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# The ECB's Pandemic Emergency Purchase Programme and Fiscal Policy: Synergies or Conflict?*

António Afonso[$], Jorge Braga Ferreira[#]

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**Abstract**

We assess how countries' fiscal policies during COVID-19 pandemic influenced the effects of the Pandemic Emergency Purchase Programme (PEPP) on sovereign bond Option-Adjusted Spreads. Using a cross-sectional regression model with country and time-fixed effects, we analyse a sample of 1,368 euro-denominated sovereign bonds issued between Q1:2018 and Q1:2022 in 19 Eurozone countries. We consider the PEPP net purchases by country, and the fiscal policy is measured through changes in debt-to-GDP ratio and net lending/borrowing as a percentage of GDP. The results indicate that PEPP's effectiveness in reducing spreads was strongly conditional on fiscal conditions, and then fiscal fundamentals condition the effectiveness of ECB interventions. In high-debt countries, PEPP did not lower spreads, which suggests that fiscal concerns remained dominant. PEPP was more effective in low-debt countries, but its effects diminished as the level of debt increased, which suggest rising fiscal risks. Furthermore, eligibility status was more important in economies with low debt levels, where eligible bonds were seen as riskier assets. Finally, the results suggests that PEPP's effectiveness was stronger for higher-rated bonds, longer-maturity bonds, and central government bonds, in fiscally sound countries.

**JEL:** C23, E52, E58, E62, G12
**Keywords:** ECB, PEPP, unconventional monetary policy, fiscal policy, sovereign bond yields, COVID-19 pandemic

* The opinions expressed herein are those of the authors and do not necessarily reflect those of the author' employer. Any remaining errors are the author' sole responsibility.

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## 1. Introduction

The COVID-19 pandemic brought significant challenges and uncertainty to the global economy. The financial markets were deeply affected by the increased uncertainty, namely the government bond market, as central banks pursued highly accommodative policies. Several central banks started promptly to implement measures to control the effects of the pandemic and ensure financial stability. The European Central Bank (ECB) was not an exception and announced the Pandemic Emergency Purchase Programme (PEPP), which allowed the purchase of a broad set of government and corporate bonds to inject liquidity into financial markets and lower funding costs. This programme represented a significant innovation within the context of the monetary central bank's policy strategy due to the need to rapidly address the incomparable conditions during the pandemic.

Monetary policies are supposed to work together with fiscal policies, but conflicts can arise in certain circumstances. For instance, in countries with high debt, expansionary fiscal policy can raise concerns about debt sustainability. At the same time, the central bank's actions to stabilise the markets can be seen as supporting unsustainable budgetary practices. This can create conflicts between short-term recovery goals and long-term fiscal discipline. These dynamics highlight the importance of analysing the interaction between monetary and fiscal policies to identify how they work together. In this context, this study attempts to determine in which extension the PEPP's impact on sovereign bond spreads was influenced by the country's fiscal stances. As the pandemic was a period characterised by exceptional fiscal measures, this study aims to examine whether the PEPP's impact was amplified or offset by the countries' fiscal stance.

For our study, we use a sample of 1,368 Eurozone sovereign bonds issued between 2018:Q1 and 2022:Q1 to assess the impact of the PEPP on their spreads and the extent to which it was conditioned by the countries' fiscal positions. Our main results suggest that PEPP's effectiveness in reducing spreads was strongly conditional on fiscal conditions. PEPP was more effective in low-debt countries than in high-debt countries, where fiscal concerns seem to remain dominant. The remainder of the paper is organised as follows. Section 2 briefly reviews the ECB's PEPP. Section 3 provides a literature review. Section 4 describes the methodology. Section 5 provides the analysis results. Section 6 concludes.

## 2. Pandemic Emergency Purchase Programme (PEPP)

The ECB's Governing Council announced the PEPP on March 18, 2020, to mitigate the economic and financial consequences of the COVID-19 pandemic. As pandemic caused uncertainty that spread rapidly in the Eurozone, the credit risk premiums on sovereign bonds rose sharply. To address this, the ECB quickly introduced several instruments, including the PEPP, to inject liquidity into financial markets and support an efficient transmission of monetary policy.

The ECB initially set the PEPP at 750 billion euros, which was primarily for tackling market fragmentation in the spring of 2020. In this, the ECB followed flexible purchase strategies that accommodated heterogeneity in purchase flows over time, between asset classes, and among jurisdictions. The total programme size increased to EUR 1,350 billion as of June 4, 2020, and was further increased to EUR 1,850 billion as of December 10, 2020. The PEPP included all the assets already covered under the Asset Purchase Programme (APP) as well as certain assets not covered, such as Greek government bonds. Also, the minimum remaining maturity threshold for public sector assets was lowered to 70 days from the one-year minimum under the APP. Figure 1 shows the evolution of cumulative net purchases under the PEPP.

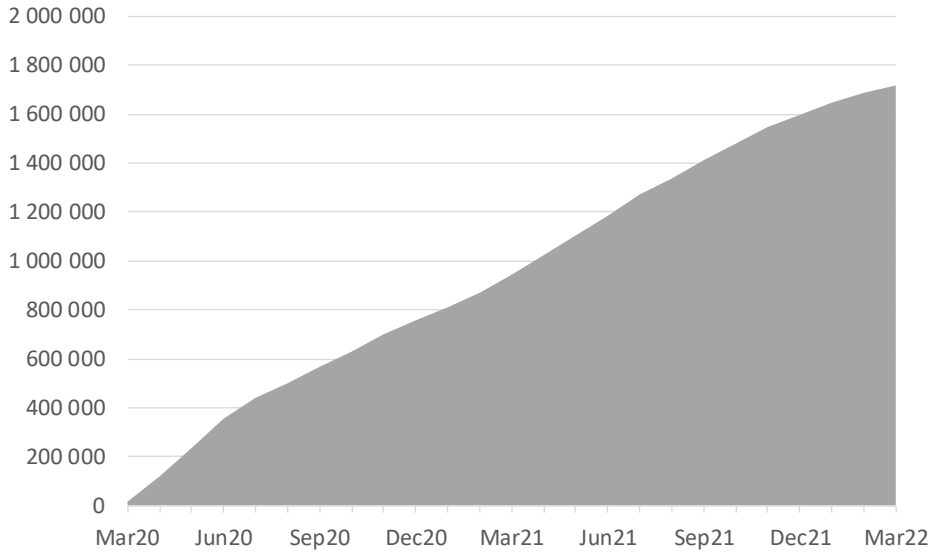


Figure 2: Cumulative net purchases under the PEPP (in EUR million at the month end)
Source: ECB.

The national central banks within the Eurosystem made most of the purchases under the PEPP, with the ECB directly making a small portion. The PEPP's risk-sharing principles, aligned with those of the APP, ensured a coordinated approach to managing the risks involved. Although the

allocation of purchases of public sector securities between the Eurozone jurisdictions continued to be based on the Eurosystem's capital subscription key, the national central banks had the flexibility to make purchases to avoid tightening financing conditions.

The programme was developed by the ECB Governing Council to last until the end of the COVID-19 crisis phase, with net purchases ending in March 2022. Nevertheless, the proceeds from maturing PEPP securities are reinvested flexibly until at least the end of 2024, to reduce the risks to the transmission mechanism linked with the pandemic.

## 3. Literature Overview

The COVID-19 pandemic has forced unprecedented policy responses from central banks, particularly the ECB, through measures such as the PEPP. As this programme was very recent, the literature addressing the impacts of this type of programme on economic and financial stability remains limited. This is a gap in the research, especially on the interactions of the ECB's non-standard monetary policy with the fiscal policies of Eurozone countries during the pandemic.

The financial consequences of the pandemic were different among Eurozone countries due to the heterogeneity of their economic conditions. As stated by Carnazza and Liberati (2021), although the pandemic might be classified as a symmetrical shock, its effects on sovereign bond markets were, however, asymmetrical. The authors showed the existence of significant differences in sovereign bond yields and credit default swap (CDS) spreads amongst the Eurozone countries, which reflect different levels of sovereign risk and economic resilience. It is therefore sufficient to argue that economic heterogeneity requires us to consider how national fiscal conditions have affected the effectiveness of the ECB's interventions, including the PEPP. The role played by the PEPP in addressing these disparities has been the subject of a few studies. For example, Moessner and Haan (2022) analysed the effects of PEPP announcements on sovereign bond term premia, as measured by the changes in CDS spreads. They found that countries with greater sovereign risk experienced a more significant reduction in risk premia following PEPP announcements. This means that the PEPP might have been particularly effective in stabilizing financial conditions in more exposed countries. Furthermore, as the PEPP also included the purchase of corporate bonds, Demirgüç-Kunt, Horváth and Huizinga (2020) found that investment-grade rated benefited more from the programme, through increased share prices and lower CDS spreads. However, firms with lower ratings or those

severely affected by the pandemic recorded modest increases, highlighting the constraints of the PEPP in reaching all segments of the economy.

Specifically, the interplay between ECB policies such as the PEPP and national fiscal policies has been less studied and is an essential avenue for future research. For example, Corradin, Grimm, and Schwaab (2021) analysed the overall impacts of both ECB unconventional monetary policy and European Union (EU) fiscal policy announcements during a pandemic. They found that the ECB's interventions were more effective in vulnerable countries, but that the EU's fiscal policy announcements could reduce bond yields more evenly across countries. This indicates that the monetary support may have complemented fiscal efforts differently, given the economic situation in each country. Similarly, Fendel, Neugebauer, and Zimmermann (2021) observed that both the ECB and European Commission's announcements reduced spreads for high-debt countries essentially due to increases in the yields of stronger financial countries such as Germany or the Netherlands.

Despite evidence of synergies, some studies highlight potential conflicts between monetary and fiscal policy. Sargent and Wallace (1981) provide a classical fundamental analysis of fiscal dominance, in which large deficits pressure central banks to accommodate debt financing, which may undermine inflation control and the maintenance of monetary independence. In the context of Europe's monetary union, Beetsma and Giuliodori (2010) highlight that the absence of centralized fiscal control can promote fiscal profligacy. The overall fiscal discipline can be undermined as national governments, operating under a shared monetary framework, may depend on central bank interventions to contain risk premiums. Based on these insights, Constâncio (2020) highlights the need for a revised European fiscal framework that minimizes potential conflicts. According to the author, as fiscal policy takes on a more active role in macroeconomic stabilisation, there is a need to review the fiscal framework to avoid conflicts and ensure effective policy coordination.

Further research has analysed the scope and effectiveness of these monetary policies in relation to the pandemic. To cite a few examples, Rebucci, Hartley and Jiménez (2022) provided evidence that QE measures in advanced economies worked effectively during the COVID-19 pandemic, especially in influencing government bond yields. Benigno et al. (2022) found evidence of a positive impact on the economic system, the improvement in banks' lending activity, which created opportunities for expansionary fiscal policies in highly indebted eurozone countries. This type of relationship between improved financing conditions and fiscal

expansion indicates a strong potential for synergies between monetary policy and fiscal policy in crisis management, an aspect that has not yet been well studied.

Most of the existing literature has examined the PEPP's effectiveness in national markets through the announcement-driven reduction of sovereign risk (e.g., Carnazza and Liberati, 2021; Moessner and Haan, 2022). Also, some studies have examined the impact of fiscal policies on sovereign bond spreads, but mainly from the perspective of announcements (e.g., Fendel et al., 2021). However, these areas are often analysed separately and focus mainly on short-term announcement effects, rather than the continuous interaction between monetary and fiscal measures during the pandemic period. Even when differences among countries is considered, such as distinctions between high- and low-debt economies, the dynamic relationship between the PEPP purchases and fiscal conditions remains underexplored. This gap is important to address because the PEPP was implemented when national governments were increasing spending, which may have influenced the effectiveness of the ECB's interventions. This study contributes to filling that gap through the model that consider the relationship between PEPP purchases, fiscal positions and sovereign bond spreads, while distinguishing between high- and low-debt countries.

Other major contribution of this paper is the distinction between PEPP-eligible and non-eligible bonds, which provides greater clarity on the effects of ECB interventions. Bond eligibility allows the analysis to reflect both the direct effect of PEPP purchases and potential spillover effects on non-eligible bonds. The results of this article contribute to the literature by showing how unconventional monetary policy can complement or contradict fiscal policies in periods of economic distress.

## 4. Methodology

Using a cross-sectional regression approach, this study examines the influence exerted by PEPP purchases and fiscal policies on sovereign bond spreads while allowing for variations across countries. The dataset, however, is not structured as a typical panel since there is only one observation of each bond at issuance and no further observations post-issuance. Instead, a pooled regression model is employed with country ($\delta_i$) and time fixed effects ($\varphi_q$) to capture country-specific factors and general macroeconomic trends. To improve reliability of the estimation, standard errors are clustered at the country level, correcting to correct for possible heteroskedasticity and within-country correlation. This allows a clean and robust estimate of

the ECB's impact on sovereign bond spreads while controlling for fiscal and economic conditions. The equation of baseline model is given as:

$$Spread_{ij} = \alpha_0 + \beta_0 PEPP_{it} + \beta_1 PEPP_{it-1} + \gamma \Delta Fiscal_{it} + \rho(PEPP_{it-1} \times \Delta Fiscal_{it}) + Eligibility_{ij} + \lambda X_{ijt} + \delta_i + \varphi_q + \varepsilon_{ij} \quad (1)$$

where $Spread_{ij}$ is the Option-Adjusted Spread (OAS)[1] at issuance for bond $j$ issued by country $i$. The model assesses the impact of the PEPP interventions on the bond market by analysing variations in risk perception and the cost of borrowing between different countries. To do this, it also considers the fiscal position of each country, reflecting the fiscal policies implemented during the COVID-19 pandemic. This study focuses only on the primary sovereign bond market.[2]

To capture monetary policy effects, the model includes both contemporaneous ($PEPP_{it}$) and lagged ($PEPP_{it-1}$) net PEPP purchases. While contemporaneous purchases reflect immediate effects, lagged purchases account for delayed impacts on spreads and help mitigate endogeneity concerns by ensuring that the effects of monetary interventions are not confounded with contemporaneous market responses.[3] In turn, fiscal policy is measured by the quarter-on-quarter changes ($\Delta Fiscal_{it}$) in the debt-to-GDP ratio and net lending/borrowing as a percentage of GDP.[4] The inclusion of quarterly changes of these indicators allows the model able to incorporate the immediate fiscal responses to the evolving challenges and consequently the short-term changes that investors consider in their bond pricing decisions. The two chosen fiscal indicators, both with quarterly frequency[5], were selected for their complementary perspectives: the debt-to-GDP captures long-term fiscal sustainability, while net lending/borrowing ratio

[1] The OAS is the difference between the bond's yield and the risk-free rate, adjusted for embedded options. This metric isolate credit and liquidity risks, serving as a refined measure of the additional risk premium that investors demand to hold a country's debt.

[2] The spreads at issuance directly reflect governments' borrowing costs and the immediate impact of fiscal and monetary policies, avoiding distortions from secondary market dynamics (Broner, et al., 2014; Passadore and Xu, 2022).

[3] Contemporary PEPP purchases are expected to have mixed effects on spreads: they can reduce them immediately by improving liquidity and investor confidence but also increase them if they are interpreted as a response to market instability. Conversely, lagged PEPP purchases are expected to have a negative impact on spreads, as the cumulative effects of liquidity injections tend to stabilize markets and reduce refinancing risks (Altavilla et al., 2021; Böninghausen et al., 2023).

