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# The Relevance of Liquidity and Country Risk to Euro-Denominated Bonds and the Influence of ECB Monetary Policy

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**Abstract**

This paper investigates the main determinants of euro denominated corporate bond yields, then analyses the "country effect" by focusing on economic reasons for the strong link between country and corporate yields. It also examines the potential impact of monetary policy of the European Central Bank (ECB) on corporate bond yields on the days of Governing Council meetings.

A sample of 1,762 corporate euro-country bonds is analyzed for the period May 2005 – January 2012 using OLS panel data. The economic reason for the strong link between countries and corporate yields is investigated up to 2017. We find that idiosyncratic liquidity and risk have a crucial impact on bond yields, but yields are also strongly influenced by the risk of the corresponding sovereign bonds. Finally, we show that unexpectedness component of ECB policy also exerts a strong short-term effect.

**Keywords**: Bid-ask spread, country risk, credit spread, European Central Bank (ECB), liquidity risk, yield to maturity

## 1. Introduction

The Covid-19 pandemic has caused a sharp decline in global economic growth and has heightened market risk aversion in ways not seen since the financial crisis of 2007-2008. In this paper, we focus on bond markets, that play a primary role in financial systems and are an important source of financing for businesses. The liquidity of the corporate bond market and its impact on the value of the related assets have been frequently studied in the finance literature (Amihud & Mendelson, 1986; Boudoukh & Whitelaw, 1993; Chordia, Roll, & Subrahmanyam, 2000; Vayanos, 1998). This issue has become particularly important since the financial crisis, when asset prices have been influenced by liquidity shocks. The European Central Bank (ECB), among other institutions, expressed, in fact, concern about the entity of this liquidity risk factor: "*Unsecured interbank money market rates such as the Euribor increased strongly with the start of the financial market turbulences in August 2007. There is clear evidence that these rates reached levels that cannot be explained alone by higher credit risk*" (Eisenschmidt & Tapking, 2009). Nowadays, in the times of Covid-19 crisis, the liquidity level in the bond markets is a crucial aspect (Kargar et al., 2020). At this purpose and in order to support the real economy, and stabilize financial conditions and credit, Central bank responses consisted in easier monetary policy, massive liquidity provision, and targeted credit (Mosser, 2020).

Consistently with existing literature (e.g. Jacoby, Fowler, & Gottesman, 2000), showing how liquidity impacts financial market prices, our paper has the following specific objectives: (i) as well as investigating the main determinants of European corporate bond yields, we analyse the extent to which bond yield is influenced by the country of issuance; (ii) we examine the economic reasons for the strong link between countries and corporate yields; (iii) we analyse the influence of ECB monetary policy on corporate and treasury bonds during the meeting day, considering decisions taken about the Official Interest Rate (Main Refinancing Operations – MRO) and the press conference held by the ECB President.

Our analysis is carried out on a whole period from May 2005 to January 2012, and two sub-periods: (1) the period from August 2007 to April 2010, corresponding to the worldwide financial crisis and (2) the period from

May 2010 to January 2012, corresponding to the Eurozone sovereign debt crisis. In order to estimate the relevance of the issuer country on bond yields, we analyse the main Eurozone countries (i.e. Austria, Belgium, Finland, France, Greece, Ireland, Italy, Netherlands, Portugal and Spain), considering Germany as benchmark. We investigate the economic reason for the strong link between countries and corporate yields up to 2017. Finally, we examine the effect of ECB monetary policy on corporate bond yields on Governing Council meeting days, evaluating the potential "surprise" effect of ECB policy. The structure of this paper is as follows. In the next section, we discuss how our paper is related to the existing literature on liquidity and risk in bond markets and the influence of ECB monetary policy on bond yields. Section 3 describes the dataset. Sections 4 and 5 introduce our model and discuss the empirical findings, respectively. Finally, Section 6 presents some conclusions. The Appendix provides further analysis and evaluations of the variables used in the study.

## 2. The literature

### *2.1 The Impact of Liquidity, Default and Country Risk on Corporate Yields (and Spread)*

The role of liquidity in bond pricing has attracted great attention especially since the financial crisis of 2007-2008. During the Covid-19 pandemic, the corporate bond market was defined as "under significant stress" (Bernanke & Yellen, 2020) and the market as "basically broken" (Idzelis, 2020). In response, Central banks introduced several facilities designed to bolster liquidity and reduce the costs and risks of intermediating corporate debt. Contemporaneous works (Boyarchenko, Kovner, & Shachar, 2020; O'Hara & Zhou, 2020) investigate liquidity conditions in the corporate bond market during the Covid-19 crisis, and the effects of the Central banks' interventions. Acharya, Amihud, and Bharath (2013) show that pricing of liquidity risk in the bond market depends on the state of the economy: liquidity risk become higher at times of financial and economic distress. Friewald, Jankowitsch, and Subrahmanyam (2012) state that the economic impact of liquidity measures is stronger in periods of crisis, and for speculative grade bonds. The lack of liquidity in an asset is a negative component of its price (Huang & Wang, 2009) and affects its return (Dick-Nielsen, Feldhutter, & Lando, 2012; Lin, Wang, & Wu, 2011). Sadka (2005) finds that liquidity is a systematic risk factor. Investors usually demand a liquidity premium for holding illiquid securities in corporate bond markets. Thus, it is important to study all dimensions of liquidity (Schultz, 2001): ease of trade, transaction costs, and price impact. Two strands of literature can be identified on the basis of the type of dependent variable used in the empirical analysis: (a) the excess of return or the spread ($R_t$ - $R_{F,t}$), where $R_F$ is the risk free return and $R_t$ is the return of the asset in the period *t*. $R_t$ is: $R_t \equiv (\Delta P_t + C)/P_{t-1}$), where P is the asset price and C is the coupon; (b) the yield to maturity $r_t$, in the period *t*, compared with $r_{F,t}$, which is the corresponding risk free asset (Note 1) yield to maturity. De Jong and Driessen (2012) estimate the excess corporate bond return with respect to the market, including the exposure to changes in the liquidity factors. Ericsson and Renault (2006) break the yield spread on the illiquid bond down into three components: a "pure" liquidity spread, the interaction between liquidity and credit risk and the default risk of the firm in a perfectly liquid setting. They find a positive correlation between the illiquidity and default components of yield spread. Several measures of illiquidity have been considered in the literature, for example the bid-ask spread (Arcuri et al., 2020; Bessembinder, Maxwell, & Venkataraman, 2006; Edwards, Harris, & Piwowar, 2007; Hong & Warga, 2000) and the market depth (Goldstein & Kavajecz, 2000). Chen, Lesmond, and Wei (2007) use three liquidity measures: the bid-ask spread, the liquidity proxy of zero returns and a liquidity estimator based on a model variant of Lesmond, Ogden, and Trzeinka (1999). Nashikkar et al. (2008) relate a measure of latent liquidity to bond-specific characteristics (e.g. age, coupon, rating, maturity) and find that bonds with higher latent liquidity are more expensive relative to their CDS contracts. Mullineaux and Roten (2002) find significant certain bond characteristics, including some not contained in the Fama-French model (1993) (see also Gebhardt, Hvidkjaer, & Swaminathan, 2005). Chordia, Sarkar, and Subrahmanyam (2001, 2005) suggest the existence of a link between money flows and transactions liquidity. Hasbrouck and Seppi (2001) and Huberman and Halka (2001) show that there is significant co-movement of asset liquidity with market-wide liquidity. Bao, Pan, and Wang (2011) construct a measure of illiquidity by estimating the magnitude of price reversals in corporate bonds and identify two properties of illiquidity: market frictions are what give rise to illiquidity, and its impact on the market is transitory (Huang & Wang 2009). Holmstrom and Tirole (2001) and Acharya and Pedersen (2005) find that a security's required return depends on its expected liquidity, the covariances of its own return and liquidity with the market return and liquidity. Recent authors focus on the impact of the Covid-19 crisis on the liquidity and depth of this market (Duffie, 2020; Fleming & Ruela, 2020; He, Nagel, & Song, 2020; Nozawa & Qiu, 2020). Downing, Underwood, and Xing (2005) and de Jong and Driessen (2012) show that systematic liquidity risk factors in both Treasury bond and equity markets are also priced in corporate bonds. Díaz and Navarro (2002) analyze the yield spreads between Treasury and non-Treasury Spanish fixed income assets and their relationship with the term to maturity. Elton et al. (2001) find a significant coupon effect in

