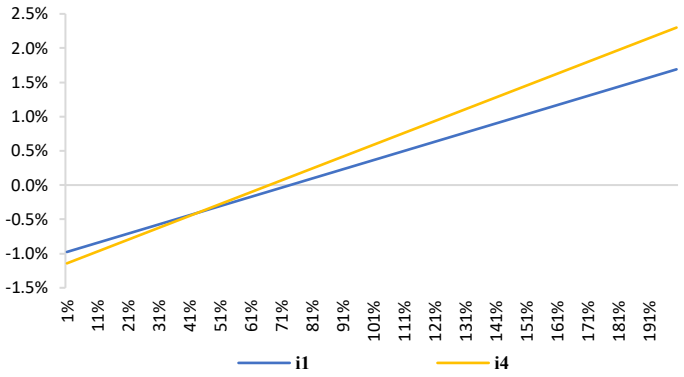
Note: the above coefficients derive from the daily trend starting from 31 December 2019 to 31 December 2020.
Source: authors' elaborations on *Thomson-Reuters* data

Figure 2 – 10-year sovereign bond yields and government debt-to-GDP



Note: the vertical axis represents the average of the 10-year sovereign yield reported in the headline while the horizontal axis is the level of the debt-to-GDP ratio in the last quarter of 2019.
Source: authors' elaborations on *Thomson-Reuters* and *Eurostat* data

Figure 3 – 10-year sovereign bond yields and government debt: difference among linear trends



Note: the linear trend "i1" refers to the last quarter of 2019 while "i4" refers to the period after the PEPP's first announce.
Source: authors' elaborations on *Thomson-Reuters* and *Eurostat* data

Table 3 – Gross issues of debt securities – Central Government – 2020

	January	February	March	April	May	June	Total	% of gross debt	Gross debt
France	88,877	75,260	94,781	139,594	148,523	117,639	664,674	27.9%	2,380,041
Germany	49,613	44,784	49,677	82,670	85,970	77,640	390,354	19.0%	2,057,166
Greece	6,114	4,100	600	3,201	2,601	6,201	22,817	6.9%	331,072
Italy	44,898	40,588	32,004	65,542	73,259	56,353	312,642	13.0%	2,409,904
Netherlands	6,533	6,519	19,136	34,118	31,310	26,607	124,223	31.5%	394,670
Portugal	7,088	2,721	2,229	7,607	4,717	2,918	27,281	10.9%	249,985
Spain	28,102	18,940	31,143	41,530	29,848	39,940	189,503	15.9%	1,188,859

Note: data relative to Ireland are missing.
Note: data relative to gross debt refers to the end of 2019.
Source: authors' elaborations on *ECB* and *Eurostat* data

Table 4 – Breakdown of public sector securities under the PEPP – Net purchases – 2020

	March - May	June - July	Total
France	23,575	35,845	59,420
Germany	46,749	46,266	93,016
Greece	4,690	5,256	9,946
Ireland	3,000	2,972	5,972
Italy	37,365	36,067	73,432
Netherlands	10,389	10,285	20,674
Portugal	4,150	4,655	8,805
Spain	22,392	23,719	46,111

Source: authors' elaborations on *ECB* data

Table 5a – ADF test, correlation and Granger causality between bond yields and CDS