[4] Fiscal policy indicators reflect the fiscal stance of each country (Bohn, 1998; Corsetti et al., 2012; Afonso and Jalles, 2013) and capture the impact of the measures adopted during the pandemic.

[5] Quarterly frequency, which is in line with the time granularity of the analysis, enables a more accurate identification of fiscal dynamics.

reflects short-term fiscal adjustments.[6] In addition, these metrics capture the specific fiscal challenges imposed by the COVID-19 pandemic, a period in which governments implemented both extensive fiscal expansions and significant borrowing.

To capture the combined effects of monetary and fiscal policies on sovereign bond spreads, the model includes an interaction term ($PEPP_{it} \times \Delta Fiscal_{it}$). This term is essential for the identification strategy because it allows an assessment of whether the effectiveness of PEPP purchases varies according to the fiscal stance of countries, especially in periods of dynamic fiscal adjustments. An expansionary fiscal policy can strengthen the positive effects of the PEPP by boosting economic recovery but can also generate concerns among investors about the sustainability of public debt, attenuating these benefits (Woodford, 2011; De Grauwe and Ji, 2013; Bech et al., 2014). By modelling this interaction, the study seeks to understand how the dynamic relationship between changes in fiscal policy and PEPP interventions has influenced sovereign bond spreads during the COVID-19 crisis.[7]

To distinguish between direct and indirect effects, the model classifies bonds into eligible or non-eligible bonds based on their compliance with the ECB's PEPP purchase criteria ($Eligibility_{ij}$). A bond is considered eligible when it meets the following two core conditions: (i) a minimum investment grade credit rating (BBB- or higher) from at least one of the three main rating agencies (Moody's, Standard & Poor's or Fitch), with the lowest available rating used for the analysis (Greek sovereign bonds are an exception and were eligible for the PEPP, regardless of the rating, due to the waiver from ECB to Greece); and (ii) a maturity of between 70 days and up to 30 years. This differentiation allows for a detailed assessment of the programme's impact. Eligible bonds reflect the direct effects of the ECB's interventions, as they were actively purchased under the PEPP, while ineligible bonds help capture the indirect effects, such as improved market liquidity or reduced systemic risk, which may have amplified

[6] Other measures, such as the primary balance, are typically reported on an annual basis and therefore are less suitable for reflecting short-run fiscal dynamics during the pandemic. Furthermore, the employment of multiple interrelated fiscal measures, such as the primary balance and debt, can lead to multicollinearity, which can yield misleading results.

[7] The size of this coefficient will tell us the strength of the synergies between monetary and fiscal policy. A more negative value would imply that the PEPP was successful in counterbalancing concerns about fiscal expansion and fostering market stability. A smaller or statistically insignificant coefficient, however, may reveal limited synergies or even possible conflicts, highlighting the need for closer coordination between fiscal and monetary policies.

the broader impact of monetary policy (Fratzscher et al., 2016; Altavilla et al., 2021; Mudde et al., 2024).[8]

Following the approach of Sironi (2003) and Zaghini (2016, 2019), who extensively analyse the determinants of risk premiums in the primary bond market, we incorporate several control variables ($\lambda X_{it}$) to consider bond features, market dynamics, domestic economic conditions and Eurozone-specific factors. These controls are essential to isolate the effects of PEPP purchases and fiscal measures, ensuring more robust estimates of the impact of these interventions on sovereign bond spreads.

The analysis includes bond-specific features that may influence the spreads and their eligibility for the programme, following the approach of Zaghini (2019). These characteristics include: the logarithm of the issue amount[9], the initial maturity period (in years) and the bond's credit rating.[10] The rated and non-rated bonds were differentiated by adding a dummy variable that assume the value of 1 for the first case and 0 otherwise. For rated bonds, the bond is assigned a numerical score according to the credit quality, with a higher score indicating higher creditworthiness.[11] The model includes an interaction between both variables in order to incorporate these two dimensions of bond rating: if the bond is non-rated, the interaction term equals 0; otherwise, the bond is assigned a numerical score from 1 (D) to 22 (AA), just reflecting its credit quality. Additionally, we control for the issuer type by introducing a dummy variable that takes the value of 1 if the central governments issued the bond and 0 if issued by a subnational government. This control is important to ensure that the estimated effects of PEPP purchases and fiscal conditions are not influenced by differences in sovereign issuer types.[12]

[8] Based on this distinction, the hypothesis is that PEPP-eligible bonds show negative coefficients, reflecting the direct benefits of liquidity. On the other hand, non-eligible bonds may exhibit more ambiguous effects since they balance the indirect benefits of the programme with the absence of direct support.

[9] Larger issuance tends to be associated with greater liquidity in secondary markets, which can lead to lower spreads. Conversely, bonds with longer maturities tend to have higher spreads, due to the associated greater interest and credit risk (Elton et al., 2002).

[10] Investment-grade bonds are expected to have lower spreads, reflecting their lower perceived risk (Huang and Huang, 2012).

[11] Each credit rating level is assigned a numerical score with AAA/Aaa corresponding to 22, AA+/ Aa1 to 21; AA/Aa2 to 20, and so on, decreasing sequentially D, which corresponds to 1. This is similar to the approach of Afonso et al. (2012).

[12] Previous studies explain why sub-national governments may face higher risk premiums than central governments. Schuknecht, von Hagen, and Wolswijk (2008) point out that, sub-nationals, in comparison with central governments, often have smaller tax bases, less fiscal autonomy, and a more mobile tax base, making it harder for them to raise revenue during fiscal crises. In this context, some studies have shown that the spreads of central and subnational governments are interdependent, as subnational entities often rely on fiscal support from the central government. (e.g., Jenkner and Lu, 2014; Bellot, Selva, and Menéndez, 2017).

The domestic economic conditions are represented in the model by the inflation rate, the nominal GDP growth rate, and the unemployment rate. These three variables capture the specific macroeconomic context of each country that influence investor perceptions of sovereign risk. The bond yields are impacted directly by the inflation due to expectations for tighter monetary policies and therefore a decrease in the real value of bonds. In turn, nominal GDP growth reflects the country's economic performance which is a significant consideration in the context of the pandemic. Finally, the unemployment rate indicates the labour market conditions, with higher levels indicating weaker economic fundamentals and greater fiscal pressure on the economy.[13]

We also include the European Economic Sentiment Indicator (ESI)[14] and the 10-year US Treasury yield as control variables. The ESI reflects the level of economic sentiment across the Eurozone. A higher ESI, it is, generally, associated with lower spreads, as they indicate lower economic risks. Studies such as that of Afonso and Nunes (2015) underscored the significance of macroeconomic expectations in shaping yield spreads, which reinforces the relevance of the ESI in the analysis. At the same time, the 10-year US Treasury yield captures the evolution of global interest rates, which can affect the sovereign spreads of eurozone countries through global capital movements (Bernoth et al. 2004; Longstaff et al. 2011).

In addition to the baseline model, we estimate extended specifications that incorporate interaction terms to explore the heterogeneous effects of PEPP purchases on sovereign bond spreads. The first extension introduces an interaction of lagged PEPP purchases and a continuous time trend variable ($Time\ trend_t$). This specification captures the gradual evolution of the PEPP's effectiveness, allowing us to test whether its impact intensified, remained stable, or weakened throughout its implementation period (2020–2022). [15] The second extension examines the role of bond eligibility by interacting lagged PEPP purchases with

[13] GDP growth is expected to show a negative coefficient, reflecting the increased perception of sovereign risk during an economic downturn. Contrasting this, both inflation and unemployment are expected to have positive coefficients, as each signals macroeconomic instability and weaker economic fundamentals, respectively.

[14] The ESI is a composite measure from the European Commission's Directorate General for Economic and Financial Affairs, designed to monitor GDP growth across EU member states, the EU, and the euro area. It combines responses from business and consumer surveys across five sectors: industry (40%), services (30%), consumers (20%), retail (5%), and construction (5%). Balances are calculated as the difference between positive and negative responses, with the ESI standardized to a mean of 100 (long-term) and a standard deviation of 10. Values above 100 indicate stronger-than-average economic sentiment, and data are seasonally adjusted.

[15] This variable is defined as the number of quarters elapsed since the start of the sampling period, providing a continuous, time-dependent measure to capture potential changes in the effectiveness of the PEPP. Accordingly, $Time\ trend_t$ is set to 0 for 2018: Q1 (the first quarter in the dataset), 1 for 2018: Q2, and so on, increasing by 1 each quarter.

eligibility status. While the standalone eligibility term accounts for systematic differences between eligible and non-eligible bonds, this interaction helps determine whether the PEPP's effect was stronger for eligible bonds over time. Since the programme specifically targeted eligible securities, this interaction provides insights into whether the PEPP effectively reduced risk premia for the intended bonds.

We further extend the model by incorporating an interaction between lagged PEPP purchases and bond credit ratings. This interaction examines whether riskier bonds benefited more from ECB intervention. Given that higher credit risk typically translates into wider spreads, this interaction allows us to assess whether the PEPP was particularly effective in stabilizing borrowing costs for riskier issuers. Another critical extension involves interacting lagged PEPP purchases with bond maturity. This interaction enables us to assess whether the PEPP had a stronger effect on long-term bonds, which are more exposed to market volatility and shifts in risk sentiment. The last extension introduces a triple interaction term between past PEPP interventions, bond eligibility, and the two fiscal indicators: the debt-to-GDP ratio and net lending/borrowing ratio. This specification allows us to measure the PEPP's effectiveness by considering the eligibility status and the country's fiscal position.

This model provides a robust framework for analysing how PEPP purchases, fiscal stances, and their interactions influenced sovereign bond markets. An important innovation is the bond-level eligibility data utilized to distinguish direct impacts on PEPP-eligible bonds from overall market spillovers. The integration of interaction terms and dynamic fiscal indicators ensures a robust identification strategy by revealing important insights about synergies and trade-offs of monetary and fiscal policies during the COVID-19 crisis.

## 5. Empirical analysis

### 5.1. Data

The study covers the period between Q1:2018 and Q1:2022, which includes not only the pandemic years as well as the pre-pandemic period to establish a normal economic context period. Our analysis only focuses on the period with active purchases under the PEPP to focus only on the direct effects of purchases and at same time to avoid later distortions such as reinvestments.

This study analyses data on sovereign bond issuance, considering each bond as an individual observation. The sample includes 1,368 euro-denominated sovereign bonds[16] issued by 19 Eurozone countries over the reference period (Table A1), with data obtained from Bloomberg. The sample includes nominal and inflation-linked sovereign bonds issued by central, regional and local governments. In addition, only bonds with an OAS available at the time of issue were included in the sample. It is important to highlight that there are some bonds that have negative OAS values, and these are caused by some of the market conditions prevailing at the time in analysis. Along with the historically low and even negative interest rate environment in the Eurozone, the ECB's substantial purchases of bonds under the PEPP significantly compressed spreads, especially for high-liquidity sovereign bonds. The ECB's asset purchase programmes were already affecting sovereign bond markets even before the pandemic, but the unprecedented scale of PEPP further compressed spreads, particularly for very liquid bonds. The prevailing environment of historically low interest rates in the eurozone also played an important role.

The sample selection follows the eligibility criteria of the PEPP, which allows the purchase of regional and local bonds within the same framework as the PSPP (Public Sector Purchase Programme). By including both categories, the study provides a more comprehensive view of the impact of PEPP interventions on sovereign bond yields.[17]

For bond rating classification, this study considers credit ratings assigned by the three major rating agencies – Moody's, Standard & Poor's, and Fitch, when available. To ensure a conservative evaluation, a bond is found to be eligible based on the assumption of the lowest rating assigned by one of the three agencies. This approach reduces the risk of over-optimistic assessment, and it is in line with standard investor practices, which typically use the most conservative rating for the analysis of the sovereign credit risk. In this case, bonds rated with a minimum rating of BBB- (investment grade) are classified as eligible for the PEPP and those rated BB+ or lower are ineligible. Due to the ECB's temporary exemption from the minimum rating standards for Greece, the sovereign bonds of this country are also considered eligible despite the fact of being rated below investment grade.

[16] The total dataset includes 1,368 bond issuances, but the fixed effects estimation drops one singleton observation, resulting in N = 1,367 in the regression models.

[17] Although the ECB recognizes the eligibility of certain public agencies under the PSPP and, consequently, under the PEPP, we have chosen to exclude bonds issued by public agencies and other quasi-sovereign entities from the sample. This decision ensures a clearer assessment of the PEPP's impact on sovereign yields while avoiding distortions from semi-public institutions that may exhibit different market dynamics.

To align with the reporting frequency of explanatory variables, we assigned the quarterly macroeconomic and policy variables to bonds based on their issuance date. Although bond issuance occurs on specific dates, quarterly frequency ensures consistency with data reporting practices and provides a robust representation of the fiscal and monetary environment that influences bond issuance spreads. This approach balances temporal granularity with data availability and ensures alignment between bond-specific observations and broader macroeconomic trends.

We use net purchases to capture the ECB's active interventions, reflecting the flow of liquidity added to sovereign bond markets, net of redemptions. The data on the PEPP net purchases was obtained from the ECB, which reports these figures on a bimonthly basis. To align the data with the quarterly frequency of the analysis, the bimonthly figures were adjusted proportionally to create quarterly estimates. This adjustment assumes that PEPP purchases were evenly distributed across the months within the reporting period. While this assumption simplifies the distribution, it allows for consistency in integrating the PEPP data with quarterly fiscal and macroeconomic variables.

To enhance clarity and reflect proportional changes in intervention size, we incorporate the natural logarithm of the PEPP net purchases into the model. By converting the data to a quarterly format and utilizing the natural logarithm, the analysis maintains consistency with other variables and effectively illustrates the magnitude and impact of the ECB's interventions.

The fiscal policy indicators, namely the debt-to-GDP ratio and government budget balance, were obtained from Eurostat. These indicators are assigned to bonds based on their issuance date, with the assumption that the quarterly values adequately represent the fiscal stance during that period. The same approach is applied to domestic economic conditions, namely the inflation rate, nominal GDP growth and unemployment rate, which are also reported quarterly and sourced from Eurostat. The definition of used variables and their sources are described in the Table A2.

### 5.2. Results

This section presents the results of the regression of Equation (1) and its extensions. The summary statistics of the data used are presented in Table A3, while Table A4 presents the information about on bond credit ratings. The PEPP was launched during an unprecedented global crisis when governments were engaged in substantial fiscal and monetary measures. Due to the very specific nature of the conditions surrounding the COVID-19 pandemic, these unique

factors may mean that market dynamics during this period might have deviated from historical patterns and may have had responses that did not fully fit conventional economic relations. Consequently, the interaction between sovereign spreads, fiscal fundamentals, and monetary interventions during this period should be interpreted considering these unique conditions.