corporate bonds yield. However, there is no full consensus on whether illiquidity can adequately explain corporate bond pricing. For example, Culp, Nozawa, and Veronesi (2018) claims that the explanatory power of bond market illiquidity to bond pricing is somewhat limited.

A wide body of literature (Black & Cox, 1976; Kim, Krishna, & Suresh, 1993; King & Khang, 2005; Lando, 1998; Longstaff & Schwartz, 1995; Liu et al., 2008; Giesecke et al., 2011) focuses on default risk. Models based on default risk alone tend to misprice long-term corporate bonds. Eom, Helwege, and Huang (2004) find that extensions of the basic Merton model (Merton, 1974), such as Goldstein, Hotchkiss, and Sirri (2007), over-price bonds issued by large and well capitalized firms and under-price bonds issued by risky firms. Reduced-form models, such as Duffie and Singleton (1999), cannot fully explain the level of corporate bond yield spread. Duffie and Lando (2001) state that asymmetric information about default risk between issuers and investors boosts risk spreads. Giesecke (2006) considers the role of uncertainty in model parameters. Liquidity appears to explain a large part of the "credit spread puzzle" (Amato & Remolona, 2003). The determinants of credit spread changes are studied in Collin-Dufresne, Goldstein, and Spencer (2001) and Collin-Dufresne and Goldstein (2001). Several studies break corporate bond spreads down into default and non-default components. Longstaff, Mithal, and Neis (2005) find that the non-default component is closely related to bond specific illiquidity measures. Blanco, Brennan, and Marsh (2005) investigate the co-integration relationship between corporate bond spreads and CDS spreads, documenting a strong non-default component in corporate bond yields.

Literature on EU corporate bond market (Díaz & Navarro, 2002; Horny, Manganelli, & Mojon, 2018; Houweling, Mentink, & Vorst, 2005; Krylova, 2016; Pieterse-Bloem et al., 2016; Zanighi, 2016) often analyzes the impact of sovereign or country risk. Klein and Stellner (2014) find that sovereign risk is a significant driver of corporate risk and Bedendo and Colla (2015) show that an increase in sovereign credit spreads is associated with significant increase in corporate spreads and firms' borrowing costs. Bernoth, von Hagen, and Schuknecht (2004) show that yield spread between EU countries and Germany and the US are affected by international risk factors and reflect positive liquidity and default risk premia (see also Borensztein et al., 2013). Pieterse-Bloem et al. (2016) analyze the European financial integration process between 1991 and 2013 focusing on the corporate bond markets and find that although the country factor unconditionally overrides the industry factor, there is time variation, and no trend towards full integration. Zanighi (2016) examines the determinants of the risk premium paid on bonds at origin. He isolates the country-specific effects and finds that after the peak of the sovereign debt crisis, fragmentation declined in 2013 and reached pre-crisis levels only in 2014. Some authors (Edwards, 1984; Haugh et al. 2009) show that debt, debt service and deficit are crucial in explaining the country risk spread. Many studies (Sgherri & Zoli, 2009; Baldacci, Gupta, & Mati, 2011) find that volatility in terms of trade, inflation rate and public investment is among the elements impacting significantly on sovereign credit spreads.

### *2.2 The Influence of ECB Monetary Policy on Corporate Yields (and Spread)*

To our knowledge, there is comparatively little literature exploring the impact of ECB monetary policy on financial markets (Wilhemsen & Zaghini, 2005; Gaspar, Perez-Quiros, & Sicilia, 2001; Perez-Quiros & Sicilia, 2002; Ross, 2002), although it is an important area for policymakers and financial market operators (Rigobon & Sack, 2004). Many researchers (Bomfim, 2003; Cochrane & Piazzesi, 2002; Bernanke & Kuttner, 2005; Hartley & Rebucci, 2020; Roley & Sellon, 1996, 1998; Thornton, 1998) estimate the interactions between monetary policy and asset prices by focusing on periods immediately surrounding changes in the policy instrument, using an event-study approach. Recently, Fendel, Neugebauer and Zimmerman (2020) evaluate the impact of announcements of Covid-19 related monetary and fiscal policy measures by the ECB and the European Commission and find that the announcements predominantly affect the government bond yields of more solvent countries such as Germany and the Netherlands. Makinen et al. (2020) show that the effects of ECB asset purchase programs are in no way limited to the prices of the specific assets acquired. Rosa and Verga (2007) study the consistency and effectiveness of ECB communication. They find that the statements of the ECB press conference have similar effects compared to market-based measures of monetary policy expectations. They also find that ECB statements provide information which supplements macroeconomic variables, and alterations in market expectations about future monetary policy can be explained by this unexpected information, or surprise component. Pelizzon et al. (2016) analyse the relation between credit risk and liquidity in the Italian sovereign bond market during the eurozone crisis and the subsequent ECB interventions. They find that credit risk drives the liquidity of the market, and that Long-Term Refinancing Operations of the ECB weakened the sensitivity of market makers' liquidity provision to credit risk. This highlights the importance of funding liquidity measures as determinants of market liquidity.

Cook and Hahn (1989) were the first to assess market reaction to monetary policy actions. They investigate the one-day response of bond rates to changes in the Fed funds rate target from 1974 through 1979. Kuttner (2001)

estimates the impact of monetary policy actions on bill, note and bond yields and finds that the interest rate response to the "surprise" component of Fed policy is significant. Some studies (Demiralp & Jorda, 1999; Mehra, 1996) use a Vector Autoregression to model monetary policy. Edelberg and Marshall (1996) find a large significant response of bill rates to policy shocks, and a small, marginally significant response of bond rates.