31/12/2019-30/06/2020

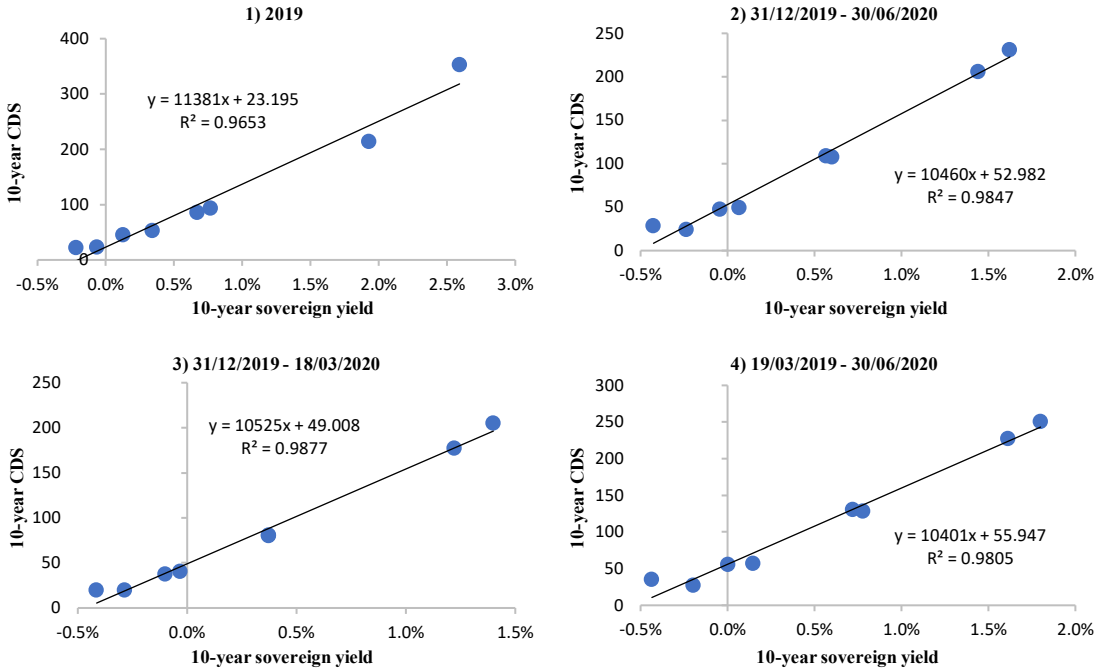
	ADF statistics (with constant and trend)				Rate of growth			Granger causality	
	Interest rate (IR)	CDS	IR_rate of growth	CDS_rate of growth	Correlation	p-value	VAR lag selection (HQC)	IR -> CDS	CDS -> IR
France	-2.93	-1.72	-5.44***	-3.81**	0.43	0***	4	no	yes
Germany	-3.05	-0.71	-9.90***	-4.26***	0.22	0.0157*	4	yes	yes
Greece	-2.46	-1.53	-5.15***	-4.90***	0.82	0***	8	yes	yes
Ireland	-1.52	-1.73	-5.90***	-4.23***	0.49	0***	4	no	yes
Italy	-2.04	-2.35	-10.41***	-4.22***	0.83	0***	2	yes	yes
Netherlands	-2.83	-1.04	-9.06***	-15.05***	-0.11	0.2280	2	yes	yes
Portugal	-1.76	-1.55	-5.20***	-6.95***	0.63	0***	9	yes	yes
Spain	-1.74	-1.39	-5.15***	-4.29***	0.69	0***	2	yes	yes

Note: p-values are represented in brackets. * means that the correlation is significative at 1% level, ** at 5% level and *** at 10% level. Critical values are taken from MacKinnon (1991).
Source: authors' elaborations on *Thomson-Reuters* data

Table 5b – ADF test, correlation and Granger causality between bond yields and CDS