The baseline model analyses the relationship between sovereign bond spreads, PEPP purchases and countries' fiscal situation while controlling for key macroeconomic and financial factors. The results (Table 1, Column I) suggest that PEPP purchases alone did not have a statistically significant impact on sovereign bond spreads. Both contemporaneous and lagged PEPP purchase coefficients are not statistically significant, suggesting that any effects of the programme were neither immediate nor persistent over time. This finding contrasts with studies such as Moessner and Haan (2022), who document a significant decline in term premia following PEPP announcements, which indicates that announcement effects may have been stronger than actual purchase flows. Instead, the results suggest that PEPP's effectiveness depends more on countries' fiscal conditions, especially the debt-to-GDP dynamics. The findings indicate that in countries where the debt ratios were rising, the PEPP purchases were associated with higher, not lower, spreads. This result indicates that PEPP purchases did not mitigate the concerns about fiscal sustainability in countries with weakening debt positions. This result aligns with Benigno et al. (2022), who argue that fiscal fundamentals condition the effectiveness of ECB interventions, especially in the presence of high debt levels. On the contrary, the interaction between lagged PEPP and changes in net borrowing/lending ratio is not statistically significant, implying that long-term debt accumulation played a stronger impact in shaping PEPP's effectiveness than temporary fiscal balances. Thus, when assessing sovereign risks, the markets appear to be more concerned about structural debt than about temporary fluctuations in the fiscal situation.

**TABLE I.** Results of the Baseline Model and Its Extensions.

| | (I) | (II) | (III) | (IV) | (V) | (VI) |
|---|---|---|---|---|---|---|
| $PEPP_{it}$ (log) | 0.039 | 0.044 | 0.038 | 0.039 | 0.041 | 0.042 |
| | (0.051) | (0.052) | (0.050) | (0.050) | (0.049) | (0.049) |
| $PEPP_{it-1}$ (log) | 0.060 | -0.035 | 0.054 | 0.055 | 0.061 | 0.052 |
| | (0.049) | (0.123) | (0.054) | (0.053) | (0.045) | (0.054) |
| $\Delta\, debt\, ratio_{it}$ | 0.009 | 0.007 | 0.008 | 0.008 | 0.008 | 0.004 |
| | (0.011) | (0.012) | (0.012) | (0.012) | (0.011) | (0.014) |
| $\Delta\, net\ lend./Borr_{it}$ | -0.002 | -0.002 | -0.002 | -0.002 | -0.002 | -0.003 |
| | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) | (0.012) |
| $(PEPP_{it-1} \times \Delta\, debt\, ratio_{it})$ | 0.005** | 0.006*** | 0.005** | 0.005** | 0.005** | 0.006** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) |
| $(PEPP_{it-1} \times \Delta\, net.\, lend/borr_{it})$ | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.001) |
| $Eligibility_{it}$ | 0.475* | 0.472* | 0.439* | 0.477* | 0.512** | 0.435* |
| | (0.239) | (0.238) | (0.246) | (0.239) | (0.221) | (0.249) |
| $Issue\ amount_{jt}$ (log) | -0.160 | -0.160 | -0.160 | -0.160 | -0.158 | -0.157 |
| | (0.151) | (0.151) | (0.151) | (0.151) | (0.152) | (0.152) |
| $Maturity_{jt}$ (years) | 0.031*** | 0.030*** | 0.031*** | 0.031*** | 0.036*** | 0.030*** |
| | (0.008) | (0.008) | (0.008) | (0.008) | (0.007) | (0.008) |
| $Credit\ Rating_{jt}$ | -0.007 | -0.007 | -0.008 | -0.009* | -0.009* | -0.007 |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) |
| $Issuer\ Type_{it}$ | 0.030 | 0.031 | 0.030 | 0.029 | 0.040 | 0.021 |
| | (0.299) | (0.298) | (0.298) | (0.298) | (0.289) | (0.298) |
| $GDP\ growth_{it}$ | 0.007 | 0.009 | 0.007 | 0.007 | 0.006 | 0.011 |
| | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) |
| $Inflation_{it}$ | -0.049** | -0.048** | -0.049* | -0.050* | -0.042* | -0.049* |
| | (0.023) | (0.022) | (0.024) | (0.024) | (0.021) | (0.025) |
| $Unemployment_{it}$ | -0.036 | -0.039 | -0.043 | -0.042 | -0.023 | -0.027 |
| | (0.042) | (0.043) | (0.046) | (0.044) | (0.040) | (0.050) |
| $ESI_{it}$ | -0.010 | -0.010 | -0.010 | -0.010 | -0.009 | -0.008 |
| | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) |
| $US\ Treasury_t$ | 0.175 | 0.175 | 0.176 | 0.179 | 0.154 | 0.176 |
| | (0.143) | (0.143) | (0.144) | (0.143) | (0.150) | (0.144) |
| $(PEPP_{it-1} \times Time\ trend_t)$ | | 0.007 | | | | |
| | | (0.007) | | | | |
| $(PEPP_{it-1} \times Eligibility_{it})$ | | | 0.008 | | | 0.008 |
| | | | (0.007) | | | (0.008) |
| $(PEPP_{it-1} \times Credit\ Rating_{jt})$ | | | | 0.000 | | |
| | | | | (0.000) | | |
| $(PEPP_{it-1} \times Maturity_{jt})$ | | | | | -0.001* | |
| | | | | | (0.000) | |
| $(PEPP_{it-1} \times Elig._{jt} \times \Delta\, debt\, ratio_{it})$ | | | | | | -0.000 |
| | | | | | | (0.002) |
| $(PEPP_{it-1} \times Elig._{jt} \times \Delta\, net.\, lend/borr_{it})$ | | | | | | 0.003* |
| | | | | | | (0.002) |
| Constant | 0.487 | 0.508 | 0.592 | 0.574 | 0.251 | 0.220 |
| | (1.494) | (1.498) | (1.601) | (1.594) | (1.529) | (1.598) |
| Country and Time Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of observations | 1,367 | 1,367 | 1,367 | 1,367 | 1,367 | 1,367 |
| $R^2$ | 0.4397 | 0.4400 | 0.4401 | 0.4399 | 0.4435 | 0.4434 |
| Within $R^2$ | 0.2801 | 0.2804 | 0.2806 | 0.2803 | 0.2849 | 0.2849 |

This table presents the regression results from the baseline model (Equation 1) and its extensions, analyzing the impact of the Pandemic Emergency Purchase Programme (PEPP) on sovereign bond spreads.The dependent variable is the sovereign bond spread, reflecting market risk perception. The independent variables include PEPP purchases and several interaction terms to explore how different factors influence PEPP's effectiveness. Columns I to VI display results from different model specifications: I) Estimates the general effect of PEPP on sovereign bond spreads, controlling for macroeconomic factors; II) Examines whether the impact of the PEPP has evolved over time, testing whether its effectiveness has increased or decreased over the course of the programme's implementation; III) Assesses whether eligible bonds responded differently to PEPP purchases compared to non-eligible bonds; IV) Explores the role of sovereign credit risk by interacting PEPP purchases with bond ratings to determine if riskier bonds benefited more; V) Investigates whether the impact of PEPP varied across bonds with different maturities, testing if shorter or longer-term bonds experienced larger spread reductions, VI) Introduces a three-way interaction to assess whether PEPP was most effective in eligible bonds of countries with different debt levels, capturing fiscal policy effects. Statistical significance is indicated by *p < 0.1, **p < 0.05, ***p < 0.01.

Additionally, the eligibility term is positive and significant. This indicates that eligible bonds had wider spreads, which might well convey an initial perception that they were riskier assets. It suggests that the PEPP did not immediately eliminate risk perceptions related to eligible bonds, meaning that investors may have needed time to fully adapt their asset pricing behaviour to ECB interventions. This is in line with Demirgüç-Kunt et al. (2020), whose results indicate that higher-rated investment grade firms benefited more from ECB corporate bond purchases, suggesting that eligibility alone does not fully eliminate market concerns about credit risk. In addition to PEPP-specific factors, spreads were also influenced by macroeconomic conditions and bond characteristics. Inflation was negatively associated with spreads, probably reflecting a reduction of the real debt burden. Conversely, bonds with longer maturities were related to wider spreads, supporting the idea that the markets remained cautious about the risks of long-term debt, even in the presence of central bank intervention. Finally, it should also be noted that the dummy variable for central government issuers is positive but not statistically significant, suggesting that the market perceives similar levels of risk between central and subnational issuers.

The findings of the baseline model do not determine whether PEPP's effectiveness changed over time. To address this, Column II of Table 1 introduces a time trend interaction, ($PEPP_{it-1}$ x $Time\ trend_t$). The coefficient of this interaction is positive but statistically insignificant, indicating that PEPP's effectiveness did not strengthen or weaken over time, but remained constant throughout the programme. This finding contradicts theoretical expectations that monetary interventions could lose their effectiveness as the market adjusts or that their effects accumulate over time. Instead, the consistent stability of the PEPP's effectiveness indicates that its influence could be closely linked to underlying fiscal conditions, namely the evolution of the debt-to-GDP ratio, rather than the simple passage of time.

When analysing the role of eligibility status, we verified that the PEPP's effectiveness was not differentiated between eligible and non-eligible bonds. The results demonstrate that while eligible bonds tend to have higher spreads, the interaction between lagged PEPP purchases and eligibility status is not statistically significant (Table I, Column III). This finding suggests that eligibility status did not influence PEPP's impact, with eligible bonds not presenting a differentiated effect. Instead, this extension confirms again that rising debt levels played a more significant role in determining how sovereign bond spreads reacted to the ECB's interventions.

Regarding the bond credit rating role, the results of Column IV of Table I demonstrate that the interaction between this term and lagged PEPP purchases is not statistically significant. This indicates that PEPP's impact on spreads remained consistent at different levels of sovereign credit risk and did not benefit riskier bonds to a greater extent. In this extension, the stand-alone coefficient of the credit rating becomes slightly negative and significant, confirming that bonds with higher ratings generally have lower spreads. Rather than market-perceived risk, the PEPP's effectiveness was influenced, in line with previous findings, by the dynamics of a country's debt ratio.

The bond maturity also seems to play an important role in influencing the effectiveness of the PEPP. The combined impact of lagged PEPP purchases and bond maturity is negative and significant (Table I, Column V). As indicated by this result, PEPP's effectiveness in reduce the spreads seems to be stronger in longer maturity bonds. This is consistent with previous research that suggests that central banks' asset purchases have a more substantial effect on longer-duration securities, due to their sensitivity to interest rates and risk premia (Li and Wei, 2013; Altavilla et al., 2021). In terms of fiscal policy, the results remain practically the same. Additionally, the stand-alone coefficient of the credit rating is also negative and significant, which reinforces the idea that longer maturity bonds are more sensitive to credit risk. which are usually more vulnerable to changes in risk perceptions and central bank actions.

As the fiscal conditions, particularly the debt ratio dynamics, appear to have influenced PEPP's effectiveness, we extend our analysis to examine whether this impact varies based on bond eligibility status. The results of this extension (Table 1, Column VI) indicate that while the stand-alone eligibility term remains statistically significant, its interaction with lagged PEPP purchases is insignificant. This result supports the previous finding that eligibility status does not influence the PEPP's effectiveness in reducing sovereign spreads. However, the role of eligibility status in shaping PEPP's interaction with fiscal conditions is mixed. Although the PEPP's effectiveness remains influenced by debt ratio dynamics, the introduction of eligibility in this interaction becomes the coefficient not significant, which suggests that PEPP's response to rising debt levels did not depend on eligibility status. In contrast, the addition of eligibility status to the interaction of PEPP purchases with the variation of net lending/borrowing ratio results in a positive and significant coefficient. This suggests that fiscal imbalances affected PEPP's impact primarily for eligible bonds, rather than as a broad response. These conclusions

indicate that the ECB's intervention has not eliminated perceptions of sovereign credit risk, especially in the case of PEPP-eligible bonds.

Our earlier results suggest that the PEPP's impact was conditional on fiscal conditions of countries where the debt stance was deteriorating. To analyse this relationship further, we now evaluate the model through an analysis based on the countries' debt-to-GDP ratios. More specifically, we classify the countries into two distinct groups based on their historical debt levels: (i) high-debt countries, which include Portugal, Spain, Italy, Greece, France, Belgium, and Cyprus; and (ii) low-debt countries, which include the rest of the sample.[18] As shown in column I of Table II, the results suggest that the PEPP's impacts differ across countries with different levels of debt.

In high-debt countries, the coefficient on lagged PEPP purchases is positive and significant, suggesting that the programme did not reduce sovereign spreads but was instead associated with persistent risk perceptions. This suggests that in these countries, PEPP interventions did not fully compensate for the concerns about fiscal sustainability. These findings contrast with those of Corradin et al. (2021), who report that sovereign risk premia declined in vulnerable countries following the ECB monetary announcements. However, our results partially reflect the conclusions of Fendel et al. (2021) which find that the spreads in high-debt countries decreased after policy announcements, mainly due to an increase in yields in fiscally stronger countries, rather than a decrease in their yields.

In the case of low-debt countries, contemporary PEPP purchases coincided with rising spreads, possibly indicating that the markets perceived them as a response to emerging risks rather than a stabilisation measure. This interpretation is consistent with Fendel et al. (2021) that argue that investors anticipated a greater fiscal burden for fiscally stronger countries, resulting in a temporary increase in their risk premia. However, in these countries, lagged PEPP purchases are negative and statistically significant in these countries, suggesting that the programme eventually led to a reduction in spreads. From this result, we can infer that PEPP's effectiveness was more substantial in markets with better fiscal fundamentals.

In countries with high debt levels, the interaction between lagged PEPP purchases and changes in the debt-to-GDP ratio is not statistically significant. This implies that the PEPP's impact was

[18] We define high-debt countries as those with an average debt-to-GDP ratio exceeding 90% during the pre-pandemic period (2016–2019). See Afonso and Jalles (2013), who report different economic growth effects of debt above and below such threshold.

not affected by changes in the debt ratio. It suggests that in these countries, the markets had probably already incorporated fiscal risks due to their historically high debt. Consequently, the PEPP seems to act more as a stabilizing force rather than a reactive measure to fiscal changes. Similarly, the interaction between lagged PEPP purchases and variations in net lending/borrowing ratio also is insignificant, reinforcing the idea that fiscal balance variations did not play a major role in determining PEPP's effectiveness in these economies.

In contrast, our results indicate that the PEPP's interaction with fiscal indicators becomes significant in low-debt countries, suggesting that fiscal conditions were essential for PEPP's effectiveness. The positive and significant coefficient of the interaction between lagged PEPP purchases and changes in the debt-to-GDP ratio indicates that PEPP's ability to lower spreads decreased as debt levels increased. Furthermore, there is a positive and significant interaction between lagged PEPP purchases and changes in net lending/borrowing ratio, which demonstrates that the PEPP's effectiveness decreased as fiscal imbalances occurred.

Regarding the other factors that influence sovereign spreads, the eligibility term is positive for both subsamples but only significant in the low-debt countries. This suggests that eligible bonds were initially seen as riskier assets, indicating that the PEPP did not immediately reduce risk perceptions in these bonds. For high debt, the lack of significance of the eligibility status may be related to the fact the markets already consider concerns about fiscal sustainability and do not make a clear distinction between eligible and ineligible bonds in these countries. Furthermore, both subsamples show that maturity is still positively significant, which indicates that longer-term bonds usually have higher spreads because they are more susceptible to market volatility. At last, the central government dummy coefficient is positive but not statistically significant in high-debt countries, while it is negative and significant in low-debt countries. These results suggest that the market does not clearly distinguish between central and subnational issuers when fiscal sustainability concerns are already notable. In contrast, central government bonds are perceived as safer than subnational ones in low-debt countries, which may reflect the stronger fiscal credibility of central governments in fiscal sound economies.