## 3. The Dataset

The universe used in the first part of our research includes 2,959 bonds, and is derived from the European Monetary Union (EMU) Broad Market Index (Note 2). All bonds in the index in January of years 2002-2011 are included (Note 3). Bonds which are subordinated, covered or securitization are excluded from the sample because of their non-pure debt nature: this yields a universe of 5,362 senior bonds. All 5 year CDS associated with the specific bond issuer were downloaded. If no CDS was associated with the issuer, the CDS of its parent issuer were searched. Where the parent company issuer had no CDS, the CDS of the ultimate parent company was downloaded. If the ultimate parent had no active CDS quote either, then no CDS was considered in our analysis. The total number of issuers associated with the 5,362 original bond universe is 657. Of these, 455 have a ticker CDS and 202 have no ticker CDS. Of the 455 with a ticker CDS, 31 have no quote in any trading day. The bond quote source used is the CBBT (Composite Bloomberg Bond Trader), which is an arithmetic average of all executable prices posted by market makers. Executable price are prices at which market makers are committed to trade upon bid or ask orders by clients (Note 4). The yield to maturity resulting from the specific BID and ASK prices for each business date was then downloaded from Bloomberg, resulting in two 3059 rows (dates) by 5362 columns (bonds) panel datasets. The Credit Default Swap spread (CDS) source is CBIL (Composite Bloomberg Intraday London). All the bonds that had no CBBT quotes, or more than 30% of stale or missing CBBT quotes were excluded. In our analysis, we used only a subsample of bonds included in the dataset: corporate bonds issued in the main Eurozone countries, with the corresponding CDS and rating existing and residual maturity under 13 years. The total number of these securities is 1,762 (Note 5). We examine the importance of the "country effect" for the yield levels by both introducing dummy variables and by considering a set of macroeconomic variables, including Central government debt and deficit, TARGET2 (Note 6), Treasury bond rating and CDS, Gross Domestic Product (GDP), Current account balance (BOP), Fixed investment growth, Economic Sentiment Indicator (ESI) (Note 7). We used official databases of the Organisation for Economic Co-operation and Development (OECD), ECB and World Bank. We also estimated a small sample of Italian and German bonds in recent years, supplementing the above variables with using balance sheet data and stock prices of the issuing companies (Source: Thomson Reuters Datastream).

## 4. The Model

The first part of our research verifies how risk and liquidity variables are important for the level of yields compared to their corresponding risk-free measure, and the yield daily variations. Our dependent variable is the bond yield to maturity (*R*) (Note 8). For every bond its corresponding risk-free yield was determined on the basis of the Eurirs (Euro interest swaps) of the same maturity adjusted for the presence of coupons. This risk-free yield (henceforth *RF*) was approximated by solving the following equation with respect to $i^F$ for every day and bond:

$$\sum_{h=0}^{n} C/(1+i_t^F)^{h+d} + 100/(1+i_t^F)^{n+d} = \sum_{h=0}^{n} C/(1+i_{h+d,t}^{Eurirs})^{h+d} + 100/(1+i_{h+d,t}^{Eurirs})^{n+d} \quad (1)$$

where c is the coupon, h+d is the time to maturity expressed in years h + days/365.25, $i^{Eurirs}_{h+g}$ is the interpolation between Eurirs interest rates with maturities h and h+1.

As suggested by most authors, we included in our model all the main bond characteristics representing the direct and indirect measures of risk and liquidity usually employed in the literature, plus the corresponding CDS. These variables are listed in Table 1 and the symbol used in this paper is shown in brackets.

Table 1. Measure of liquidity and default risk used in this paper

| Liquidity measures | Default risk measures |
|---|---|
| *Direct measures* | *Direct measures* |
| Bid-ask spread (*BIDASK*) (+) | Rating (*RATING*) (+) |
| Zero-transaction days (%) (*IDLEDAYS*) (+) | Bond CDS (*BONDCDS*) (+) |
| *Indirect measures* | *Indirect measures* |
| Issued amount (*AMOUNT*) (-) | term structure slope (*SLOPE*) (-) |
| | Risk-free yield (*RFC*) (-) |
| Years to Maturity (*MATURITY*) (+) | |
| Coupon (*COUPON*) (-) | |
| Price volatility (*VOLATILITY*) (+) | |

*Note*. The table reports measures of liquidity and default risk used in our analysis. The signs in round brackets refer to the influence any variable is thought to have on the yield to maturity spread. Variables related to both liquidity and default risk are shown in the centre of the table.

The meaning of the direct liquidity measures (Bid-ask spread [*BIDASK*] and the percentage of the zero-transaction days [*IDLEDAYS*]) is clear. Unfortunately, the trading volume, which is another direct measure of liquidity (Fisher, 1959), was not available to us. Among indirect measures, the amount issued (*AMOUNT*) could be a proxy of liquidity because large issues should trade more often; moreover, Crabbe and Turner (1995) state that large issues may have lower information costs and therefore a lower yield due to a low illiquidity premium. Some empirical studies employ coupon (*COUPON*) as a bond liquidity measure, although results are conflicting: Amihud and Mendelson (1991) find a significant negative effect, whereas other contributions note an insignificant positive coefficient. The years to maturity (*MATURITY*) is also considered a bond liquidity measure: the shorter the residual maturity of a bond, the less trading takes place and the lower its liquidity (Sarig & Warga, 1989). Moreover, Schultz (2001) finds that the new issues usually trade more than the old ones. Price volatility (*VOLATILITY*) was estimated by a 4-week moving standard deviation of the logarithm changes in an approximation of daily prices corresponding to our yields. Price volatility measures price uncertainty and is therefore negatively related to liquidity; it is however usually positively correlated to default risk. Some researchers, including Shulman, Bayless, and Price (1993) actually find a significant positive effect on bond spreads. The direct measures of the default risk we considered, i.e. rating [*RATING*] and CDS [*BONDCDS*]), are intuitive. The relevance of rating has already been identified in the literature (Gabbi & Sironi, 2005). In the present paper, we convert the rating into a numerical scale from 1 (AAA) to 10 (BBB3) and our variable *RATING* is therefore positively related to risk. We used both rating and bond CDS as default risk measures, because the CDS market is often thin and may not accurately represent the actual risk. On the other hand, the rating is only changed from time to time (and often with some delay); it is moreover a qualitative and not a quantitative judgment. Given the nature of our dependent variable, we did not include the credit factor defined by Fama and French (1993) among our regressors, because its main components are always among our dependent variables. We included however the slope (*SLOPE*) of the 10-year risk free asset – MRO as a further indirect measure of risk: the higher the slope, the lower the weight given to the bond face value to be paid at maturity (i.e. the value more sensitive to a possible default). For the same reason, the corresponding risk-free yield of a bond (*RFC*) and its coupon (*COUPON*) may also exert a negative impact on risk and were included among its indirect components. The higher the coupons the higher the weight of the payments to the owner. The default risk, on the other hand, is positively correlated to a bond residual maturity (MATURITY). On the basis of the influence of our variables on liquidity and risk, it is possible to establish their expected signs in an equation showing the spread (SPREAD=R-RF) between the bond yield to maturity and its corresponding risk-free yield: BIDASK (+), IDLEDAYS (-), AMOUNT (-), RATING (+), BONDCDS (+), VOLATILITY (+), (SLOPE) (-), MATURITY (+), RF (-), COUPON (-). Of course, the same considerations are valid for the yield and not only for the spread. Table 2 shows descriptive statistics of variables included in our analysis.

