BANCA D'ITALIA
EUROSISTEMA

Mercati, infrastrutture, sistemi di pagamento

(Markets, Infrastructures, Payment Systems)

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The papers published in the 'Markets, Infrastructures, Payment Systems' series provide information and analysis on aspects regarding the institutional duties of the Bank of Italy in relation to the monitoring of financial markets and payment systems and the development and management of the corresponding infrastructures in order to foster a better understanding of these issues and stimulate discussion among institutions, economic actors and citizens.

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Printed copies can be requested from the Paolo Baffi Library: richieste.pubblicazioni@bancaditalia.it.

ISSN 2724-6418 (online)
ISSN 2724-640X (print)

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Designed and printing by the Printing and Publishing Division of the Bank of Italy

Investigating the determinants of corporate bond credit spreads in the euro area

by Simone Letta* and Pasquale Mirante**

Abstract

The COVID-19 pandemic led to a surge in credit spreads that cannot be fully explained by a higher probability of issuer defaults. The sharp rise in spreads is consistent with a liquidity shock caused by heavy selling pressure that mainly affected the more liquid and safer bonds. Indeed, the results of a panel analysis confirm that the credit spread depends not only on idiosyncratic factors, such as duration and rating attribution, but also on liquidity and macroeconomic factors, especially in times of crisis. Furthermore, over the last decade, sustainability factors have increasingly affected the choices of bond investors. Our findings suggest that a better ESG performance may be associated with lower credit spreads.

JEL Classification: C32, F36, G12, G15, Q01.
Keywords: Corporate credit spread, COVID-19 crisis, ESG.

Sintesi

Lo scoppio della pandemia di Covid-19 ha causato un'impennata dei *credit spread* che non può essere totalmente attribuita a un aumento della probabilità di insolvenza degli emittenti. Il forte rialzo appare legato a uno shock di liquidità causato da vendite ingenti che hanno colpito principalmente le obbligazioni più liquide e sicure. I risultati di un'analisi panel confermano che il *credit spread* dipende non solo da fattori idiosincratici, quali la duration o il rating creditizio, ma anche dalla liquidità di mercato e da fattori macroeconomici, soprattutto in tempi di crisi. Inoltre, nell'ultimo decennio le scelte degli investitori obbligazionari sono state condizionate in misura crescente dal tema della sostenibilità. I nostri risultati suggeriscono che una migliore performance ESG può essere associata a *credit spread* inferiori.

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CONTENTS

1. Introduction[1]

The corporate bond market experienced a severe disruption in March 2020, following the outbreak of the COVID-19 pandemic. Bond prices plummeted and credit spreads soared within a few weeks. Market liquidity evaporated, as dealers were unwilling or unable, also due to balance sheet constraints, to absorb the sharply increasing sell-off. Fire sales primarily hit investment grade (IG) bonds as they were more easily sellable compared to lower rated bonds (i.e. high yield – HY); consequently, the increase in credit spreads of IG bonds was relatively larger than that of HY bonds.

The purpose of this paper is to identify the factors that most contributed to the evolution of corporate bond spreads in the euro area in the recent past, with a particular focus on the pandemic period. The analysis spans across bonds of different credit quality, issued by non-financial corporations. The determinants of credit spreads are first of all identified with reference to the empirical literature available. Overall, it has been found that the credit spread mainly includes three sources of risk: credit risk, liquidity risk and systemic risk. Liquidity, financial and macroeconomic factors have proven essential in explaining the effects of the pandemic on the credit spread fluctuations in March 2020, particularly when looking at IG bonds. With respect to HY bonds, however, idiosyncratic factors, such as duration and ratings, tend to prevail. Looking at the comparison between Italian companies and issuers from other euro area countries, credit spreads are influenced by the sectoral and rating composition of the respective corporate bond markets. Specifically, the Italian corporate bond market credit spread in the early stages of the pandemic was lower than in other euro area markets. This is explained by the fact that the Italian corporate bond market was tilted towards sectors more resilient to the closure of activities imposed by governments.

We contribute to the existing literature –which so far has mainly focussed on the US bond market– by investigating what happened in the euro area. The question is whether the explanations provided for the US corporate bond market also hold for the euro area.

Another main driver of corporate bond spreads over the recent years could be related to the growing attention to sustainability issues and, in particular, to the exposure to climate risks. The sustainability profile of an issuer can be synthetically measured by the ESG (Environmental, Social, Governance) score, that focuses on three pillars: governance, environmental and social sustainability. The impact of ESG performance on credit spreads is likely to grow further in coming years and will likely affect companies' access to financial markets. For this reason, the analysis is completed with cross-sectional regressions that investigate whether ESG factors can be considered further determinants of credit spreads. Our evidence suggests that ESG scores do affect credit spreads.