For both subsamples, we applied the same model extensions as in the full sample analysis. Columns II to VI of Table II present the corresponding results. The first important finding is the role of eligibility (Table II, Column III). In high-debt countries, neither the eligibility term nor its interaction with PEPP purchases are statistically significant.

**TABLE II.** Results of the Baseline Model and Its Extensions: High- vs Low-Debt Countries.

| | (I) | | (II) | | (III) | | (IV) | | (V) | | (VI) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* |
| $PEPP_{it}$ (log) | -0.067 | 0.146** | -0.079 | 0.146** | -0.067 | 0.153** | -0.064 | 0.150** | -0.057 | 0.132** | -0.058 | 0.144** |
| | (0.130) | (0.049) | (0.127) | (0.048) | (0.130) | (0.053) | (0.132) | (0.050) | 0.125 | (0.056) | (0.130) | (0.052) |
| $PEPP_{it-1}$ (log) | 0.249* | -0.085** | 0.517 | -0.194 | 0.249* | -0.129*** | 0.249* | -0.107*** | 0.233* | -0.056 | 0.252* | -0.129*** |
| | (0.121) | (0.035) | (0.274) | (0.130) | (0.121) | (0.036) | (0.121) | (0.033) | (0.116) | (0.038) | (0.125) | (0.033) |
| $\Delta\, debt\, ratio_{it}$ | 0.027 | -0.004 | 0.038 | -0.015 | 0.027 | 0.005 | 0.026 | -0.000 | 0.024 | 0.004 | 0.028* | 0.001 |
| | (0.016) | (0.018) | (0.021) | (0.024) | (0.015) | (0.021) | (0.016) | (0.019) | (0.015) | (0.015) | (0.013) | (0.020) |
| $\Delta\, net\ lend./Borr_{it}$ | 0.003 | -0.062** | 0.002 | -0.059** | 0.003 | -0.069** | 0.003 | -0.065** | 0.003 | -0.054* | 0.002 | -0.062** |
| | (0.017) | (0.023) | (0.016) | (0.023) | (0.017) | (0.025) | (0.017) | (0.024) | (0.017) | (0.028) | (0.017) | (0.025) |
| $(PEPP_{it-1}$ x $\Delta\, debt\, ratio_{it})$ | 0.001 | 0.008*** | -0.001 | 0.010*** | 0.001 | 0.006 | 0.001 | 0.007** | 0.001 | 0.006 | 0.001 | 0.010* |
| | (0.001) | (0.002) | (0.002) | (0.002) | (0.001) | (0.003) | (0.001) | (0.003) | (0.001) | (0.004) | (0.001) | (0.005) |
| $(PEPP_{it-1}$ x $\Delta\, net.lend/borr_{it})$ | 0.000 | 0.007* | 0.000 | 0.007 | 0.000 | 0.008* | 0.000 | 0.008* | 0.000 | 0.006 | -0.001 | 0.007* |
| | (0.002) | (0.004) | (0.002) | (0.004) | (0.002) | (0.004) | (0.002) | (0.004) | (0.002) | (0.004) | (0.001) | (0.004) |
| $Eligibility_{it}$ | 0.314 | 0.536** | 0.310 | 0.517** | 0.320 | 0.347 | 0.316 | 0.531** | 0.345 | 0.570** | 0.317 | 0.336 |
| | (0.277) | (0.214) | (0.274) | (0.226) | (0.267) | (0.238) | (0.278) | (0.212) | (0.253) | (0.228) | (0.267) | (0.229) |
| $Issue\ amount_{jt}$ (log) | 0.009 | -0.388*** | 0.011 | -0.388*** | 0.009 | -0.385*** | 0.006 | -0.385*** | 0.008 | -0.387*** | 0.020 | -0.385*** |
| | (0.076) | (0.094) | (0.075) | (0.094) | (0.076) | (0.095) | (0.078) | (0.094) | (0.076) | (0.093) | (0.082) | (0.093) |
| $Maturity_{jt}$ (years) | 0.043** | 0.018*** | 0.043** | 0.018*** | 0.043** | 0.018*** | 0.043** | 0.018*** | 0.048** | 0.027*** | 0.043** | 0.017*** |
| | (0.016) | (0.005) | (0.016) | (0.005) | (0.016) | (0.005) | (0.016) | (0.005) | (0.013) | (0.005) | (0.016) | (0.005) |
| $Credit\ Rating_{jt}$ | -0.009 | -0.011 | -0.008 | -0.010 | -0.008 | -0.010 | -0.011 | -0.014 | -0.010 | -0.012 | -0.008 | -0.009 |
| | (0.010) | (0.009) | (0.010) | (0.010) | (0.010) | (0.010) | (0.011) | (0.009) | (0.009) | (0.010) | (0.010) | (0.010) |
| $Issuer\ Type_{it}$ | -0.270 | 0.433** | -0.270 | 0.432** | -0.271 | 0.438** | -0.267 | 0.432** | -0.258 | 0.444** | -0.284 | 0.416** |
| | (0.240) | (0.164) | (0.239) | (0.164) | (0.242) | (0.168) | (0.245) | (0.167) | (0.218) | (0.165) | (0.235) | (0.175) |
| $GDP\ growth_{it}$ | 0.008 | 0.015 | 0.005 | 0.017 | 0.008 | 0.015 | 0.008 | 0.014 | 0.007 | 0.018 | 0.008 | 0.018 |
| | (0.017) | (0.014) | (0.019) | (0.012) | (0.017) | (0.013) | (0.017) | (0.014) | (0.018) | (0.011) | (0.018) | (0.011) |
| $Inflation_{it}$ | -0.041 | 0.013 | -0.060 | 0.004 | -0.040 | 0.041** | -0.043 | 0.025 | -0.036 | 0.012 | -0.039 | 0.050*** |
| | (0.045) | (0.017) | (0.043) | (0.025) | (0.045) | 0.015 | (0.044) | (0.018) | (0.045) | (0.014) | (0.047) | (0.013) |
| $Unemployment_{it}$ | 0.024 | -0.076 | 0.025 | -0.103 | 0.024 | -0.105 | 0.022 | -0.092 | 0.033 | -0.034 | 0.033 | -0.129* |
| | (0.076) | (0.059) | (0.079) | (0.081) | (0.076) | (0.063) | (0.078) | (0.064) | (0.076) | (0.057) | (0.081) | (0.063) |
| $ESI_{it}$ | -0.009 | 0.003 | -0.009 | 0.002 | -0.009 | 0.002 | -0.009 | 0.003 | -0.008 | 0.004 | -0.008 | 0.004 |
| | (0.008) | (0.010) | (0.008) | (0.009) | (0.008) | (0.010) | (0.008) | (0.010) | (0.009) | (0.011) | (0.009) | (0.010) |
| $US\ Treasury_{t}$ | 0.066 | 0.150 | 0.057 | 0.141 | 0.066 | 0.138 | 0.077 | 0.149 | 0.060 | 0.116 | 0.061 | 0.140 |
| | (0.198) | (0.089) | (0.194) | (0.084) | (0.199) | (0.100) | (0.210) | (0.092) | (0.197) | (0.094) | (0.204) | (0.103) |
| $(PEPP_{it-1}$ x $Time\ trend_{t})$ | | | -0.020 | 0.009 | | | | | | | | |
| | | | (0.017) | (0.010) | | | | | | | | |
| $(PEPP_{it-1}$ x $Eligibility_{it})$ | | | | | -0.001 | 0.031*** | | | | | -0.003 | 0.035*** |
| | | | | | (0.009) | (0.008) | | | | | (0.009) | (0.010) |
| $(PEPP_{it-1}$ x $Credit\ Rating_{jt})$ | | | | | | | 0.000 | 0.001* | | | | |
| | | | | | | | (0.001) | (0.000) | | | | |
| $(PEPP_{it-1}$ x $Maturity_{jt})$ | | | | | | | | | -0.001 | -0.001*** | | |
| | | | | | | | | | (0.001) | (0.000) | | |
| $(PEPP_{it-1}$ x $Elig._{jt}$ x $\Delta\, debt\, ratio_{it})$ | | | | | | | | | | | 0.001 | -0.005 |
| | | | | | | | | | | | (0.001) | (0.006) |
| $(PEPP_{it-1}$ x $Elig._{jt}$ x $\Delta\, net.lend/borr_{it})$ | | | | | | | | | | | 0.005 | 0.001 |
| | | | | | | | | | | | (0.003) | (0.002) |
| Constant | -1.483 | 0.901 | -1.522 | 1.201 | -1.482 | 1.304 | -1.484 | 1.113 | -1.688 | 0.585 | -1.903 | 1.189 |
| | (1.445) | (1.376) | (1.506) | (1.283) | (1.439) | (1.398) | (1.453) | (1.387) | (1.386) | (1.526) | (1.674) | (1.466) |
| Country and Time Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of observations | 823 | 544 | 823 | 544 | 823 | 544 | 823 | 544 | 823 | 544 | 823 | 544 |
| $R^2$ | 0.4597 | 0.3757 | 0.4606 | 0.3764 | 0.4597 | 0.3806 | 0.4600 | 0.3764 | 0.4614 | 0.3920 | 0.4637 | 0.3837 |
| Within $R^2$ | 0.3980 | 0.2494 | 0.3989 | 0.2501 | 0.3980 | 0.2553 | 0.3983 | 0.2502 | 0.3998 | 0.2689 | 0.4024 | 0.2590 |

This table presents the regression results from the baseline model (Equation 1) and its extensions, analyzing the impact of the Pandemic Emergency Purchase Programme (PEPP) on sovereign bond spreads.The dependent variable is the sovereign bond spread, reflecting market risk perception. Countries are divided into two groups based on historical debt levels: (i) high-debt countries (Portugal, Spain, Italy, Greece, France, Belgium, and Cyprus) and (ii) low-debt countries (all other sample countries).The independent variables include PEPP purchases and several interaction terms to explore how different factors influence PEPP's effectiveness. Columns I to VI display results from different model specifications: I) Estimates the general effect of PEPP on sovereign bond spreads, controlling for macroeconomic factors; II) Examines whether the impact of the PEPP has evolved over time, testing whether its effectiveness has increased or decreased over the course of the programme's implementation; III) Assesses whether eligible bonds responded differently to PEPP purchases compared to non-eligible bonds; IV) Explores the role of sovereign credit risk by interacting PEPP purchases with bond ratings to determine if riskier bonds benefited more; V) Investigates whether the impact of PEPP varied across bonds with different maturities, testing if shorter or longer-term bonds experienced larger spread reductions, VI) Introduces a three-way interaction to assess whether PEPP was most effective in eligible bonds of countries with different debt levels, capturing fiscal policy effects, VII) Splits the analysis into high-debt and low-debt countries, examining whether sovereigns with different debt burdens experienced different impacts from PEPP and VIII) Splits the analysis into high-debt and low-debt countries, examining whether PEPP eligibility and fiscal policy stances affects PEPP efectiveness. Standard errors are clustered at the country level to account for potential correlation within sovereign bond markets. Statistical significance is indicated by *p < 0.1, **p < 0.05, ***p < 0.01.

This suggests that the distinction between eligible and non-eligible bonds was not a major driver of spreads in these countries. Additionally, the fiscal indicators and their interactions with lagged PEPP purchases are not statistically significant for the high-debt countries. However, in low-debt countries, the results present a different picture. While the eligibility status term remains not statistically significant, the interaction of lagged PEPP purchases with eligibility becomes statistically significant, a different result from the full sample analysis. This suggests that PEPP purchases had a distinct impact on eligible bonds in fiscally more robust economies and may have reflected market responses to the ECB's interventions in lower-risk sovereigns. The positive coefficient indicates that PEPP's effectiveness in reducing spreads may have been weaker for these bonds, possibly because markets interpreted the purchases as a reaction to emerging risks rather than a direct stabilizing measure.

Concerning bond credit ratings (Table II, Column IV), the positive and significant interaction between lagged PEPP purchases and credit rating in low-debt countries suggests that the programme was more effective for higher-rated bonds. This implies that markets in fiscally solid countries are more responsive when credit quality is strong. In contrast, in high-debt countries, the interaction term remains positive but statistically insignificant, which indicates that differences in bond ratings did not significantly change PEPP's effectiveness. This reinforces the idea that fiscal sustainability concerns were the primary market focus, limiting the differentiation based on creditworthiness.

Regarding bond maturity (Table II, Column V), in high-debt countries, the coefficient of the interaction between lagged PEPP purchases and maturity remains negative and statistically insignificant. This suggests that PEPP's effectiveness does not show a differentiated impact across maturities. However, the stand-alone maturity term remains positive and significant, reinforcing that longer-term bonds have higher spreads in these economies, probably due to a higher fiscal uncertainty perception. In low-debt countries, the results indicate that while longer-term bonds generally have higher spreads, the PEPP intervention was more effective in reducing their spreads, as evidenced by the negative and significant interaction term.

Including triple interactions in the segmented sample offers additional insights (Table II, Column VI). In countries with the high debt, both triple interactions are statistically insignificant, indicating that eligibility did not consistently change PEPP's effectiveness in these countries. Similarly, the interactions between lagged PEPP and variations in debt and net lending/borrowing ratios are also insignificant, as is the direct interaction between the PEPP

and eligibility status. These results imply that in high-debt countries, sovereign spreads were less affected by PEPP interventions and were primarily driven by broader fiscal sustainability concerns. Conversely, in low-debt countries, the triple interactions also show no significance, reinforcing that eligibility did not significantly influence PEPP's response to fiscal conditions. Even in stronger fiscal countries, eligible bonds are still perceived by markets as riskier assets, with a positive and statistically significant interaction between lagged PEPP purchases and eligibility. This result supports the view that the PEPP did not immediately eliminate the risk perception associated with eligible bonds. Another important observation for low-debt countries is that the interaction between lagged PEPP purchases and changes in both the debt-to-GDP ratio and the net lending/borrowing ratio becomes positive and statistically significant. This indicates that PEPP's effectiveness in reducing bond spreads decreases as fiscal conditions worsen. Even in fiscally solid countries, markets appear to interpret fiscal deterioration as a warning indicator, thus weakening the ability of PEPP purchases to reduce spreads.

### 5.3. Robustness checks

In this part, we check for the robustness of our findings through alternative model specifications. An initial check was the inclusion of the Volatility Index (VIX) to account for global uncertainty. However it was excluded due to collinearity, which suggest that the model's controls already account for the major drivers of sovereign spreads already captures key sources of endogeneity.

To confirm that our conclusions are not sensitive to the selection of a spread metric, we replaced the ASW with the OAS in the regression. The results (Table IV and V) are broadly stable, with the response to the PEPP being stronger in economies with low debt ratio and weaker in countries with high debt level, corroborating that the effect of the programme was conditional on fiscal conditions. However, certain linkages that are statistically significant under OAS are not so in the case of ASW, probably because OAS captures additional liquidity effects, while ASW reflect fundamentally credit risk. The results about eligibility effects and PEPP's dependence on fiscal policy are robust as well, reinforcing our main conclusions.

Additionally, we re-estimate the model by replacing the variation in net lending/borrowing ratio with the variation in the primary balance-to-GDP, while maintaining the debt ratio variation. This robustness check (Table A5.1. and A5.2.) ensures that our results are not sensitive to the choice of fiscal measures and confirms that PEPP's effectiveness is not solely driven by interest payments on existing debt but also reflects active fiscal policy decisions. In all specifications,

the conclusions remain consistent, confirming that the PEPP's effectiveness was mainly influenced by fiscal conditions before interest payments and not by overall fiscal deficits. Furthermore, the analysis between high and low-debt countries shows that the relationship holds in both groups, reinforcing the role of fiscal fundamentals in determining the impact of the PEPP interventions on sovereign bond spreads.