Table 2. Descriptive statistics

| Variables | Mean | Median | Max | Min | Std. Dev. | Skewness | Kurtosis | Obs. | Cross sections |
|---|---|---|---|---|---|---|---|---|---|
| ΔR/10 | -0.001 | 0.000 | 15.805 | -15.815 | 0.122 | 0.06 | 2296.21 | 1227299 | 1468 |
| ΔRFC | -0.002 | -0.000 | 0.304 | -0.272 | 0.043 | 0.10 | 5.74 | 1227299 | 1468 |
| (R/10 -RFC) | 0.782 | 0.418 | 44.728 | -15.474 | 1.520 | 5.99 | 75.01 | 1227299 | 1468 |
| $RFC_{t-1}$ | 3.05069 | 2.97378 | 5.52793 | 1.05051 | 1.06029 | 0.13 | 1.95 | 1227299 | 1468 |
| BIDASK/10 | 0.21140 | 0.10000 | 58.90000 | -1.85500 | 0.48349 | 31.32 | 2203 | 1227299 | 1468 |
| VOLATILITY | 0.00309 | 0.00220 | 0.08648 | 0.00000 | 0.00356 | 6.12 | 73.73 | 1227299 | 1468 |
| COUPON | 4.69 | 4.625 | 10.150 | 0.00 | 1.182 | 0.47 | 4.69 | 1227299 | 1468 |
| MATURITY/365 | 6.16 | 4.62 | 30.02 | 1.00 | 5.24 | 2.19 | 8.47 | 1227299 | 1468 |
| LOG(AMOUNT) | 21.34 | 20.77 | 26.94 | 18.83 | 1.28 | 0.85 | 2.45 | 1227299 | 1468 |
| IDLEDAYS | 0.087 | 0.056 | 0.299 | 0.000 | 0.064 | 1.23 | 3.55 | 1227299 | 1468 |
| RATING | 4.571 | 4.000 | 10.000 | 1.000 | 2.941 | 0.16 | 1.67 | 1227299 | 1468 |
| BONDCDS | 1.503 | 0.801 | 169.000 | 0.012 | 3.080 | 9.71 | 140.89 | 1227299 | 1468 |
| SLOPE | 0.586 | 0.425 | 2.796 | -0.679 | 0.669 | 0.79 | 2.93 | 1227299 | 1468 |
| ΔUY10 | -0.0017 | 0.0000 | 0.3200 | -0.5000 | 0.0684 | -0.42 | 7.47 | 1227299 | 1468 |
| $TOT\_OPERATIONS_{t-1}$/1000000 | 600269 | 601972 | 1028994 | 333998 | 167916 | 0.33 | 2.03 | 1227299 | 1468 |
| ΔTOT_OPERATIONS/1000000 | 510 | 0 | 419895 | -361498 | 49485 | 0.53 | 27.49 | 1227299 | 1468 |

*Note*. The table reports summary statistics of variables used in our analysis. R is the bond yield, RFC is the corresponding free interest rate. A detailed definition of variables is provided is Section 5.

The econometric tool used in this paper is OLS panel data. The program employed is Eviews 9.

## 5. Empirical Results

### *5.1 Main Determinants of Corporate Euro-Bond Yields*

A preliminary unit root test applied to the corporate bond yields as well their corresponding risk-free yields suggests that both variables contain a unit root, under the null hypothesis of common process as well as individual unit root process.

Table 3. Unit roots and integration

| | Probability[1] | | | | |
|---|---|---|---|---|---|
| | R[4] | RFC[4] | R-RFC | Bond CDS | Bid-Ask spread |
| Levin, Lin & Chu t[2] | 1.0000 | 1.0000 | 1.0000 | 0.9949 | 0.0000 |
| Im, Pesaran and Shin W-stat[3] | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 |
| ADF – Fisher Chi-square[3] | 0.9200 | 1.0000 | 0.0000 | 0.0000 | 0.0000 |
| PP – Fisher Chi-square[3] | 0.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 |

*Note.* Automatic lag length selection based on SIC: 0 to 24.

Probability if referred to H0 of non-stationarity.

Newey-West automatic bandwidth selection and Bartlett kernel.

[1] Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

[2] Null: Unit root (assumes common unit root process).

[3] Null: Unit root (assumes individual unit root process).

[4] R and RFC are, respectively, the risk-free yield and the risk-free yield considering the coupon.

Our first results are reported in Table 4 (Note 9). Since yields are non-stationary variables, a panel partial adjustment model is used. The dependent variable (bond yield) is in difference, while the I(1) regressors (lagged dependent variable included) are introduced in level at t-1, and in difference also when significant. Data are daily, and the days the ECB Governing Council met are not considered. Meeting days are separately described in Section 5.3. All data have been divided by 10 since they were in thousandths and not in hundredths. The whole period considered in this analysis is May 2005-January 2012, and the two sub-periods August 2007-April 2010 and May 2010-January 2012 are also explicitly considered. August 2007-April 2010 corresponds to the worldwide financial crisis and May 2010-January 2012 corresponds to the Eurozone sovereign debt crisis. In order to estimate the relevance of the issuer country on bond yields, dummies for the main Eurozone countries (Austria, Belgium, Finland, France, Greece, Ireland, Italy, Netherlands, Portugal and Spain) are introduced into the model. There is no dummy for Germany, which is used as benchmark. Among the regressors, we include: (1) TOT OPERATIONS, the total amount of ECB interventions; a positive amount of TOT OPERATIONS indicates an increase in liquidity deriving from ECB operations; (2) UY10, the 10-year swap dollar interest rates. Although this variable has no link to ECB monetary policy, its movements are relevant for medium-long term Euro bond yields, whose variations are known to be closely influenced by corresponding variations in the American long-term interest rate.

IDLEDAYS and LOG(AMOUNT) are not significant and we exclude them from the regression.

Table 4**.** Panel estimation of the corporate bond yield

| Dependent variable = $\Delta(R_t)/10$ | Period | | | | |
|---|---|---|---|---|---|
| | 3/05/2005-30/03/2012 | 1/08/2007-30/04/2010 | 3/05/2010-31/01/2012 | 3/05/2010-31/01/2012 | 3/05/2010-31/01/2012 |
| Independent variables | All maturities | All maturities | All maturities | Maturities < 4 years | Maturities> 4 years |
| Equation | (1) | (2) | (3) | (4) | (5) |
| Constant | 0.0062*** | -0.0075*** | 0.0172*** | 0.0207*** | 0.0170*** |
| "Austria" | 0.0015*** | 0.0037*** | 0.0004 | -0.0016 | 0.0007 |
| "Belgium" | 0.0008 | 0.0010 | 0.0034 | 0.0024 | 0.0024 |
| "Finland" | 0.0008 | 0.0023 | 0.0015 | -0.0007 | 0.0025 |
| "France" | 0.0012*** | 0.0016*** | 0.0022*** | 0.0009 | 0.0023*** |
| "Greece" | 0.0179*** | 0.0015 | 0.0508*** | 0.0830*** | 0.0216*** |
| "Ireland" | 0.0087*** | 0.0100*** | 0.0109*** | 0.0148*** | 0.0046** |
| "Italy" | 0.0034*** | 0.0012 | 0.0070*** | 0.0056*** | 0.0078*** |
| “Netherlands” | 0.0010*** | 0.0015 | 0.0018** | 0.0008 | 0.0018* |
| "Portugal" | 0.0112*** | 0.0052*** | 0.0261*** | 0.0271*** | 0.0241*** |
| "Spain" | 0.0032*** | 0.0026*** | 0.0065*** | 0.0059*** | 0.0059*** |