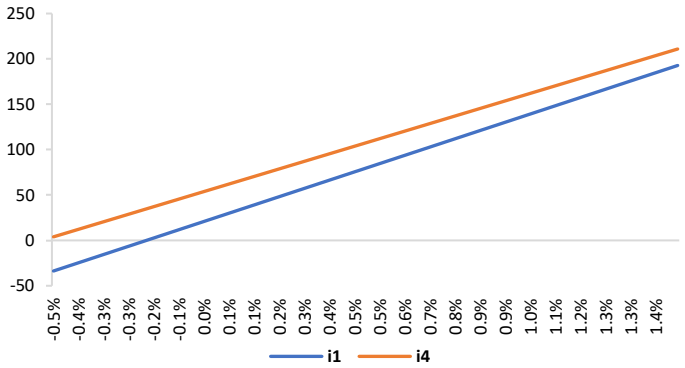
31/12/2019 - 31/12/2020

Figure 4 – 10-year sovereign bond yields and 10-year CDS



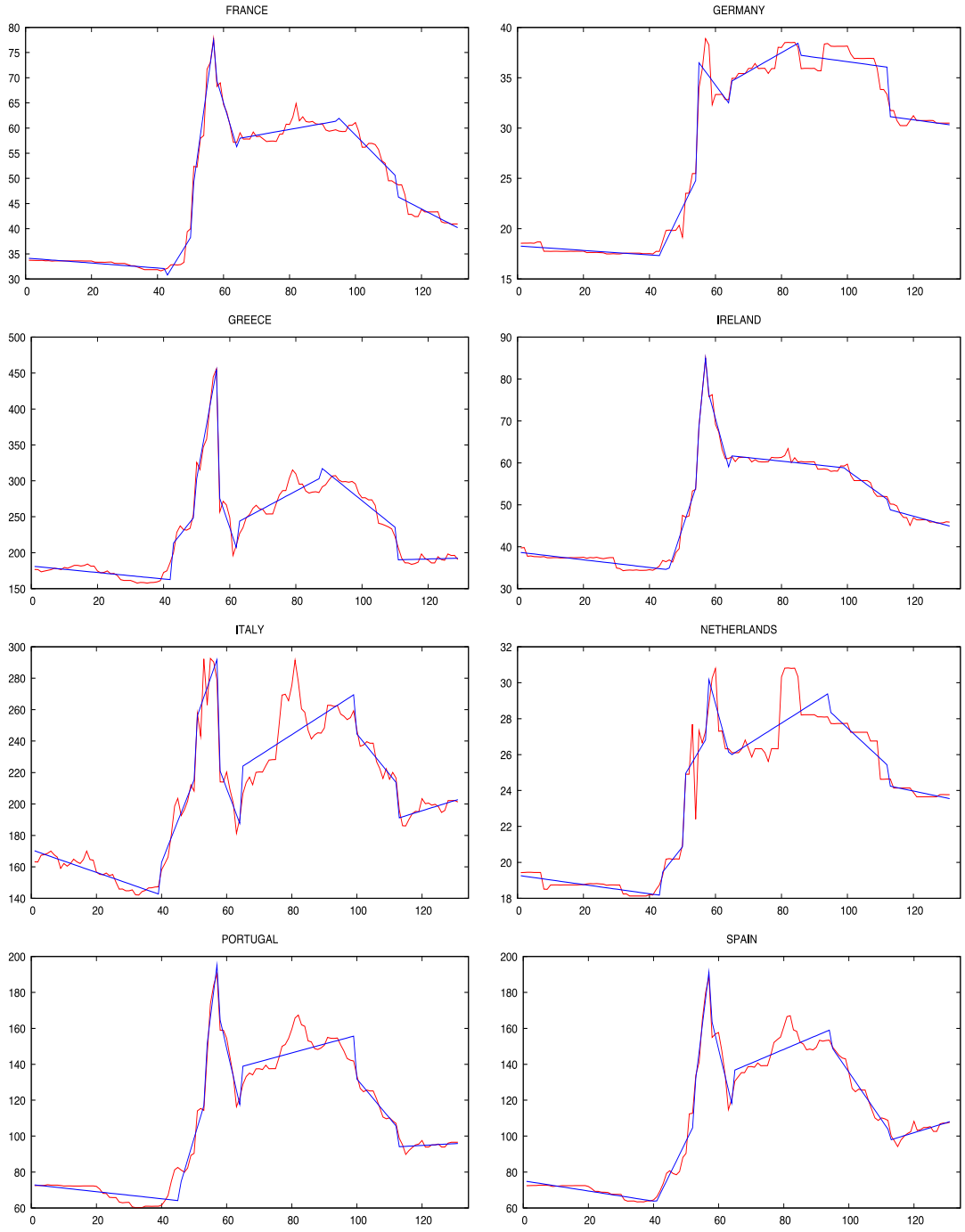
Note: the vertical and the horizontal axes always refer to the average of the period reported in the headline.
Source: authors' elaborations on *Thomson-Reuters* data