To ensure that our results are not influenced just by the extraordinary market conditions of 2020, the peak of the pandemic, we re-evaluate the model by dropping this year in a robustness check. The findings (Table A6.1. and A6.2.) are broadly consistent with our baseline analysis, which confirms that PEPP's effects over sovereign spreads was not simply a temporary reaction to the initial crisis. Although there are some changes in magnitude and sign of some fiscal interactions' terms, the overall structure of the relationships remains intact. This implies that PEPP's effectiveness was conditional on fiscal conditions during the pandemic, and just not on the emergency phase of the crisis. The distinction between high-debt and low-debt countries remains, reinforcing the conclusion that market perceptions about fiscal sustainability played a central role in shaping PEPP's impact.

**Table III.** Robustness Check: Results of the Baseline Model and Its Extensions Using ASW as the Spread Measure.

| | (I) | (II) | (III) | (IV) | (V) | (VI) |
|---|---|---|---|---|---|---|
| $PEPP_{it}$ (log) | 0.065 | 0.066 | 0.065 | 0.065 | 0.066 | 0.066 |
| | (0.058) | (0.061) | (0.060) | (0.060) | (0.058) | (0.059) |
| $PEPP_{it-1}$ (log) | 0.007 | -0.020 | 0.012 | 0.014 | 0.008 | 0.013 |
| | (0.045) | (0.098) | (0.044) | (0.044) | (0.043) | (0.046) |
| $\Delta\, debt\, ratio_{it}$ | 0.017 | 0.016 | 0.018 | 0.019 | 0.016 | 0.016 |
| | (0.011) | (0.010) | (0.012) | (0.012) | (0.011) | (0.011) |
| $\Delta\, net\ lend./Borr_{it}$ | -0.019 | -0.019 | -0.019 | -0.019 | -0.018 | -0.019 |
| | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) | (0.014) |
| $(PEPP_{it-1} \times \Delta\, debt\, ratio_{it})$ | 0.003** | 0.003** | 0.003*** | 0.003** | 0.003** | 0.003** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | 0.001 |
| $(PEPP_{it-1} \times \Delta\, net.\, lend/borr_{it})$ | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) |
| $Eligibility_{it}$ | 0.352* | 0.351* | 0.384* | 0.347* | 0.370* | 0.382* |
| | (0.194) | (0.194) | (0.216) | (0.193) | (0.182) | (0.217) |
| $Issue\ amount_{jt}$ (log) | -0.084 | -0.084 | -0.083 | -0.084 | -0.083 | -0.081 |
| | (0.090) | (0.090) | (0.090) | (0.090) | (0.090) | (0.091) |
| $Maturity_{jt}$ (years) | 0.019*** | 0.019*** | 0.019*** | 0.019*** | 0.022*** | 0.019*** |
| | (0.006) | (0.006) | (0.006) | (0.006) | (0.005) | (0.006) |
| $Credit\ Rating_{jt}$ | -0.012* | -0.012* | -0.012* | -0.010 | -0.013** | -0.012* |
| | (0.007) | (0.007) | (0.007) | (0.006) | (0.006) | (0.007) |
| $Issuer\ Type_{it}$ | -0.111 | -0.111 | -0.111 | -0.109 | -0.107 | -0.117 |
| | (0.233) | (0.233) | (0.234) | (0.234) | (0.229) | (0.235) |
| $GDP\ growth_{it}$ | 0.011 | 0.012 | 0.011 | 0.011 | 0.011 | 0.013 |
| | (0.007) | (0.008) | (0.007) | (0.007) | (0.007) | (0.008) |
| $Inflation_{it}$ | -0.039 | -0.038 | -0.039* | -0.038* | -0.035 | -0.039* |
| | (0.022) | (0.022) | (0.021) | (0.021) | (0.024) | (0.021) |
| $Unemployment_{it}$ | -0.044 | -0.045 | -0.037 | -0.033 | -0.039 | -0.028 |
| | (0.040) | (0.041) | (0.040) | (0.039) | (0.040) | (0.043) |
| $ESI_{it}$ | -0.010* | -0.010* | -0.010* | -0.009* | -0.009* | -0.008* |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) |
| $US\ Treasury_{t}$ | -0.111 | -0.111 | -0.112 | -0.117 | -0.122 | -0.108 |
| | (0.233) | (0.123) | (0.122) | (0.120) | (0.128) | (0.122) |
| $(PEPP_{it-1} \times\ Time\ trend_{t})$ | | 0.002 | | | | |
| | | (0.005) | | | | |
| $(PEPP_{it-1} \times\ Eligibility_{it})$ | | | -0.007 | | | -0.006 |
| | | | (0.006) | | | (0.006) |
| $(PEPP_{it-1} \times Credit\ Rating_{jt})$ | | | | -0.000* | | |
| | | | | (0.000) | | |
| $(PEPP_{it-1} \times Maturity_{jt})$ | | | | | -0.000 | |
| | | | | | (0.000) | |
| $(PEPP_{it-1} \times Elig._{jt} \times \Delta\, debt\, ratio_{it})$ | | | | | | -0.001 |
| | | | | | | (0.001) |
| $(PEPP_{it-1} \times Elig._{jt} \times \Delta\, net.\, lend/borr_{it})$ | | | | | | 0.001 |
| | | | | | | (0.001) |
| Constant | 2.874*** | 2.881*** | 2.779*** | 2.726*** | 2.761*** | 2.552*** |
| | (0.742) | (0.744) | (0.749) | (0.742) | (0.768) | (0.814) |
| Country and Time Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of observations | 1,367 | 1,367 | 1,367 | 1,367 | 1,367 | 1,367 |
| $R^2$ | 0.3907 | 0.3907 | 0.3911 | 0.3913 | 0.3917 | 0.3924 |
| Within $R^2$ | 0.1445 | 0.1445 | 0.1451 | 0.1453 | 0.1459 | 0.1469 |

This table presents the regression results from the baseline model (Equation 1) and its extensions, analyzing the impact of the Pandemic Emergency Purchase Programme (PEPP) on sovereign bond spreads.The dependent variable is the sovereign bond spread, reflecting market risk perception. The independent variables include PEPP purchases and several interaction terms to explore how different factors influence PEPP's effectiveness. Columns I to VI display results from different model specifications: I) Estimates the general effect of PEPP on sovereign bond spreads, controlling for macroeconomic factors; II) Examines whether the impact of the PEPP has evolved over time, testing whether its effectiveness has increased or decreased over the course of the programme's implementation; III) Assesses whether eligible bonds responded differently to PEPP purchases compared to non-eligible bonds; IV) Explores the role of sovereign credit risk by interacting PEPP purchases with bond ratings to determine if riskier bonds benefited more; V) Investigates whether the impact of PEPP varied across bonds with different maturities, testing if shorter or longer-term bonds experienced larger spread reductions, VI) Introduces a three-way interaction to assess whether PEPP was most effective in eligible bonds of countries with different debt levels, capturing fiscal policy effects. Statistical significance is indicated by *p < 0.1, **p < 0.05, ***p < 0.01.

**Table IV.** Robustness Check: Results of the Baseline Model and Its Extensions by High- vs Low-Debt Countries Using ASW as the Spread Measure.

| | (I) | | (II) | | (III) | | (IV) | | (V) | | (VI) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* |
| $PEPP_{it}$ (log) | -0.097 | 0.092 | -0.105 | 0.092 | -0.098 | 0.094 | -0.097 | 0.090 | -0.091 | 0.087 | -0.090 | 0.096 |
| | (0.090) | (0.072) | (0.091) | (0.072) | (0.089) | (0.072) | (0.089) | (0.070) | 0.088 | (0.075) | (0.087) | (0.074) |
| $PEPP_{it-1}$ (log) | 0.229* | -0.057 | 0.415 | -0.124 | 0.229* | -0.067 | 0.229* | -0.045 | 0.219* | -0.046 | 0.232* | -0.068* |
| | (0.108) | (0.039) | (0.251) | (0.108) | (0.106) | (0.037) | (0.108) | (0.037) | (0.105) | (0.039) | (0.108) | (0.037) |
| $\Delta\, debt\, ratio_{it}$ | 0.014 | 0.001 | 0.021 | -0.006 | 0.014 | 0.003 | 0.014 | -0.001 | 0.012 | 0.004 | 0.015 | 0.004 |
| | (0.015) | (0.025) | (0.018) | (0.025) | (0.015) | (0.026) | (0.015) | (0.024) | (0.015) | (0.027) | (0.014) | (0.027) |
| $\Delta\, net\ lend./Borr_{it}$ | -0.028 | -0.020 | -0.028 | -0.019 | -0.028 | -0.022 | -0.028 | -0.019 | -0.027 | -0.017 | -0.028 | -0.024 |
| | (0.016) | (0.023) | (0.017) | (0.023) | (0.015) | (0.023) | (0.016) | (0.023) | (0.015) | (0.025) | (0.016) | (0.024) |
| $(PEPP_{it-1}$ x $\Delta\, debt\, ratio_{it})$ | 0.002 | 0.007* | 0.000 | 0.008* | 0.002 | 0.006 | 0.002 | 0.007* | 0.002 | 0.006 | 0.001 | 0.006 |
| | (0.001) | (0.004) | (0.002) | (0.005) | (0.001) | (0.004) | (0.001) | (0.004) | (0.002) | (0.004) | (0.001) | (0.005) |
| $(PEPP_{it-1}$ x $\Delta\, net.\, lend/borr_{it})$ | 0.001 | 0.004 | 0.002 | 0.004 | 0.001 | 0.004 | 0.001 | 0.004 | 0.002 | 0.004 | 0.001 | 0.005 |
| | (0.002) | (0.004) | (0.002) | (0.004) | (0.002) | (0.004) | (0.002) | (0.004) | (0.002) | (0.004) | (0.002) | (0.004) |
| $Eligibility_{it}$ | 0.170 | 0.576** | 0.168 | 0.564** | 0.214 | 0.532* | 0.170 | 0.578** | 0.190 | 0.588** | 0.212 | 0.536* |
| | (0.199) | (0.245) | (0.198) | (0.251) | (0.227) | (0.274) | (0.198) | (0.248) | (0.187) | (0.243) | (0.229) | (0.278) |
| $Issue\ amount_{jt}$ (log) | 0.022 | -0.219 | 0.023 | -0.219 | 0.025* | -0.218 | 0.022 | -0.220 | 0.021 | -0.219 | 0.034 | -0.218 |
| | (0.036) | (0.137) | (0.036) | (0.137) | (0.013) | (0.137) | (0.035) | (0.137) | (0.036) | (0.138) | (0.039) | (0.138) |
| $Maturity_{jt}$ (years) | 0.025* | 0.015* | 0.025* | 0.015* | 0.025* | 0.015* | 0.025* | 0.015* | 0.028* | 0.018*** | 0.025* | 0.015* |
| | (0.013) | (0.007) | (0.013) | (0.007) | (0.013) | (0.007) | (0.013) | (0.007) | (0.011) | (0.006) | (0.013) | (0.007) |
| $Credit\ Rating_{jt}$ | -0.009 | -0.020 | -0.009 | -0.020 | -0.009 | -0.020 | -0.008 | -0.018 | -0.010 | -0.021 | -0.008 | -0.021 |
| | (0.009) | (0.014) | (0.009) | (0.014) | (0.008) | (0.014) | (0.007) | (0.014) | (0.008) | (0.014) | (0.009) | (0.014) |
| $Issuer\ Type_{it}$ | -0.452** | 0.320 | -0.452** | 0.319 | -0.457*** | 0.321 | -0.452*** | 0.320 | -0.444*** | 0.324 | -0.463*** | 0.328 |
| | (0.123) | (0.306) | (0.122) | (0.305) | (0.120) | (0.307) | (0.121) | (0.305) | (0.112) | (0.309) | (0.124) | (0.305) |
| $GDP\ growth_{it}$ | -0.001 | 0.018** | -0.003 | 0.020** | -0.001 | 0.019** | -0.001 | 0.019** | -0.001 | 0.020** | -0.003 | 0.018* |
| | (0.013) | (0.007) | (0.014) | (0.008) | (0.013) | (0.007) | (0.014) | (0.007) | (0.014) | (0.007) | (0.014) | (0.008) |
| $Inflation_{it}$ | 0.011 | -0.009 | -0.002 | -0.015 | 0.014 | -0.003 | 0.012 | -0.015 | 0.014 | -0.010 | 0.011 | -0.004 |
| | (0.050) | (0.016) | (0.050) | (0.015) | (0.050) | 0.013 | (0.050) | (0.015) | (0.050) | (0.015) | (0.050) | (0.016) |
| $Unemployment_{it}$ | 0.003 | -0.062 | 0.004 | -0.079 | 0.005 | -0.069 | 0.004 | -0.054 | 0.009 | -0.047 | 0.015 | -0.064 |
| | (0.081) | (0.059) | (0.083) | (0.076) | (0.079) | (0.056) | (0.081) | (0.052) | (0.081) | (0.059) | (0.085) | (0.056) |
| $ESI_{it}$ | -0.010* | -0.002 | -0.010* | -0.003 | -0.011* | -0.002 | -0.010* | -0.002 | -0.009 | -0.002 | -0.009 | -0.003 |
| | (0.005) | (0.006) | (0.005) | (0.006) | (0.005) | (0.006) | (0.005) | (0.006) | (0.005) | (0.007) | (0.005) | (0.007) |
| $US\ Treasury_t$ | -0.241 | -0.072 | -0.247 | -0.077 | -0.247 | -0.075 | -0.243 | -0.071 | -0.245 | -0.084 | -0.237 | -0.075 |
| | (0.167) | (0.057) | (0.165) | (0.052) | (0.163) | (0.059) | (0.161) | (0.058) | (0.165) | (0.058) | (0.169) | (0.060) |
| $(PEPP_{it-1}$ x $Time\ trend_t)$ | | | -0.014 | 0.005 | | | | | | | | |
| | | | (0.015) | (0.007) | | | | | | | | |
| $(PEPP_{it-1}$ x $Eligibility_{it})$ | | | | | -0.010 | 0.007 | | | | | -0.008 | 0.007 |
| | | | | | (0.009) | (0.008) | | | | | (0.007) | (0.011) |
| $(PEPP_{it-1}$ x $Credit\ Rating_{jt})$ | | | | | | | -0.000 | -0.000 | | | | |
| | | | | | | | (0.000) | (0.000) | | | | |
| $(PEPP_{it-1}$ x $Maturity_{jt})$ | | | | | | | | | -0.000 | -0.001 | | |
| | | | | | | | | | (0.000) | (0.000) | | |
| $(PEPP_{it-1}$ x $Elig._{jt}$ x $\Delta\, debt\, ratio_{it}$ ) | | | | | | | | | | | -0.001 | 0.001 |
| | | | | | | | | | | | (0.001) | (0.005) |
| $(PEPP_{it-1}$ x $Elig._{jt}$ x $\Delta\, net.\, lend/borr_{it})$ | | | | | | | | | | | 0.002 | -0.001 |
| | | | | | | | | | | | (0.002) | (0.002) |
| Constant | 1.865 | 2.899** | 1.838 | 3.083** | 1.872 | 2.992** | 1.865 | 2.787** | 1.737 | 2.782* | 1.445 | 3.044** |
| | (1.183) | (1.259) | (1.227) | (1.360) | (1.152) | (1.213) | (1.180) | (1.236) | (1.137) | (1.249) | (1.266) | (1.194) |
| Country and Time Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of observations | 823 | 544 | 823 | 544 | 823 | 544 | 823 | 544 | 823 | 544 | 823 | 544 |
| $R^2$ | 0.5110 | 0.2396 | 0.5117 | 0.2398 | 0.5118 | 0.2398 | 0.5110 | 0.2397 | 0.5121 | 0.2410 | 0.5165 | 0.2400 |
| Within $R^2$ | 0.3349 | 0.0727 | 0.3359 | 0.0729 | 0.3361 | 0.0729 | 0.3349 | 0.0728 | 0.3365 | 0.0744 | 0.3425 | 0.0731 |