| | | | | | |
|---|---|---|---|---|---|
| Δ(RFC) | 0.4619*** | 0.5440*** | 0.4010*** | 0.4743*** | 0.3475*** |
| $\Delta(R_{t-1})/10$ | -0.2131*** | -0.2919*** | -0.0657*** | -0.0503*** | -0.1046*** |
| $\Delta(RFC_{t-1})$ | 0.0672*** | 0.1679*** | -0.1057*** | -0.0979*** | -0.0881*** |
| $((R_{t-1}/10) - RFC_{t-1})$ | -0.0038*** | -0.0094*** | -0.0049*** | -0.0044*** | -0.0053*** |
| $BIDASK_{t-1}/10$ | 0.0051*** | 0.0055*** | 0.0276*** | 0.0265*** | 0.0526*** |
| $VOLATILITY_{t-1}$ | 0.2407*** | 1.1223*** | -0.1936** | -1.7969*** | -0.3868*** |
| COUPON | -0.0005*** | -0.0004 | -0.0002 | -0.0006 | 0.0006*** |
| MATURITY/365 | 0.0004*** | 0.0007*** | 0.0008*** | 0.0067*** | 0.0006*** |
| RATING | 0.0006*** | 0.0019*** | 0.0004*** | 0.0004** | -0.0002 |
| $BONDCDS_{t-1}/1000$ | 0.0003*** | 0.0007*** | 0.0001 | 0.0001 | 0.0002* |
| Δ(BONDCDS)/1000 | 0.0089*** | 0.0021*** | 0.0243*** | 0.0173*** | 0.0437*** |
| SLOPE | -0.0035*** | -0.0066*** | -0.0018*** | -0.0085*** | -0.0023*** |
| ΔUY10 | 0.2077*** | 0.1944*** | 0.1752*** | 0.0942*** | 0.2571*** |
| $TOT\_OPERATIONS_{t-1}/1000000$ | -12.3827*** | 0.8221 | -34.2747*** | -48.6688*** | -34.9573*** |
| ΔTOT_OPERATIONS/1000000 | -29.9268*** | -13.3097*** | -58.5380*** | -71.8036*** | -54.3684*** |
| Adjusted R-squared | 0.0899 | 0.1394 | 0.0448 | 0.0261 | 0.0998 |
| Durbin-Watson stat (Note 10) | 1.9306 | 1.9842 | 1.8951 | 1.9303 | 1.8059 |
| Included observations | 1539 | 592 | 377 | 377 | 377 |
| Cross-sections included | 1468 | 1200 | 1063 | 655 | 602 |
| Total pool (unbalanced) observations: | 1,050,315 | 437,052 | 342,215 | 163,596 | 178,619 |

*Note*. The table reports the panel estimation of the corporate bond yield during the whole period (May 2005-January 2012) and the two sub-periods (August 2007-April 2010 and May 2010-January 2012) considered in our analysis. The last two columns show results during the recent Eurozone sovereign debt crisis by distinguishing maturities < 4 years and > 4 years. The significance is expressed with one, two or three asterisks, i.e. the rejection of the hypothesis of values equivalent to 0 with a probability level equal to 10%, 5% or 1%. Country dummies refer to the corresponding bond issuer country. Dependent variable: ΔR. Daily data.

The first finding is that change in yield is always related positively to the corresponding change in the risk free interest rate, and negatively related to its previous spread ($(R_{t-1}/10) - RFC_{t-1}$). Secondly, independently of the period examined, numerous explanatory variables, i.e. RFC, BIDASK, VOLATILITY, RATING (Note 11), BONDCDS, SLOPE, MATURITY/365, UY10 and TOT OPERATIONS are always significant and of the right sign. (Results are similar if bank total liquidity is employed instead of TOT OPERATIONS). Not surprisingly, these tend to be the variables taken as most relevant in the literature. They make up an entire set related to both liquidity and risk, and need to be taken into account to explain movements and equilibria of corporate yields. On the other hand, the explanatory variables COUPON and lagged TOT OPERATIONS are not always significant.

### *5.2 The "Country Effect" and Some Possible Explanations*

Another important result is that the "country effect", measured by the country-dummy coefficients, appears very strong during the period of sovereign debt crisis. In particular, the coefficients of the dummy variables of the five-eurozone nations considered weaker following the financial crisis, the so-called PIIGS countries, are positive, significant and high. Moreover, their values are closely related to the corresponding Treasury bond CDS and the spread between the corresponding Treasury bond yields and similar bonds issued by the German government. In other words, other things being equal, the corporate bond spread was higher in the countries where the public debt crisis was deeper, in the order: Greece, Portugal, Ireland, Spain and Italy.

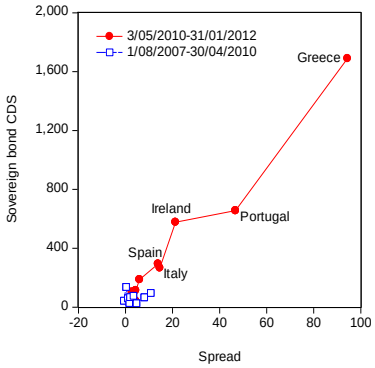


Figure 1. "Country effect" on corporate bond spread and sovereign bond CDS

*Note*. The graph reports a comparison between the "country effect" and the country CDS during the two sub-periods 1/08/2007-30/04/2010 (worldwide financial crisis) and 3/5/2010-31/01/2012 (Eurozone sovereign debt crisis).

A comparison between the "country effect" and the country treasury bonds CDS is reported in Figure 1. The link between the two variables during the public debt crisis (3/05/2010-31/01/2012) is apparent. But during the previous financial crisis, both the "country effect" and the value of sovereign CDS were small, even for the PIIGS countries.

An analysis of the influence of ten years (10y) sovereign index on our sample yields divided by sectors is reported in Table 5. The effect was measured by limiting the regression on single sectors (all securities, sovereign, finance and industrial) and to PIIGS countries, by adding to Table 4 estimation the spread by any country and German ten years treasury bond (both in level *t-1* and in variation at *t*).

Table 5. Influence of 10y sovereign index

| Countries | Sector | Equilibrium coefficient of 10y treasury bond spread | Mean lag of adjustment |
|---|---|---|---|
| Greece, Ireland, Italy, Portugal, Spain | All securities | 0.725 | 101.8 |
| | Sovereign | 1.254 | 18.3 |
| | Finance | 0.832 | 166.9 |
| | Industrial | 0.493 | 96.1 |
| Italy, Portugal, Spain | All securities | 1.030 | 72.9 |
| | Sovereign | 1.254 | 18.3 |
| | Finance | 1.361 | 48.9 |
| | Industrial | 0.583 | 108.6 |

*Note.* Our elaborations.

Economic explanations can be put forward for the "country effect". Table 6 shows the correlations between country dummies and main macroeconomic variables: 10years Treasury bond, Treasury bond rating, Treasury bond CDS, TARGET2/GDP, GDP growth, Debt/GDP, Deficit/GDP, Current account balance/GDP (BOP/GDP), Fixed investment growth (Ginv). We consider the period May 2010 - January 2012 which coincided with the Eurozone sovereign debt crisis.