Figure 5 – 10-year sovereign bond yields and 10-year CDS premium: difference among linear trends



Note: CDS values cannot be, by definition, negative; in any case, we choose also to show the negative values in order to compare the two periods.
Source: authors' elaborations on *Thomson-Reuters* data

Figure 6a – CDS: 10-year sovereign bond – Linear trend estimation with structural breaks



Note: each figure represents the daily trend starting from 31 December 2019. Difference in the number of observations are due to different trading days on the various markets.
Source: authors' elaborations on *Thomson-Reuters* data

Table 6a – CDS: 10-year sovereign bond – Trend estimates

	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
	Variation in absolute terms							
Covid19	-1.29	0.73	50.83	0.34	20.12	1.29	10.57	0.13
Unknown break	11.05	11.70	54.82	14.69	40.78	4.09	34.54	27.48
PEPP's announce	-8.09	-	-178.36	-8.64	-70.87	3.36	-30.61	-27.97
PEPP's purchases	1.68	2.17	36.44	2.61	36.41	-0.14	21.29	18.58
End of lockdown	0.57	-1.20	14.04	-0.63	-24.96	-1.04	-23.93	-10.15
PEPP's reinforcement	-4.33	-4.92	-45.28	-2.54	-22.57	-1.19	-11.63	-5.89
	Coefficient							
Pre-Covid19	-0.05	-0.02	-0.45	-0.09	-0.72	-0.03	-0.20	-0.28
Covid19	1.06	0.67	5.81	2.38	5.25	0.23	6.03	3.69
Unknown break	4.70	-0.44	25.14	8.14	5.94	0.31	14.56	14.84
PEPP's announce	-2.18	-	-13.61	-2.88	-5.54	-0.67	-7.82	-7.54
PEPP's purchases	0.12	0.19	2.46	-0.08	1.33	0.12	0.49	0.76
End of lockdown	-0.66	-0.04	-3.71	-0.57	-2.56	-0.17	-2.17	-2.64
PEPP's reinforcement	-0.34	-	0.13	-0.22	0.64	-0.04	0.10	0.56
Adjusted R-squared	*0.99*	*0.96*	*0.97*	*0.99*	*0.94*	*0.89*	*0.97*	*0.98*

Source: authors' elaborations on *Thomson-Reuters* data

Figure 6b – CDS: 10-year sovereign bond – Linear trend estimation with structural breaks

31/12/2019 - 31/12/2020

Table 6b – CDS: 10-year sovereign bond – Trend estimates

31/12/2019 - 30/12/2020

Table 7 – Results of the Vector Error Correction Model

Spread with Germany		2019 until the end of lockdown	From the end of lockdown onwards (until 30 June)
Bond	**France**	**-0.086**	**-0.126**
CDS		0.022	0.147
Bond	**Greece**	0.029	-0.091
CDS		**0.057**	**0.233**
Bond	**Ireland**	**-0.155**	-0.116
CDS		-0.069	**0.517**
Bond	**Italy**	0.011	0.111
CDS		0.033	**0.234**
Bond	**Netherlands**	**-0.042**	**-0.189**
CDS		0.043	0.317
Bond	**Portugal**	**-0.047**	**-0.124**
CDS		0.022	**-0.198**
Bond	**Spain**	-0.008	**-0.174**
CDS		**0.051**	**-0.200**

Note: the statistical significance of the lambda coefficients (5 per cent) are reported in bold. The countries which ended the lockdown in the latest date (Ireland, Italy and Portugal: 18 May) have been taken as a benchmark for the choice of the watershed of the two sub-samples. The reasons are reported in the text.
Source: authors' elaborations on *Thomson-Reuters* data