This table presents the regression results from the baseline model (Equation 1) and its extensions, analyzing the impact of the Pandemic Emergency Purchase Programme (PEPP) on sovereign bond spreads.The dependent variable is the sovereign bond spread, reflecting market risk perception. Countries are divided into two groups based on historical debt levels: (i) high-debt countries (Portugal, Spain, Italy, Greece, France, Belgium, and Cyprus) and (ii) low-debt countries (all other sample countries).The independent variables include PEPP purchases and several interaction terms to explore how different factors influence PEPP's effectiveness. Columns I to VI display results from different model specifications: I) Estimates the general effect of PEPP on sovereign bond spreads, controlling for macroeconomic factors; II) Examines whether the impact of the PEPP has evolved over time, testing whether its effectiveness has increased or decreased over the course of the programme's implementation; III) Assesses whether eligible bonds responded differently to PEPP purchases compared to non-eligible bonds; IV) Explores the role of sovereign credit risk by interacting PEPP purchases with bond ratings to determine if riskier bonds benefited more; V) Investigates whether the impact of PEPP varied across bonds with different maturities, testing if shorter or longer-term bonds experienced larger spread reductions, VI) Introduces a three-way interaction to assess whether PEPP was most effective in eligible bonds of countries with different debt levels, capturing fiscal policy effects, VII) Splits the analysis into high-debt and low-debt countries, examining whether sovereigns with different debt burdens experienced different impacts from PEPP and VIII) Splits the analysis into high-debt and low-debt countries, examining whether PEPP eligibility and fiscal policy stances affects PEPP efectiveness. Standard errors are clustered at the country level to account for potential correlation within sovereign bond markets. Statistical significance is indicated by *p < 0.1, **p < 0.05, ***p < 0.01.

## 6. Conclusion

This study analyses the impact of the PEPP on Eurozone sovereign bond spreads, by considering the role of country's fiscal stance. We use a cross-sectional regression model with country and time fixed effects, to examine 1,368 euro-denominated sovereign bonds issued by 19 Eurozone countries between Q1:2018 to Q1:2022. We found that the PEPP's impact on sovereign spreads was not uniform, and it depended on country-specific fiscal conditions. In our base model analysis, we observed that fiscal fundamentals, namely debt ratio dynamics, were key to determining PEPP's effectiveness. In countries with rising debt-to-GDP ratios, PEPP's purchases are accompanied by an increase in spreads, indicating that concerns about fiscal sustainability have prevailed over the effects of the programme. The results also show that the markets were more reactive to debt accumulation than to short-term fiscal balances, implying that structural debt was a primary concern for the market. The results of the base model also showed that eligibility did not influence PEPP's effectiveness and that there was no evidence that PEPP favoured lower-rated or riskier bonds. We found a stronger effect of the PEPP on longer-term bonds, which are more sensitive to risk and policy signals.

For a more detailed analysis, we divided the sample between countries with historical high and low levels of debt. In high-debt countries, PEPP purchases did not reduce spreads and were associated with persistent risk perceptions. For these countries, the results suggest that markets were already pricing in fiscal risks and the PEPP had a limited marginal impact. However, the results for low-debt countries indicate that the PEPP was more effective, leading to a spread reduction. This implies that the programme was more effective in fiscally sound economies. However, as debt and deficits rose, PEPP's effectiveness weakness, which suggests that rising fiscal imbalances were still a concern even in lower-risk markets. For eligible bonds, PEPP's effectiveness in reducing bond spreads seems to be weaker in the countries with more robust fiscal positions, probably because markets perceive purchases as a reaction to emerging risks and not as a direct stabilizing measure. Furthermore, the results indicate that PEPP's effectiveness was stronger for higher-rated bonds and for bonds with longer maturities bonds in low-debt countries. Finally, the distinction between central and subnational issuers only appears relevant in fiscally strong countries, where central government bonds are perceived as safer.

Our findings indicate that the PEPP effects were not uniform but directly linked to the country's fiscal credibility. Despite the exceptional context of a pandemic and the unprecedented ECB

intervention, these results highlight the importance of the countries' fiscal fundamentals in the effectiveness of unconventional monetary policies designed to stabilize sovereign bond markets. These findings add to the broader literature on the interactions of monetary and fiscal policy. They clearly indicate that, in determining the success of unconventional monetary interventions, the credibility of fiscal policy is a crucial factor. Future research could explore the mechanisms behind these differentiated effects and assess their persistence beyond the crisis period.

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## Appendix: Figures and tables

**Table A1.** Breakdown of the sample by country.

| Country | Nr. Bonds | Issued Amount (€ Mn) |
|---|---|---|
| France | 368 | 829 398,4 |
| Germany | 317 | 828 295,9 |
| Belgium | 276 | 176 236,8 |
| Spain | 88 | 595 814,8 |
| Netherlands | 76 | 175 545,3 |
| Italy | 48 | 788 020,5 |
| Austria | 38 | 131 134,5 |
| Ireland | 30 | 83 443,9 |
| Malta | 24 | 3 097,4 |
| Portugal | 22 | 89 188,2 |
| Finland | 14 | 56 386,0 |
| Lithuania | 14 | 8 952,0 |
| Greece | 12 | 49 688,6 |
| Slovenia | 10 | 15 207,5 |
| Cyprus | 9 | 9 600,0 |
| Slovakia | 9 | 24 286,0 |
| Latvia | 7 | 5 287,3 |
| Luxembourg | 5 | 8 200,0 |
| Estonia | 1 | 1 500,0 |
| **Total** | **1 368** | **3 879 283,0** |

**Table A2.** Description of model's variables.

| Variable | Definition | Source data |
|---|---|---|
| $Spread_{ij}$ | The bond's Option-Adjusted Spread (OAS) at issuance, which represents the difference between its yield and the reference risk-free rate, adjusted for the value of any embedded options | Bloomberg |
| $PEPP_{it}$ | The natural logarithm of the quarterly net purchase amounts under the ECB's PEPP | European Central Bank (ECB) |
| $Eligibility_{it}$ | Binary variable indicating whether the bond meets the ECB's criteria for PEPP eligibility (1 = eligible, 0 = not eligible based on rating) | European Central Bank (ECB) |
| **Fiscal stance variables** ($\Delta\, Fiscal_{it}$) | | |
| $\Delta\, debt-to-GDP\ ratio_{it}$ | The change in the ratio of debt-to-GDP from one quarter to the next. The ratio itself represents the government's consolidated gross debt as a percentage of GDP | Eurostat |
| $\Delta\, net\ lending/borrowing_{it}$ | The change in the ratio of general government net lending (+) or net borrowing (-) to GDP (seasonally adjusted data, with exception of Italy's data) from one quarter to the next | Eurostat |
| **Control Variables** ($\lambda X_{ijt}$) | | |
| **Bonds features** | | |
| $Issue\ amount_{jt}$ | The natural logarithm of bond's issued amount | Bloomberg |
| $Maturity_{jt}$ | Bond's initial maturity period (in years) | Bloomberg |
| $Credit\ Rating_{jt}$ | | |
| $Rated_{jt}$ | Binary variable indicating whether the bond has a credit rating at issuance (1 = rated, 0 = not rated) | Bloomberg |
| $Rating_{jt}$ | Numerical score assigned to the bond based on its credit quality, with higher values indicating better creditworthiness | Bloomberg |
| **Domestic economic factors** | | |
| $GDP\ growth_{it}$ | Quarterly YoY GDP growth rate at market prices of the bond's issuing country (seasonally adjusted) | Eurostat. Author's calculation of YoY growth rate |
| $Inflation_{it}$ | Quarterly YoY percentage change in the Harmonised Index of Consumer Prices (HICP) of the bond's issuing country | Eurostat |
| $Unemployment_{it}$ | Quarterly unemployment rate of the bond's issuing country (seasonally adjusted data) | Eurostat |
| **Eurozone-specific factors** | | |
| $ESI_{it}$ | End-of-quarter Economic Sentiment Indicator (ESI) of the bond's issuing country (seasonally adjusted data) | Eurostat |
| **Global financial markets factors** | | |
| $US\ Treasury_{t}$ | The market yield on U.S. Treasury securities with a 10-year constant maturity (not seasonally adjusted) on the bond's issue date | Federal Reserve Bank of St. Louis Data (FRED) |

**Table A3.** Summary statistics.

| Variables | Obs | Mean | Median | Std.Dev. | Min | Max |
|---|---|---|---|---|---|---|
| $Spread_{ij}$ (OAS in %) | 1 368 | -0.525 | -0.555 | 0.863 | -2.402 | 3.507 |
| $PEPP_{it}$ (natural logarithm) | 886 | 4.154 | 4.467 | 0.655 | 1.38 | 4.783 |
| $\Delta\, debt - to - GDP\ ratio_{it}$ (%) | 1 368 | 0.938 | -0.2 | 3.571 | -5.4 | 15.9 |
| $\Delta\, net\ lending/borrowing_{it}$ (%) | 1 368 | -0.777 | 0.0 | 3.944 | -30.5 | 13.7 |
| $Issue\ amount_{jt}$ (natural logarithm) | 1 368 | 8.183 | 7.903 | 1.086 | 5.326 | 10.793 |
| $Maturity_{jt}$ (in years) | 1 368 | 18.39 | 13.0 | 15.767 | 3.0 | 100.0 |
| $Rating_{jt}$ (numerical score) | 682 | 19.279 (AA-) | 20.0 (AA) | 2.953 | 7.0 (B-) | 22.0 (AAA) |
| $GDP\ growth_{it}$ (%) | 1 368 | 2.665 | 3.215 | 7.193 | -20.71 | 23.427 |
| $Inflation_{it}$ (%) | 1 368 | 1.741 | 1.4 | 2.001 | -2.2 | 11.7 |
| $Unemployment_{it}$ (%) | 1 368 | 6.648 | 6.2 | 3.112 | 2.9 | 20.5 |
| $ESI_{it}$ (Index) | 1 368 | 100.774 | 102.1 | 10.973 | 64.1 | 123.6 |
| $US\ Treasury_{t}$ (%) | 1 368 | 1.658 | 1.59 | 0.783 | 0.52 | 3.22 |

**Table A4.** Average Credit Ratings for Central and Subnational Government Bonds by Country.

| Country | Nr. Rated Bonds | Central Government | Subnational Government |
|---|---|---|---|
| Austria | 36 | AA+ | AA+ |
| Belgium | 104 | AA- | AA- |
| Cyprus | 9 | BB+ | - |
| Estonia | 1 | AA- | - |
| Finland | 10 | AA+ | - |
| France | 46 | AA | AA |
| Germany | 303 | AAA | AAA |
| Greece | 11 | BB- | - |
| Ireland | 26 | A+ | - |
| Italy | 14 | BBB- | - |
| Lithuania | 14 | A | - |
| Luxembourg | 5 | AAA | - |
| Latvia | 7 | A- | - |
| Malta | 24 | A+ | - |
| Spain | 43 | BBB+ | A- |
| Portugal | 10 | BBB | BBB- |
| Slovenia | 10 | A | - |
| Slovakia | 9 | A | - |
| Total | 682 | A | AA- |

This table reports the average of the available credit ratings for rated sovereign bonds, by issuer type (central vs. subnational government) and country.

**Table A5.1.** Robustness check: Baseline and extended model results using primary balance-to-GDP instead of net lending/borrowing.

| | (I) | (II) | (III) | (IV) | (V) | (VI) |
|---|---|---|---|---|---|---|
| $PEPP_{it}$ (log) | 0.039 | 0.043 | 0.038 | 0.039 | 0.041 | 0.042 |
| | (0.051) | (0.052) | (0.050) | (0.050) | (0.049) | (0.049) |
| $PEPP_{it-1}$ (log) | 0.060 | -0.031 | 0.055 | 0.056 | 0.062 | 0.053 |
| | (0.050) | (0.122) | (0.054) | (0.053) | (0.046) | (0.054) |
| $\Delta\, debt\, ratio_{it}$ | 0.010 | 0.007 | 0.009 | 0.009 | 0.008 | 0.005 |
| | (0.011) | (0.012) | (0.012) | (0.012) | (0.011) | (0.014) |
| $\Delta\, net\ lend./Borr_{it}$ | -0.001 | -0.001 | -0.001 | -0.001 | -0.001 | -0.001 |
| | (0.013) | (0.012) | (0.013) | (0.013) | (0.013) | (0.012) |
| $(PEPP_{it-1} \times \Delta\, debt\, ratio_{it})$ | 0.005** | 0.006*** | 0.005** | 0.005** | 0.005** | 0.006*** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | 0.002 |
| $(PEPP_{it-1} \times \Delta\, primary\ balance_{it})$ | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.001) |
| $Eligibility_{it}$ | 0.474* | 0.471* | 0.438* | 0.476* | 0.511** | 0.434* |
| | (0.239) | (0.238) | (0.246) | (0.239) | (0.221) | (0.249) |
| $Issue\ amount_{jt}$ (log) | -0.161 | -0.161 | -0.161 | -0.161 | -0.159 | -0.158 |
| | (0.151) | (0.151) | (0.151) | (0.151) | (0.151) | (0.152) |
| $Maturity_{jt}$ (years) | 0.030*** | 0.030*** | 0.031*** | 0.031*** | 0.036*** | 0.030*** |
| | (0.008) | (0.008) | (0.008) | (0.008) | (0.007) | (0.008) |
| $Credit\ Rating_{jt}$ | -0.007 | -0.007 | -0.008 | -0.009* | -0.009* | -0.007 |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) |
| $Issuer\ Type_{it}$ | 0.032 | 0.032 | 0.032 | 0.031 | 0.042 | 0.022 |
| | (0.298) | (0.298) | (0.298) | (0.298) | (0.289) | (0.297) |
| $GDP\ growth_{it}$ | 0.007 | 0.009 | 0.007 | 0.007 | 0.006 | 0.011 |
| | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) |
| $Inflation_{it}$ | -0.049** | -0.048** | -0.049* | -0.050* | -0.042* | -0.049* |
| | (0.023) | (0.023) | (0.024) | (0.024) | (0.021) | (0.025) |
| $Unemployment_{it}$ | -0.035 | -0.038 | -0.042 | -0.041 | -0.022 | -0.026 |
| | (0.041) | (0.042) | (0.046) | (0.044) | (0.039) | (0.049) |
| $ESI_{it}$ | -0.010 | -0.010 | -0.010 | -0.010 | -0.009 | -0.008 |
| | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) |
| $US\ Treasury_{t}$ | 0.176 | 0.176 | 0.176 | 0.179 | 0.154 | 0.177 |
| | (0.142) | (0.142) | (0.144) | (0.143) | (0.150) | (0.144) |
| $(PEPP_{it-1} \times\ Time\ trend_{t})$ | | 0.007 | | | | |
| | | (0.007) | | | | |
| $(PEPP_{it-1} \times\ Eligibility_{it})$ | | | 0.008 | | | 0.008 |
| | | | (0.007) | | | (0.008) |
| $(PEPP_{it-1} \times Credit\ Rating_{jt})$ | | | | 0.000 | | |
| | | | | (0.000) | | |
| $(PEPP_{it-1} \times Maturity_{jt})$ | | | | | -0.001* | |
| | | | | | (0.000) | |
| $(PEPP_{it-1} \times Elig._{jt} \times \Delta\, debt\, ratio_{it})$ | | | | | | -0.000 |
| | | | | | | (0.002) |
| $(PEPP_{it-1} \times Elig._{jt} \times \Delta\, primary\ balance_{it})$ | | | | | | 0.003* |
| | | | | | | (0.002) |
| Constant | 0.473 | 0.493 | 0.578 | 0.559 | 0.235 | 0.210 |
| | (1.488) | (1.493) | (1.596) | (1.590) | (1.523) | (1.590) |
| Country and Time Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of observations | 1,367 | 1,367 | 1,367 | 1,367 | 1,367 | 1,367 |
| $R^2$ | 0.4399 | 0.4402 | 0.4403 | 0.4401 | 0.4437 | 0.4435 |
| Within $R^2$ | 0.2803 | 0.2807 | 0.2809 | 0.2806 | 0.2852 | 0.2849 |