Table 6 shows that the correlation between "country effect", CDS on five-year Treasury bonds, the spread between with 10-year Treasury bond yield and the German yield, and their rating, are very high. All these variables are also negatively related to TARGET2 divided by GDP, GDP growth, BOP and investment growth. The "country effect" is therefore strongly influenced by single country macroeconomic behaviour, which of course impacts strongly on issuers and their risk. Tables C1-C6 in Appendix C show the descriptive statistics and other period correlations.

Table 6. "Country effect": correlation analysis

| Period: 3/05/2010-31/01/2012 | Country dummies All Maturities | Maturities < 4 years | Maturities > 4 years | 10y Treasury bond | Treasury bond rating | Treasury bond CDS | TARGET2/GDP | GDP growth | Debt/GDP | Deficit/GDP | BOP/GDP | Ginv |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| All maturities | 1.00 | 0.99 | 0.90 | 0.97 | 0.96 | 0.98 | -0.64 | -0.93 | 0.52 | -0.45 | -0.79 | -0.94 |
| Maturities<4y | 0.99 | 1.00 | 0.81 | 0.95 | 0.94 | 0.99 | -0.61 | -0.93 | 0.50 | -0.43 | -0.73 | -0.93 |
| Maturities>4y | 0.90 | 0.81 | 1.00 | 0.85 | 0.86 | 0.81 | -0.57 | -0.78 | 0.51 | -0.36 | -0.83 | -0.85 |
| 10yTreasury bond | 0.97 | 0.95 | 0.85 | 1.00 | 0.99 | 0.98 | -0.81 | -0.86 | 0.57 | -0.65 | -0.81 | -0.96 |
| Treasury.bond rating | 0.96 | 0.94 | 0.86 | 0.99 | 1.00 | 0.97 | -0.76 | -0.89 | 0.55 | -0.63 | -0.83 | -0.97 |
| Treasury.bond CDS | 0.98 | 0.99 | 0.81 | 0.98 | 0.97 | 1.00 | -0.71 | -0.92 | 0.54 | -0.54 | -0.77 | -0.95 |
| TARGET2/GDP | -0.64 | -0.61 | -0.57 | -0.81 | -0.76 | -0.71 | 1.00 | 0.45 | -0.52 | 0.91 | 0.64 | 0.69 |
| GDP growth | -0.93 | -0.93 | -0.78 | -0.86 | -0.89 | -0.92 | 0.45 | 1.00 | -0.41 | 0.32 | 0.73 | 0.94 |
| Debt/GDP | 0.52 | 0.50 | 0.51 | 0.57 | 0.55 | 0.54 | -0.52 | -0.41 | 1.00 | -0.30 | -0.55 | -0.45 |
| Deficit/GDP | -0.45 | -0.43 | -0.36 | -0.65 | -0.63 | -0.54 | 0.91 | 0.32 | -0.30 | 1.00 | 0.47 | 0.59 |
| BOP/GDP | -0.79 | -0.73 | -0.83 | -0.81 | -0.83 | -0.77 | 0.64 | 0.73 | -0.55 | 0.47 | 1.00 | 0.82 |
| Ginv | -0.94 | -0.93 | -0.85 | -0.96 | -0.97 | -0.95 | 0.69 | 0.94 | -0.45 | 0.59 | 0.82 | 1.00 |

*Note.* The table reports the correlation analysis of "country effect" determinants during the period May 2010-January 2012. The variable "10-year Treasury bond" is the spread with the value of German 10years Treasury bond. The correlations significant at 5% correspond to 0.71.

Table 7. Correlation analysis: All periods

| | Correlation with 10-year Treasury bonds | | | Correlation of values in (2) to value in: | |
|---|---|---|---|---|---|
| Period | (1) | (2) | (3) | (1) | (3) |
| 10-year Treasury bond | - | - | - | 0.92 | 0.95 |
| Treasury bond rating | 0.85 | 0.99 | 0.93 | 0.85 | 0.98 |
| TARGET2/GDP | -0.55 | -0.81 | -0.79 | 0.82 | 0.77 |
| GDP growth | -0.61 | -0.86 | -0.33 | 0.08 | 0.45 |
| Debt/GDP | 0.55 | 0.57 | 0.82 | 0.88 | 0.87 |
| Deficit/GDP | -0.81 | -0.65 | -0.67 | 0.89 | 0.59 |
| BOP/GDP | -0.83 | -0.81 | -0.43 | 0.95 | 0.78 |
| Ginv | -0.67 | -0.96 | -0.33 | 0.61 | 0.18 |

*Note*. Period: (1) = 1/08/2007-30/04/2010, (2) = 3/05/2010-31/01/2012, (3) = 1/02/2012-31/12/2016

Spread refers to German yield.

Table 7 shows clearly that correlations tend to hold over time. Note also that there is a very strong correlation between the 10-year Treasury bond, TARGET2 and bond rating, which largely explains the "country effect".

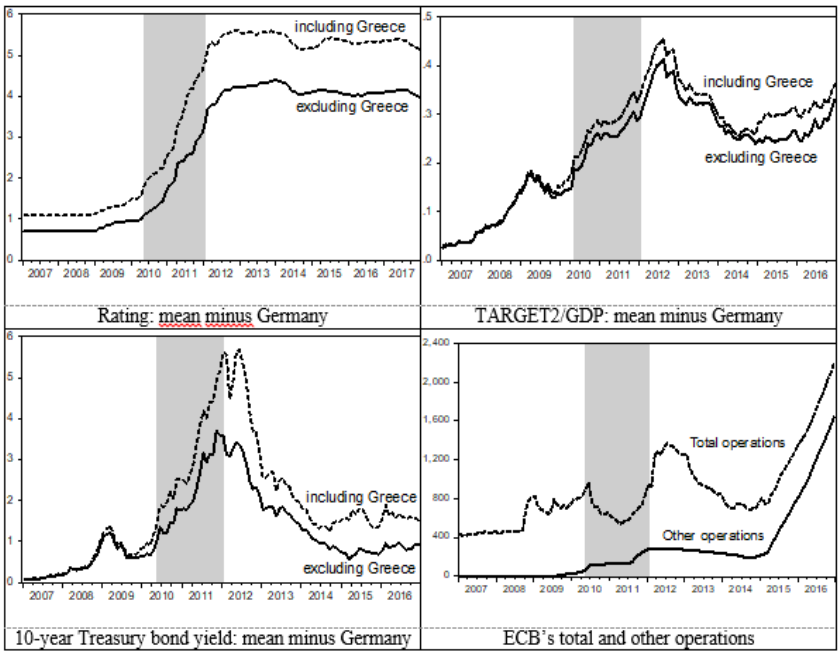


Figure 2. Historical evolution of 10-year Treasury bonds, rating, TARGET2/GDP, total ECB operations and other ECB operations

*Note.* The shaded area corresponds to the first part of the Eurozone sovereign debt crisis; the white area before that period corresponds to the worldwide financial crisis.

Figure 2 in fact shows that the interest rate spread between the different countries was not affected by the worldwide financial crisis, but increased significantly during the Eurozone sovereign debt crisis. After the crisis, the spread became smaller, while different country ratings remained stable, and TARGET2 increased again after 2015. It appears that the increase in TARGET2 had no effect on the spread, probably thanks to ECB "quantitative easing", which increased ECB demand for Treasury bonds from 2015.