Appendix

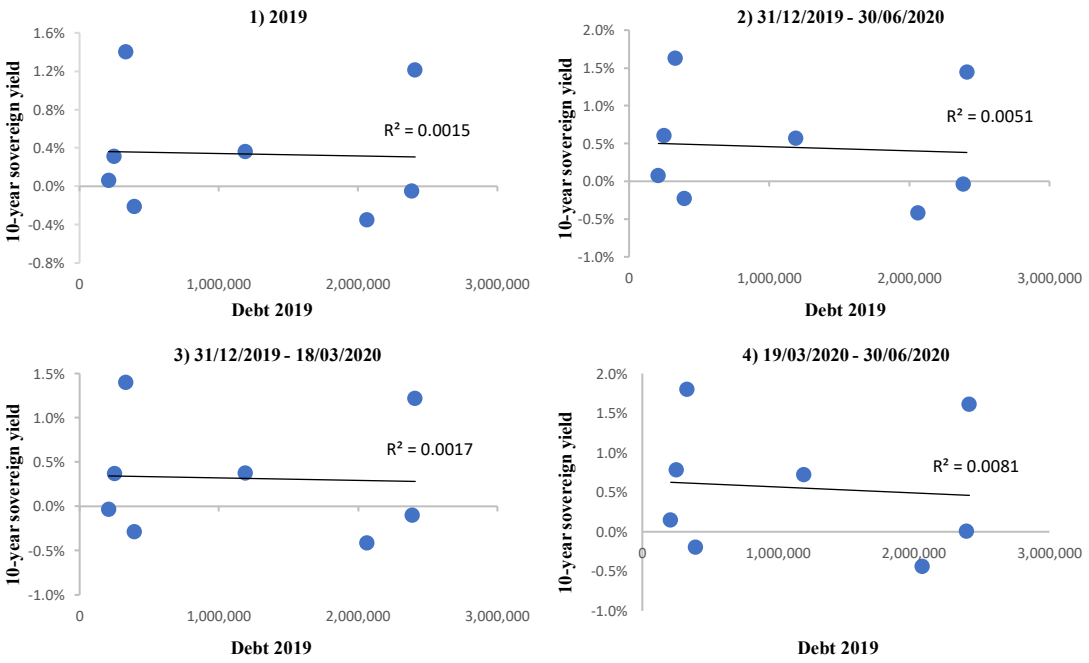
Table A.1 – Interest rate: 10-year sovereign bond – QLR and Chow tests

Source: authors' elaborations on *Thomson-Reuters* data

Table A.2 – CDS: 10-year sovereign bond – QLR and Chow tests

Source: authors' elaborations on Thomson-Reuters data

Figure A.1 – 10-year sovereign bond yields and government debt in absolute terms



Note: the vertical axis represents the average of the 10-year sovereign yield reported in the headline while the horizontal axis is the level of the debt in absolute terms in 2019.
Source: authors' elaborations on *Thomson-Reuters* and *Eurostat* data

Table A.3 – Impact of the German Federal Constitutional Court's judgment on Sovereign Bonds

Chow test - p-value

	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
10-years sovereign bond	0.4224	0.0298**	0.2552	0.3295	0.0064***	0.8116	0.0003***	0.2741
CDS 10-years sovereign bond	0.0333**	0***	0.0018***	0.0188**	0.0027***	0.018**	0***	0.0758*