This table presents the regression results from the baseline model (Equation 1) and its extensions, analyzing the impact of the Pandemic Emergency Purchase Programme (PEPP) on sovereign bond spreads.The dependent variable is the sovereign bond spread, reflecting market risk perception. The independent variables include PEPP purchases and several interaction terms to explore how different factors influence PEPP's effectiveness. Columns I to VI display results from different model specifications: I) Estimates the general effect of PEPP on sovereign bond spreads, controlling for macroeconomic factors; II) Examines whether the impact of the PEPP has evolved over time, testing whether its effectiveness has increased or decreased over the course of the programme's implementation; III) Assesses whether eligible bonds responded differently to PEPP purchases compared to non-eligible bonds; IV) Explores the role of sovereign credit risk by interacting PEPP purchases with bond ratings to determine if riskier bonds benefited more; V) Investigates whether the impact of PEPP varied across bonds with different maturities, testing if shorter or longer-term bonds experienced larger spread reductions, VI) Introduces a three-way interaction to assess whether PEPP was most effective in eligible bonds of countries with different debt levels, capturing fiscal policy effects. Statistical significance is indicated by *p < 0.1, **p < 0.05, ***p < 0.01.

**Table A5.2.** Robustness check: Baseline and extended model results (high vs. low-debt countries) using the variation in the primary balance-to-GDP ratio instead of net lending/borrowing.

| | (I) | | (II) | | (III) | | (IV) | | (V) | | (VI) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* |
| $PEPP_{it}$ (log) | -0.060 | 0.152** | -0.073 | 0.152** | -0.060 | 0.159** | -0.058 | 0.156** | -0.050 | 0.137** | -0.051 | 0.151** |
| | (0.133) | (0.051) | (0.132) | (0.050) | (0.134) | (0.055) | (0.136) | (0.052) | (0.128) | (0.058) | (0.133) | (0.054) |
| $PEPP_{it-1}$ (log) | 0.247* | -0.090** | 0.521 | -0.200 | 0.247* | -0.136*** | 0.247* | -0.114*** | 0.230 | -0.060 | 0.249 | -0.135*** |
| | (0.126) | (0.038) | (0.283) | (0.129) | (0.126) | (0.039) | (0.125) | (0.036) | (0.120) | (0.040) | (0.131) | (0.035) |
| $\Delta\, debt\ ratio_{it}$ | 0.026 | -0.005 | 0.038 | -0.016 | 0.026 | 0.004 | 0.025 | -0.001 | 0.023 | 0.003 | 0.028* | -0.000 |
| | (0.016) | (0.017) | (0.021) | (0.023) | (0.016) | (0.020) | (0.016) | (0.019) | (0.015) | (0.015) | (0.014) | (0.019) |
| $\Delta\, net\ lend./Borr_{it}$ | 0.005 | -0.068** | 0.004 | -0.066** | 0.005 | -0.076** | 0.005 | -0.072** | 0.005 | -0.058* | 0.004 | -0.069** |
| | (0.017) | (0.025) | (0.017) | (0.025) | (0.017) | (0.027) | (0.017) | (0.025) | (0.018) | (0.030) | (0.017) | (0.026) |
| $(PEPP_{it-1}$ x $\Delta\, debt\ ratio_{it})$ | 0.001 | 0.008*** | -0.001 | 0.011*** | 0.001 | 0.006 | 0.001 | 0.007** | 0.001 | 0.006 | 0.000 | 0.010* |
| | (0.001) | (0.002) | (0.002) | (0.002) | (0.001) | (0.003) | (0.001) | (0.003) | (0.001) | (0.004) | (0.001) | (0.005) |
| $(PEPP_{it-1}$ x $\Delta\, primary\ balance_{it})$ | 0.000 | 0.008* | 0.001 | 0.008* | 0.000 | 0.009* | 0.000 | 0.008* | 0.000 | 0.007 | -0.001 | 0.008* |
| | (0.002) | (0.004) | (0.002) | (0.004) | (0.002) | (0.004) | (0.002) | (0.004) | (0.002) | (0.005) | (0.002) | (0.004) |
| $Eligibility_{it}$ | 0.313 | 0.535** | 0.309 | 0.516** | 0.319 | 0.343 | 0.315 | 0.530** | 0.345 | 0.570** | 0.317 | 0.333 |
| | (0.277) | (0.214) | (0.275) | (0.226) | (0.267) | (0.238) | (0.279) | (0.212) | (0.253) | (0.228) | (0.268) | (0.229) |
| $Issue\ amount_{jt}$ (log) | 0.008 | -0.388*** | 0.010 | -0.388*** | 0.008 | -0.386*** | 0.005 | -0.385*** | 0.007 | -0.387*** | 0.019 | -0.385*** |
| | (0.075) | (0.093) | (0.074) | (0.093) | (0.075) | (0.094) | (0.077) | (0.094) | (0.075) | (0.093) | (0.081) | (0.093) |
| $Maturity_{jt}$ (years) | 0.043** | 0.018*** | 0.043** | 0.018*** | 0.043** | 0.018*** | 0.043** | 0.018*** | 0.048** | 0.026*** | 0.043** | 0.017*** |
| | (0.016) | (0.005) | (0.016) | (0.005) | (0.016) | (0.005) | (0.016) | (0.005) | (0.013) | (0.005) | (0.016) | (0.005) |
| $Credit\ Rating_{jt}$ | -0.008 | -0.011 | -0.008 | -0.010 | -0.008 | -0.010 | -0.011 | -0.015 | -0.010 | -0.012 | -0.008 | -0.009 |
| | (0.010) | (0.009) | (0.010) | (0.010) | (0.010) | (0.010) | (0.011) | (0.009) | (0.009) | (0.010) | (0.010) | (0.010) |
| $Issuer\ Type_{it}$ | -0.268 | 0.433*** | -0.269 | 0.433** | -0.269 | 0.438** | -0.265 | 0.433** | -0.255 | 0.444** | -0.283 | 0.416** |
| | (0.238) | (0.164) | (0.236) | (0.164) | (0.240) | (0.168) | (0.242) | (0.166) | (0.216) | (0.165) | (0.233) | (0.175) |
| $GDP\ growth_{it}$ | 0.008 | 0.014 | 0.005 | 0.017 | 0.008 | 0.015 | 0.008 | 0.014 | 0.007 | 0.017 | 0.008 | 0.018 |
| | (0.017) | (0.013) | (0.019) | (0.012) | (0.017) | (0.013) | (0.017) | (0.013) | (0.017) | (0.011) | (0.018) | (0.011) |
| $Inflation_{it}$ | -0.042 | 0.015 | -0.061 | 0.006 | -0.041 | 0.043** | -0.044 | 0.027 | -0.037 | 0.013 | -0.040 | 0.052*** |
| | ( 0.045) | (0.017) | (0.044) | (0.025) | (0.044) | (0.015) | (0.044) | (0.018) | (0.044) | (0.015) | (0.047) | (0.013) |
| $Unemployment_{it}$ | 0.025 | -0.080 | 0.026 | -0.107 | 0.025 | -0.110 | 0.023 | -0.097 | 0.035 | -0.037 | 0.035 | -0.133* |
| | (0.076) | (0.059) | (0.079) | (0.081) | (0.076) | (0.063) | (0.078) | (0.064) | (0.076) | (0.057) | (0.081) | (0.063) |
| $ESI_{it}$ | -0.009 | 0.003 | -0.009 | 0.002 | -0.009 | 0.002 | -0.009 | 0.002 | -0.008 | 0.004 | -0.007 | 0.004 |
| | (0.009) | (0.009) | (0.009) | (0.009) | (0.008) | (0.010) | (0.009) | (0.010) | (0.009) | (0.011) | (0.009) | (0.010) |
| $US\ Treasury_{t}$ | 0.069 | 0.153 | 0.059 | 0.144 | 0.068 | 0.140 | 0.080 | 0.151 | 0.063 | 0.118 | 0.063 | 0.142 |
| | (0.198) | (0.090) | (0.195) | (0.086) | (0.199) | (0.101) | (0.210) | (0.093) | (0.197) | (0.095) | (0.204) | (0.104) |
| $(PEPP_{it-1}$ x $Time\ trend_{t})$ | | | -0.021 | 0.009 | | | | | | | | |
| | | | (0.017) | (0.010) | | | | | | | | |
| $(PEPP_{it-1}$ x $Eligibility_{it})$ | | | | | -0.001 | 0.032*** | | | | | -0.003 | 0.035*** |
| | | | | | (0.009) | (0.008) | | | | | (0.009) | (0.010) |
| $(PEPP_{it-1}$ x $Credit\ Rating_{jt})$ | | | | | | | 0.000 | 0.001* | | | | |
| | | | | | | | (0.001) | (0.000) | | | | |
| $(PEPP_{it-1}$ x $Maturity_{jt})$ | | | | | | | | | -0.001 | -0.001*** | | |
| | | | | | | | | | (0.000) | (0.000) | | |
| $(PEPP_{it-1}$ x $Elig._{jt}$ x $\Delta\, debt\ ratio_{it})$ | | | | | | | | | | | 0.001 | -0.005 |
| | | | | | | | | | | | (0.002) | (0.006) |
| $(PEPP_{it-1}$ x $Elig._{jt}$ x $primary\ balance_{it})$ | | | | | | | | | | | 0.005 | 0.001 |
| | | | | | | | | | | | (0.003) | (0.002) |
| Constant | -1.557 | 0.927 | -1.591 | 1.229 | -1.556 | 1.339 | -1.558 | 1.154 | -1.761 | 0.605 | -1.987 | 1.221 |
| | (1.459) | (1.370) | (1.519) | (1.282) | (1.453) | (1.392) | (1.467) | (1.380) | (1.403) | (1.522) | (1.681) | (1.456) |
| Country and Time Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of observations | 823 | 544 | 823 | 544 | 823 | 544 | 823 | 544 | 823 | 544 | 823 | 544 |
| $R^2$ | 0.4599 | 0.3763 | 0.4608 | 0.3769 | 0.4600 | 0.3813 | 0.4602 | 0.3771 | 0.4616 | 0.3923 | 0.4640 | 0.3844 |
| Within $R^2$ | 0.3982 | 0.2501 | 0.3992 | 0.2508 | 0.3982 | 0.2561 | 0.3985 | 0.2510 | 0.4001 | 0.2694 | 0.4028 | 0.2598 |

This table presents the regression results from the baseline model (Equation 1) and its extensions, analyzing the impact of the Pandemic Emergency Purchase Programme (PEPP) on sovereign bond spreads.The dependent variable is the sovereign bond spread, reflecting market risk perception. Countries are divided into two groups based on historical debt levels: (i) high-debt countries (Portugal, Spain, Italy, Greece, France, Belgium, and Cyprus) and (ii) low-debt countries (all other sample countries).The independent variables include PEPP purchases and several interaction terms to explore how different factors influence PEPP's effectiveness. Columns I to VI display results from different model specifications: I) Estimates the general effect of PEPP on sovereign bond spreads, controlling for macroeconomic factors; II) Examines whether the impact of the PEPP has evolved over time, testing whether its effectiveness has increased or decreased over the course of the programme's implementation; III) Assesses whether eligible bonds responded differently to PEPP purchases compared to non-eligible bonds; IV) Explores the role of sovereign credit risk by interacting PEPP purchases with bond ratings to determine if riskier bonds benefited more; V) Investigates whether the impact of PEPP varied across bonds with different maturities, testing if shorter or longer-term bonds experienced larger spread reductions, VI) Introduces a three-way interaction to assess whether PEPP was most effective in eligible bonds of countries with different debt levels, capturing fiscal policy effects, VII) Splits the analysis into high-debt and low-debt countries, examining whether sovereigns with different debt burdens experienced different impacts from PEPP and VIII) Splits the analysis into high-debt and low-debt countries, examining whether PEPP eligibility and fiscal policy stances affects PEPP efectiveness. Standard errors are clustered at the country level to account for potential correlation within sovereign bond markets. Statistical significance is indicated by *p < 0.1, **p < 0.05, ***p < 0.01.