The above results were then used to investigate the "country effect" for Italy and Germany. We analyse a sub-sample of 40 corporate bond issues (20 Italian and 20 German), extracted in equal proportion from high and low rating and financial and industrial sector of issuing company. We introduce the following macroeconomic variables into the regression: ESI (Economic Sentiment Indicator) and TARGET2 divided by GDP, issuers' balance sheet fundamentals, i.e. Return on Equity (ROE), an equity index (INDEXAP) and issue characteristics, e.g. RATING, COUPON, MATURITY. The period considered is January 2012-February 2017. Our results are reported in Table 8. Three estimations are presented. All the above variables are used in the first regression along with a dummy variable for Italian bonds; the second regression excludes TARGET2 and "other ECB interventions" (i.e. amount of securities purchased by ECB), and the third excludes the dummy for Italy.

Table 8. Country effect" analysis

| Dependent variable = $\Delta(R_t)/10$ | Period: 2/01/2012-2/02/2017 | | |
|---|---|---|---|
| Independent variables | With TARGET2 and OTHER INTERVENTIONS | Without TARGET2 and OTHER INTERVENTIONS | Without country dummy |
| Constant | -0.0161*** | -0.0156*** | -0.0194*** |
| Dummy Italy | -0.0265*** | 0.0137*** | - |
| ROE(-6*22) | -0.0003*** | -0.0002*** | -0.0003*** |
| ΔLog(INDEXAP) | -0.3063*** | -0.3067*** | -0.3058*** |
| RATING | 0.0040*** | 0.0032*** | 0.0041*** |
| COUPON | -0.0016 | -0.0009 | -0.0013 |
| MATURITY/365 | 0.0024*** | 0.0021*** | 0.0025*** |
| $YIELD_{t-1}$ - $RFC_{t-1}$ | -0.0185*** | -0.0159*** | -0.0189*** |
| ΔRFC | 0.4146*** | 0.4166*** | 0.4167*** |
| $\Delta RFC_{t-1}$ | 0.0819*** | 0.0859*** | 0.0838*** |
| $\Delta YIELD_{t-1}$ | -0.3062*** | -0.3057*** | -0.3052*** |
| ΔESI(12*22) | -0.0002** | -0.0004*** | -0.0004*** |
| TARGET2(-22)/GDP*Dummy Italy | -0.3632*** | - | -0.1846*** |
| OTHER INTERVENTIONS*Dummy Italy/1000000 | -0.0231*** | - | -0.01872*** |
| Adjusted R-squared | 0.1351 | 0.1350 | 0.1347 |
| Durbin-Watson stat | 2.0910 | 2.0891 | 2.0897 |
| Included observations | 1325 | 1329 | 1325 |
| Cross-sections included: | 29 | 29 | 29 |
| Total pool (unbalanced) observations: | 20699 | 20727 | 20699 |

*Note*. The table reports the panel estimation of the corporate bond spread during the period January 2012-February 2017 considered in our analysis. The significance is expressed with one, two or three asterisks, i.e. the rejection of the hypothesis of values equivalent to 0 with a probability level equal to 10%, 5% or 1%. Dependent variable: ΔR. Daily data.

TARGET2 represents the total net inflow of bank liquidity in each euro-country (positive in Germany and negative in Italy). The higher its value, the higher overseas demand for national bonds and products and the lower the sovereign yield. ESI is an indicator of confidence. The higher TARGET2/GDP, the less probable a high perceived country risk, with a downward influence on national yields. ROE and ΔLog(INDEXAP) (the daily change in price of stocks of issuers) are linked to the economic strength of the issuer and both exert a negative effect on the corresponding bond yields. OTHER INTERVENTIONS correspond to the component of TOT OPERATIONS of usually bonds, and to other financial assets, purchased by the Central Bank. This variable became the most important (exogenous) component of ECB total operations in recent years, particularly in the period of "quantitative easing". The higher its value, the higher the demand for bonds, and the lower their yield.

### *5.3 The Impact of ECB's Official Interest Rates and Its Communications on Corporate Bond Yields During the Meeting Days*

After verifying that the equations confirm all theoretical relations between euro bond yields to maturity and our other explanatory variables, we examined the impact of ECB monetary policy on the bond market in the same period considered in the regressions above. We found that decisions about the Official Interest Rate (MRO) and the ECB President press conference (WORDS) became more relevant on ECB meeting days. Expected (E) and unexpected (U) components of the decisions and the press conference were predicted to show different levels of relevance for yield changes, and were investigated separately. Unexpected components were expected have more impact than the expected components. Results are reported in Table 9.

As hypothesized, the two following variables are particularly important on meeting days: (1) MRO: the interest rate on the main refinancing operations; (2) WORDS: index drawn up by Rosa and Verga (2007, 2008), identifying the President's press conference content. This index spans from -2 (probable monetary expansion expected in the near future) to +2 (probable monetary restriction), and is related to the information conveyed to the public by the ECB President in his speech on Governing council meeting days. This index is positively linked to the expectations of the public regarding changes in the Official Interest Rates in the near future.

Table 9. Panel estimation of the effect of ECB daily policy and "surprise effect" on corporate bond yield

| Dependent variable = $\Delta(R_t)/10$ | Period: 2/05/2005-31/01/2012 |
|---|---|
| Independent variables | **Daily monetary policy** |
| | All maturities |
| Constant | 0.0279*** |
| "Austria" | 0.0001 |
| "Belgium" | -0.0032 |
| "Finland" | -0.0040 |
| "France" | -0.0019 |
| "Greece" | 0.0429*** |
| "Ireland" | -0.0226*** |
| "Italy" | -0.0026 |
| "Netherlands" | -0.0005 |
| "Portugal" | -0.0044 |
| "Spain" | -0.0036* |
| $\Delta(R_{t-1})/10$ | 0.1819*** |
| $\Delta$RFC | 0.6982*** |
| $\Delta RFC_{t-1}$ | -0.0066 |
| $(R_{t-1})/10$- $RFC_{t-1}$ | 0.0077*** |
| $RFC_{t-1}$ | -0.0045*** |
| MATURITY/365 | -0.0004*** |
| RATING | -0.0038*** |
| $\Delta$(UY10) | 0.0954*** |
| EMRO change | -0.0715*** |
| UMRO change | 0.2702*** |
| EWORDS | 0.0010 |
| UWORDS | 0.0085*** |
| Adjusted R-squared | 0.1693 |
| Included observations after ADJ | 83 |
| Cross-sections included: | 1969 |
| Total pool (unbalanced) observations: | 79497 |

*Note*. The table reports the panel estimation of ECB monetary policy on bond yields during the whole period (May 2005-January 2012) considered in our analysis (non-significant variables are not shown). The significance is expressed with one, two or three asterisks, i.e. the rejection of the hypothesis of values equivalent to 0 with a probability level equal to 10%, 5% or 1%. Country dummies refer to the corresponding bond issuer country. Dependent variable: $\Delta$R. Daily data.