10-years Sovereign bond

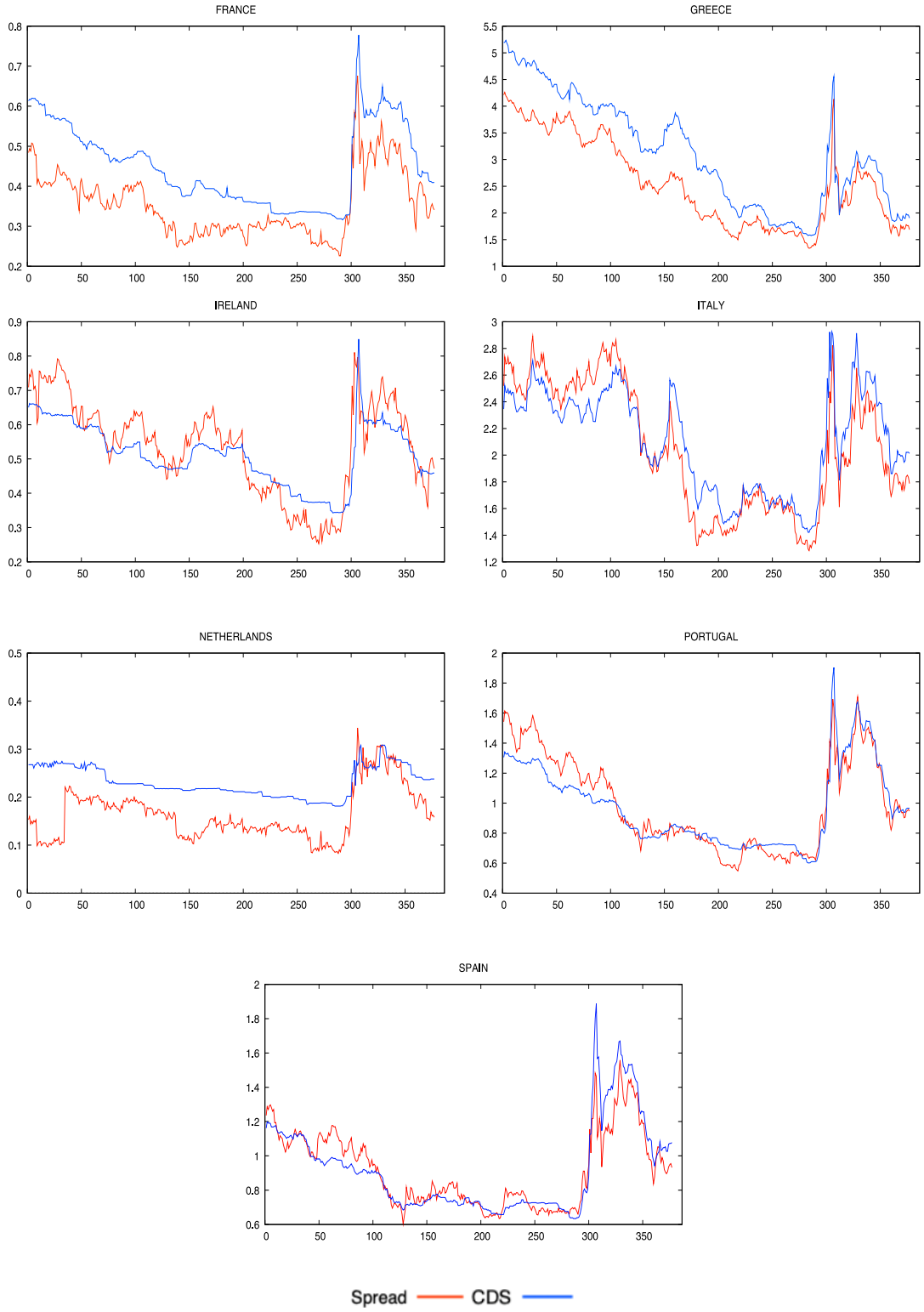
	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
Variation in absolute terms	-	0.045	-	-	-0.06	-	-0.04	-
Coefficient	-	0.008	-	-	-0.01	-	-0.02	-

CDS 10-years Sovereign bond

	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
Variation in absolute terms	-2.46	2.44	14.12	-1.72	-1.55	-1.61	-3.55	-6.69
Coefficient	-	-	-4.37	-	-2.65	0.13	-2.65	0.82

Note: on 5 May 2020, the German Federal Constitutional court issued a judgment in which it criticized the legality of the ECB's PSPP, putting in doubt the general principle of supremacy of EU law over the national law of its Member States. The impact of such sentence on Sovereign bond yields and CDS premiums has been tested the following day (6 May).
Source: authors' elaborations on *Thomson-Reuters* data

Figure A.2 – Graphs with CDS and bond spreads



Note: each figure represents the daily trend starting from 2 January 2019 to 30 June 2020. The red 'spread' line refers to the difference between the 10-year sovereign bond national yield and the German bund with the same maturity. The blue 'CDS' line to the national financial derivative with a maturity of 10 years.
Source: authors' elaborations on *Thomson-Reuters* data