**Table A6.1.** Robustness check: Baseline and extended model results excluding the year 2020.

| | (I) | (II) | (III) | (IV) | (V) | (VI) |
|---|---|---|---|---|---|---|
| $PEPP_{it}$ (log) | 0.152 | 0.161 | 0.122 | 0.135 | 0.151 | 0.139 |
| | (0.145) | (0.159) | (0.138) | (0.147) | (0.122) | (0.126) |
| $PEPP_{it-1}$ (log) | -0.031 | -0.097 | -0.011 | -0.020 | -0.021 | -0.028 |
| | (0.142) | (0.272) | (0.135) | (0.141) | (0.121) | (0.119) |
| $\Delta\, debt\, ratio_{it}$ | 0.009 | 0.009 | 0.010 | 0.009 | 0.010 | 0.009 |
| | (0.014) | (0.014) | (0.014) | (0.014) | (0.015) | (0.014) |
| $\Delta\, net\ lend./Borr_{it}$ | 0.006 | 0.006 | 0.005 | 0.005 | 0.005 | 0.006 |
| | (0.018) | (0.018) | (0.018) | (0.018) | (0.020) | (0.019) |
| $(PEPP_{it-1} \times \Delta\, debt\, ratio_{it})$ | -0.000 | -0.000 | 0.000 | -0.000 | 0.000 | -0.001 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.003) |
| $(PEPP_{it-1} \times \Delta\, \text{net. } lend/borr_{it})$ | -0.003** | -0.003** | -0.003** | -0.003** | -0.003* | -0.003* |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.002) |
| $Eligibility_{it}$ | 0.461** | 0.460* | 0.423* | 0.464** | 0.506** | 0.428* |
| | (0.203) | (0.203) | (0.214) | (0.206) | (0.179) | (0.208) |
| $Issue\ amount_{jt}$ (log) | -0.163 | -0.163 | -0.163 | -0.163 | -0.167 | -0.160 |
| | (0.172) | (0.172) | (0.171) | (0.172) | (0.164) | (0.171) |
| $Maturity_{jt}$ (years) | 0.032*** | 0.032*** | 0.032*** | 0.032*** | 0.041*** | 0.032*** |
| | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) |
| $Credit\ Rating_{jt}$ | -0.006 | -0.006 | -0.007 | -0.008 | -0.008 | -0.006 |
| | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) |
| $Issuer\ Type_{it}$ | 0.044 | 0.043 | 0.044 | 0.042 | 0.070 | 0.026 |
| | (0.379) | (0.379) | (0.378) | (0.378) | (0.345) | (0.375) |
| $GDP\ growth_{it}$ | -0.002 | -0.001 | 0.000 | -0.001 | 0.002 | 0.005 |
| | (0.015) | (0.015) | (0.015) | (0.015) | (0.014) | (0.015) |
| $Inflation_{it}$ | -0.016 | -0.014 | -0.020 | -0.018 | -0.009 | -0.017 |
| | (0.032) | (0.032) | (0.031) | (0.032) | (0.030) | (0.029) |
| $Unemployment_{it}$ | 0.025 | 0.024 | 0.005 | 0.012 | 0.069 | -0.002 |
| | (0.083) | (0.083) | (0.102) | (0.096) | (0.087) | (0.101) |
| $ESI_{it}$ | -0.009 | -0.009 | -0.008 | -0.009 | -0.005 | -0.009 |
| | (0.009) | (0.009) | (0.008) | (0.008) | (0.007) | (0.008) |
| $US\ Treasury_t$ | 0.038 | 0.036 | 0.035 | 0.040 | 0.035 | 0.017 |
| | (0.169) | (0.170) | (0.173) | (0.171) | (0.163) | (0.180) |
| $(PEPP_{it-1} \times\ Time\ trend_t)$ | | 0.004 | | | | |
| | | (0.011) | | | | |
| $(PEPP_{it-1} \times\ Eligibility_{it})$ | | | 0.012 | | | 0.017 |
| | | | (0.011) | | | (0.012) |
| $(PEPP_{it-1} \times Credit\ Rating_{jt})$ | | | | 0.000 | | |
| | | | | (0.000) | | |
| $(PEPP_{it-1} \times Maturity_{jt})$ | | | | | -0.002** | |
| | | | | | (0.001) | |
| $(PEPP_{it-1} \times Elig._{jt} \times \Delta\, debt\, ratio_{it})$ | | | | | | 0.008*** |
| | | | | | | (0.002) |
| $(PEPP_{it-1} \times Elig._{jt} \times \Delta\, net.\, lend/borr_{it})$ | | | | | | -0.002 |
| | | | | | | (0.006) |
| Constant | 0.370 | 0.388 | 0.501 | 0.468 | -0.458 | 0.602 |
| | (1.412) | (1.419) | (1.509) | (1.521) | (1.438) | (1.472) |
| Country and Time Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of observations | 908 | 908 | 908 | 908 | 908 | 908 |
| $R^2$ | 0.4128 | 0.4129 | 0.4137 | 0.4130 | 0.4255 | 0.4170 |
| Within $R^2$ | 0.2754 | 0.2755 | 0.2765 | 0.2756 | 0.2910 | 0.2805 |

This table presents the regression results from the baseline model (Equation 1) and its extensions, analyzing the impact of the Pandemic Emergency Purchase Programme (PEPP) on sovereign bond spreads.The dependent variable is the sovereign bond spread, reflecting market risk perception. The independent variables include PEPP purchases and several interaction terms to explore how different factors influence PEPP's effectiveness. Columns I to VI display results from different model specifications: I) Estimates the general effect of PEPP on sovereign bond spreads, controlling for macroeconomic factors; II) Examines whether the impact of the PEPP has evolved over time, testing whether its effectiveness has increased or decreased over the course of the programme's implementation; III) Assesses whether eligible bonds responded differently to PEPP purchases compared to non-eligible bonds; IV) Explores the role of sovereign credit risk by interacting PEPP purchases with bond ratings to determine if riskier bonds benefited more; V) Investigates whether the impact of PEPP varied across bonds with different maturities, testing if shorter or longer-term bonds experienced larger spread reductions, VI) Introduces a three-way interaction to assess whether PEPP was most effective in eligible bonds of countries with different debt levels, capturing fiscal policy effects. Statistical significance is indicated by *p < 0.1, **p < 0.05, ***p < 0.01.

**Table A6.2.** Robustness check: Baseline and extended model results (high vs. low-debt countries) excluding the year 2020.

| | (I) | | (II) | | (III) | | (IV) | | (V) | | (VI) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* | *High-debt* | *Low-debt* |
| $PEPP_{it}$ (log) | 0.866 | 0.508 | 1.046* | 0.676* | 0.902* | 0.508 | 1.091* | 0.529 | 1.161** | 0.421 | 0.874** | 0.566* |
| | (0.447) | (0.310) | (0.443) | (0.320) | (0.446) | (0.293) | (0.472) | (0.398) | (0.428) | (0.255) | (0.292) | (0.259) |
| $PEPP_{it-1}$ (log) | -0.498 | -0.445 | 3.137 | -0.806* | -0.610 | -0.445 | -1.147 | -0.147 | -1.416 | -0.056 | -0.970 | -0.478 |
| | (0.745) | (0.312) | (1.647) | (0.391) | (0.684) | (0.330) | (0.715) | (0.329) | (1.175) | (0.295) | (0.772) | (0.285) |
| $\Delta\, debt\, ratio_{it}$ | 0.409** | 0.109 | 0.559*** | -0.023 | 0.374** | 0.109 | 0.345** | 0.089 | 0.567*** | 0.084 | 0.264* | 0.089 |
| | (0.132) | (0.139) | (0.138) | (0.164) | (0.114) | (0.149) | (0.122) | (0.135) | (0.124) | (0.119) | (0.121) | (0.129) |
| $\Delta\, net\ lend./Borr_{it}$ | -0.373 | 0.120* | -0.447 | 0.141** | -0.302 | 0.120* | -0.234 | 0.098 | -0.508 | 0.105* | -0.049 | 0.124* |
| | (0.383) | (0.065) | (0.396) | (0.061) | (0.352) | (0.061) | (0.384) | (0.070) | (0.530) | (0.051) | (0.385) | (0.056) |
| $(PEPP_{it-1}$ x $\Delta\, debt\, ratio_{it})$ | -0.047*** | -0.004 | -0.060*** | 0.016 | -0.043*** | -0.004 | -0.040** | 0.001 | -0.062*** | -0.002 | -0.033** | 0.012 |
| | (0.011) | (0.020) | (0.011) | (0.024) | (0.010) | (0.022) | (0.011) | (0.020) | (0.010) | (0.018) | (0.013) | (0.021) |
| $(PEPP_{it-1}$ x $\Delta\, net.lend/borr_{it})$ | 0.030 | -0.022 | 0.037 | -0.025* | 0.023 | -0.022 | 0.017 | -0.018 | 0.043 | -0.019* | -0.001 | -0.014 |
| | (0.037) | (0.012) | (0.038) | (0.011) | (0.034) | (0.012) | (0.037) | (0.013) | (0.051) | (0.010) | (0.036) | (0.015) |
| $Eligibility_{it}$ | 0.237 | 0.159 | 0.247 | 0.148 | -0.855 | 0.159 | 0.233 | 0.162 | 0.317 | 0.211 | -0.815 | 0.429 |
| | (0.260) | (0.193) | (0.255) | (0.203) | (0.849) | (1.283 ) | (0.309) | (0.192) | (0.316) | (0.172) | (1.526) | (1.340) |
| $Issue\ amount_{jt}$ (log) | 0.143 | -0.588*** | 0.140 | -0.592*** | 0.144 | -0.588** | 0.119 | -0.601*** | -0.082 | -0.570** | 0.150 | -0.599*** |
| | (0.133) | (0.176) | (0.133) | (0.179) | (0.133) | (0.189) | (0.131) | (0.176) | (0.137) | (0.182) | (0.127) | (0.184) |
| $Maturity_{jt}$ (years) | 0.044** | 0.010** | 0.044** | 0.010** | 0.044** | 0.010* | 0.045** | 0.009* | -0.257*** | 0.026 | 0.045** | 0.011** |
| | (0.018) | (0.004) | (0.018) | (0.004) | (0.018) | (0.004) | (0.018) | (0.004) | (0.027) | (0.034) | (0.018) | (0.004) |
| $Credit\ Rating_{jt}$ | -0.006 | 0.016 | -0.006 | 0.017 | -0.007 | 0.016 | -0.196*** | 0.194*** | -0.004 | 0.013 | -0.007 | 0.004 |
| | (0.013) | (0.020) | (0.013) | (0.020) | (0.013) | (0.020) | (0.050) | (0.054) | (0.015) | (0.018) | (0.014) | (0.033) |
| $Issuer\ Type_{it}$ | -0.695 | 0.763** | -0.694 | 0.770** | -0.715 | 0.763** | -0.742 | 0.745** | -0.149 | 0.730** | -0.750 | 0.803*** |
| | (0.402) | (0.270) | (0.399) | (0.273) | (0.407) | (0.272) | (0.410) | (0.271) | (0.501) | (0.277) | (0.422) | (0.243) |
| $GDP\ growth_{it}$ | 0.060** | 0.002 | 0.071*** | -0.017 | 0.058** | 0.002 | 0.050** | 0.003 | 0.057* | -0.000 | 0.056** | -0.008 |
| | (0.019) | (0.023) | (0.017) | (0.023) | (0.018) | (0.027) | (0.015) | (0.020) | (0.023) | (0.020) | (0.016) | (0.022) |
| $Inflation_{it}$ | -0.053 | 0.018 | -0.131** | 0.058 | -0.041 | 0.018 | -0.013 | 0.028 | -0.043 | 0.006 | -0.020 | 0.053 |
| | (0.054) | (0.074) | (0.050) | (0.076) | (0.052) | (0.070) | (0.049) | (0.070) | (0.082) | (0.060) | (0.043) | (0.065) |
| $Unemployment_{it}$ | 0.024 | 0.006 | -0.034 | -0.081 | 0.045 | 0.006 | 0.113 | -0.031 | 0.022 | 0.016 | 0.046 | -0.073 |
| | (0.131) | (0.177) | (0.141) | (0.164) | (0.125) | (0.185) | (0.113) | (0.172) | (0.208) | (0.178) | (0.108) | (0.176) |
| $ESI_{it}$ | -0.010 | 0.007 | 0.009 | -0.003 | -0.008 | 0.007 | -0.005 | 0.005 | -0.000 | 0.004 | -0.011 | 0.006 |
| | (0.015) | (0.014) | (0.019) | (0.014) | (0.016) | (0.014) | (0.017) | (0.013) | (0.022) | (0.014) | (0.017) | (0.011) |
| $US\ Treasury_{t}$ | -0.008 | -0.124 | -0.031 | -0.141 | -0.008 | -0.124 | 0.038 | -0.150 | 0.109 | -0.149 | -0.057 | -0.102 |
| | (0.489) | (0.426) | (0.496) | (0.423) | (0.483) | (0.425) | (0.463) | (0.437) | (0.417) | (0.398) | (0.531) | (0.438) |
| $(PEPP_{it-1}$ x $Time\ trend_{t})$ | | | -0.097** | 0.023 | | | | | | | | |
| | | | (0.031) | (0.018) | | | | | | | | |
| $(PEPP_{it-1}$ x $Eligibility_{it})$ | | | | | 0.112 | 0.000 | | | | | 0.121 | -0.007 |
| | | | | | (0.080) | (0.141) | | | | | (0.144) | (0.132) |
| $(PEPP_{it-1}$ x $Credit\ Rating_{jt})$ | | | | | | | 0.019** | -0.018*** | | | | |
| | | | | | | | (0.006) | (0.005) | | | | |
| $(PEPP_{it-1}$ x $Maturity_{jt})$ | | | | | | | | | 0.031*** | -0.002 | | |
| | | | | | | | | | (0.003) | (0.003) | | |
| $(PEPP_{it-1}$ x $Elig._{jt}$ x $\Delta\, debt\, ratio_{it}$ ) | | | | | | | | | | | 0.006 | -0.015* |
| | | | | | | | | | | | (0.003) | (0.007) |
| $(PEPP_{it-1}$ x $Elig._{jt}$ x $\Delta\, net.lend/borr_{it})$ | | | | | | | | | | | -0.007 | -0.009 |
| | | | | | | | | | | | (0.019) | (0.011) |
| Constant | -5.057 | 2.472 | -31.107 | 2.741 | -4.704 | 2.473 | -2.073 | -0.171 | 1.449 | 2.543 | -0.571 | 2.618 |
| | (11.438) | (2.874) | (16.355) | (2.598) | (10.903) | (2.024) | (10.832) | (2.440) | (16.222) | (2.825) | (10.477) | (1.850) |
| Country and Time Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of observations | 260 | 165 | 260 | 165 | 260 | 165 | 260 | 165 | 260 | 165 | 260 | 165 |
| $R^2$ | 0.3962 | 0.3507 | 0.3974 | 0.3532 | 0.3972 | 0.3507 | 0.4095 | 0.3590 | 0.4997 | 0.3541 | 0.4047 | 0.3572 |
| Within $R^2$ | 0.3582 | 0.2533 | 0.3595 | 0.2562 | 0.3593 | 0.2533 | 0.3723 | 0.2628 | 0.4682 | 0.2572 | 0.3673 | 0.2607 |

This table presents the regression results from the baseline model (Equation 1) and its extensions, analyzing the impact of the Pandemic Emergency Purchase Programme (PEPP) on sovereign bond spreads.The dependent variable is the sovereign bond spread, reflecting market risk perception. Countries are divided into two groups based on historical debt levels: (i) high-debt countries (Portugal, Spain, Italy, Greece, France, Belgium, and Cyprus) and (ii) low-debt countries (all other sample countries).The independent variables include PEPP purchases and several interaction terms to explore how different factors influence PEPP's effectiveness. Columns I to VI display results from different model specifications: I) Estimates the general effect of PEPP on sovereign bond spreads, controlling for macroeconomic factors; II) Examines whether the impact of the PEPP has evolved over time, testing whether its effectiveness has increased or decreased over the course of the programme's implementation; III) Assesses whether eligible bonds responded differently to PEPP purchases compared to non-eligible bonds; IV) Explores the role of sovereign credit risk by interacting PEPP purchases with bond ratings to determine if riskier bonds benefited more; V) Investigates whether the impact of PEPP varied across bonds with different maturities, testing if shorter or longer-term bonds experienced larger spread reductions, VI) Introduces a three-way interaction to assess whether PEPP was most effective in eligible bonds of countries with different debt levels, capturing fiscal policy effects, VII) Splits the analysis into high-debt and low-debt countries, examining whether sovereigns with different debt burdens experienced different impacts from PEPP and VIII) Splits the analysis into high-debt and low-debt countries, examining whether PEPP eligibility and fiscal policy stances affects PEPP efectiveness. Standard errors are clustered at the country level to account for potential correlation within sovereign bond markets. Statistical significance is indicated by *p < 0.1, **p < 0.05, ***p < 0.01.