The impact of both surprise components UMRO and UWORDS on euro bond yield is shown in Table 9. All coefficients are positive and significant. The expected component coefficient is not significant for the President's communications (EWORDS) but has a significant negative sign for EMRO. The coefficient in absolute terms is however much smaller than the coefficient of the unexpected component (-0.07 vs 0.27). Both measurements of surprise are similar to those used by Rosa and Verga (2007, 2008). The surprise value of MRO is measured by the change in 2-week Euribor rate, $\Delta(R2W_{t+1})$ after ECB's official decision taken on meeting day t. Since Euribor is priced at 11.00 a.m., and the decision about the new MRO is communicated at 1.45 p.m., the change in Euribor to be taken into account is the one between day t+1 and day t. The assumption under this measure or MRO surprise is based on the hypothesis that the change in the 2-week Euribor interest rate is mainly due to the change in market expectation about the average MRO. Once the new MRO is known, MRO expectations correspond to the actual new MRO, whose value is unchanged for about 1 month, so the difference between the 2-week Euribor after and before ECB decisions can be taken as a proxy for the difference between the new MRO and its expected value before the Governing council meeting. In other words, $\Delta(R2W_{t+1})$ is a proxy for the unexpected value (UMRO) component ("surprise") of the new ECB official interest rate. It is more complicated to estimate the "surprise" component of the content of the President's press conference, which starts at 2.45 p.m. on the days on which MRO decisions are taken. Since ECB's communications are related to further expected MRO changes in the next few months, we assumed that the index WORDS is related to the difference between the forward 1-6 month Euribor interest rates minus the 1 month Euribor, both net of the corresponding euro interbank market risk. The definition of expected and unexpected components is reported in Appendix D.

## 6. Discussion

During the financial crisis of 2007-2008 and the recent Covid-19 pandemic, the issue of liquidity in the bond markets became even more important and Central bank interventions designed to bolster liquidity and reduce the costs and risks of intermediating corporate debt prove it. This paper analyses the yields to maturity of corporate bonds issued in the Eurozone countries using OLS panel data. The overall period considered is May 2005-January 2012, but particular attention is paid to the worldwide financial crisis (August 2007-April 2010) and the Eurozone sovereign debt crisis (May 2010-January 2012). The "country effect" is also examined and macroeconomic explanations put forward. Finally, the effect of ECB monetary policy on corporate bond yields during the meeting days is analysed evaluating the potential component of "surprise" or "unexpectedness" of ECB policy. The results show that liquidity factors need to be considered along with all risk indicators. In fact, the explanatory significant variables are: risk-free rate, bid-ask spread, volatility, rating, bond CDS, risk-free term structure slope, maturity, the total amount of ECB interventions and the 10-year swap dollar interest rates. During the periods considered in our analysis, the country where the corporate bonds are issued has an enormous impact on yields, although there are significant differences between countries. In particular, during the Eurozone sovereign debt crisis, the phenomenon clearly creates difficulties for the Eurozone countries facing public debt problems (PIIGS). Related to the "country effect", the correlation analysis between country dummies and main macroeconomic variables (i.e., 10-year Treasury bond, Treasury bond rating, Treasury bond CDS, TARGET2/GDP, GDP growth, Debt/GDP, Deficit/GDP, current account balance/GDP, fixed investment growth) shows that the "country effect" is strongly influenced by single country macroeconomic conduct. We show that the interest rate spread between countries increased during the Eurozone sovereign debt crisis, and declined after the crisis. Country ratings on the other hand remained stable, and TARGET2 increased again after 2015. We also analyse the "country effect" for Italy and Germany. We consider TARGET2 (positive in Germany and negative in Italy), ESI (where ESI is high, the perceived country risk is low), while controlling for ROE and an equity risk factor represented by an European equity index (both ROE and equity prices are negatively correlated to bond yields) and, finally, other ECB interventions, i.e. bond and financial assets purchased by ECB (the greater the intervention, the lower the yields). The results concerning the impact of ECB monetary policy on the bond market during the meeting days show that unexpected MRO decisions and unexpected content in the President's press-conference exert a positive influence on bond yields. The expected component of President "WORDS" is not significant, while the expected MRO has a significant negative coefficient. Our results have important policy implications. First of all, the purchase of bonds by ECB significantly reduced their yields as planned. The idiosyncratic risk of European sovereign bonds, measured by the yield spread to comparable German bunds, appeared to have a material risk spillover effect on corporate bonds yields issued by private sector corporations domiciled in those countries. Moreover, banks became riskier (as measured by their CDS spread) in countries with increasing sovereign bond spreads because of their material positions in national sovereign and corporate bonds, which were often evaluated at mark-to-market. Considering also the Basel regulatory framework, which requires more regulatory capital in periods of financial stress for institution using an Internal Model Approach (IMA), as market volatilities are directly reflected into their Value-at-Risk (VaR) models, this phenomenon of increased riskiness of the banking sector reflects in the possibility for banks to supply loans, with a resulting final effect similar to a restrictive monetary policy. In light of the economic and financial implications stemming from the Covid-19 outbreak, among future steps of the research, there is the desire to conduct the analysis also including this recent time of crisis.

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**Notes**

Note 1. The risk-free asset is not exposed to default risk and is very liquid.

Note 2. The list of securities is available on request. It is a composite broad market index (i.e. it gives a description of the total bond market consisting of both sovereign bonds and non-sovereign bonds). The largest part of the index consists of high-grade credit bonds in the AAA and AA bonds, namely 80%. With reference to the sector distribution, more than 60% of bonds belong to "Direct government".

Note 3. The list of securities we considered is available on request.

Note 4. Executable prices are binding quotes from market makers, while indicative prices, included in the BGN (Bloomberg Generic) average, are not committed bid or ask prices, they generally indicate that the market maker has an inventory of that bond and he is willingly to trade upon a price to be agreed with the client.

Note 5. Our sample does not include junk bonds.

Note 6. *TARGET2* is the real-time gross settlement (RTGS) system owned and operated by the Eurosystem. *TARGET* stands for Trans-European Automated Real-time Gross Settlement Express Transfer system. *TARGET2* settles payments related to monetary policy operations, interbank and customer payments, and payments relating to the operations of all large-value net settlement systems and other financial market infrastructures handling the euro. Source: European Central Bank (https://www.ecb.europa.eu/paym/target/target2/html/index.en.html)

Note 7. *ESI* is a composite indicator made up of five sectoral confidence indicators with different weights: industrial confidence indicator (40%), construction confidence indicator (5%), services confidence indicator (30%), consumer confidence indicator (20%), retail trade confidence indicator (5%). Source: Eurostat.

Note 8. Of course, results do not change if using the corresponding spread as dependent variable: the only difference is that the coefficient of the regressor ΔRFC corresponds to 1 minus the coefficients reported in the tables.

Note 9. In order to detect multicollinearity of independent variables, we use Variance Inflation Factors – VIFs (see Appendix A).

Note 10. Durbin-Watson (DW) statistic measures the linear association between adjacent residuals from a regression model. The DW is a test of the hypothesis $\rho = 0$ in the specification: $u_t = \rho u_{t-1} + \varepsilon_t$

If there is no serial correlation, the DW statistic will be around 2. The DW statistic will fall below 2 if there is positive serial correlation. In the worst case, it will be near zero. If there is negative correlation, the statistic will lie somewhere between 2 and 4. In the panel case the DW statistic reported in Eviews is evaluated by considering the residuals of all equations taken together.

Note 11. For the numerical transformation of the RATING, see http://voxeu.org/article/shadow-sovereign-ratings.