The paper is organized as follows. Section 2 summarizes the existing empirical evidence on the determinants of credit spreads and on the distress of the corporate bond market caused by the pandemic. Section 3 discusses the causes of the surge, and the subsequent decline, of euro area credit spreads during the COVID-19 pandemic, taking into account sectoral characteristics and liquidity issues. Section 4 offers a panel analysis of the determinants of credit spreads in the euro area from April 2015 to December 2021 to seek confirmation of the evidence described in Section 3. Section 5 offers a cross-sectional analysis on the impact that ESG performance has on the credit spreads. Section 6 concludes.

[1] The authors are grateful to Maurizio Cassi, Emanuele Degani, Davide Di Zio, Gioia Guarini, Aviram Levy, Tommaso Perez, Antonio Scalia and Giovanni Secondin for their valuable contributions to the paper.

2. Related empirical literature

Krylova (2016) analyses the behaviour of the euro-denominated corporate bond spreads from 1999 to 2013 performing cross-sectional and time series analyses. She refers to specified bond characteristics as credit spread determinants, such as coupon rate, maturity, liquidity and rating, sector and country dummies. Ratings turn out to be the major driver of corporate bond spreads. However, results for the 2007-2008 financial crisis are characterized by a less pronounced dominance of rating effects and an increased cross-country and cross-sector heterogeneity.

The corporate bond spreads might depend not only on the specific characteristics of the bond but also on the outlook of corporate profitability that is in turn influenced by macroeconomic and financial factors. Dewatchter *et al.* (2018) propose a no-arbitrage factor model to study credit spreads in the euro area that includes macroeconomic and financial variables. They analyse the euro area corporate bond spreads over the period 2001-2015 and test the explanatory power of real economic activity and inflation expectations, as well as of variables capturing market liquidity, financial conditions and risk aversion. They find that both macroeconomic (real activity and inflation) and financial factors (risk aversion, flight to liquidity and financial market stress) are key determinants of credit spreads.

De Santis (2016) studies the euro area corporate bond spreads over the period 1999-2015, assuming that, in addition to fundamentals, credit spreads may also be driven by market news orthogonal to the current state of the economy. Thus, credit spreads are decomposed into an idiosyncratic component that represents the credit risk, and a systemic component represented by macroeconomic factors such as expected GDP and inflation. In this way he isolates the "justified credit spread", i.e. compensation requested by investors for observable risks related to the current state of economy, and the excess bond premium, which represents the unobserved systemic component of the credit spreads. According to the author, the predictive power of this unobserved macroeconomic component is related to the risk premium asked by investors to compensate for unexpected adverse macroeconomic fluctuations. In fact, risk premia rose sharply after Lehman's bankruptcy and again during the euro area sovereign debt crisis.

Further research has been conducted by Guo (2013), who highlights the role of risk information premia and ambiguity premia in determining credit spreads, by Dots (2014), who focuses on the decomposition of country-specific corporate bond spreads, and many other authors that have inspired our research (such as Chen, Collin-Dufresne and Goldstein, 2009; Collin-Dufresne, Goldstein and Martin, 2001; Gilchrist and Zakrajšek, 2011; Landshoot, 2004). The results reached by these authors show that there are three main sources of risk that add up to determine credit spreads: credit risk, which depends on the credit quality of the issuer and the specific characteristics of the bond (seniority, etc.); liquidity risk; and systemic risk, which is related to macroeconomic factors. These findings amplify the information content of credit spreads, making them proxies not only of the quality of corporate balance sheets, the easy of access to external financing and probability of default, but also of strains in the corporate bond market that might impair the effective transmission of the monetary policy through the financial markets.

More recently, several empirical studies have analysed the reaction of financial markets to the outbreak of the COVID-19 pandemic. They provide evidence that the corporate bond market has been one of the most severely distressed market segments. Haddad, Moreira and Muir (2021) extensively describe the effects of the crisis on the US corporate debt market and report severe disruptions, evidenced by the sharp spike in credit spreads. They report that the surge in credit spreads of IG bonds has not been associated with a similarly large increase in CDS spreads, which are more related to the probability of default. In contrast, credit spreads of HY bonds have experienced a trend much more

similar to that of CDS spreads. As an increased probability of default would have hit HY bonds more severely than IG bonds, credit spread behaviour cannot be explained only by an increase in the credit risk premium. The authors also argue that the most plausible explanation of the debt market disruptions is the presence of frictions in the debt market. These frictions may be caused by a large and persistent selling pressure from investors who tried to obtain cash by liquidating their portfolios. Because of the urgent need for cash, investors chose to sell safer and more liquid assets, causing the anomalous surge in credit spreads of IG bonds. This thesis is corroborated by the fact that IG corporate bonds were not the only liquid assets subject to large sales. Even the market for US Treasury bonds, considered the most liquid and safe assets in the world, experienced severe turbulences due to COVID-19 pandemic. Despite they role as 'safe haven', long term Treasury bond prices fell along with those of all other asset classes in mid-March 2020. If it had not been for the intervention of the Fed, the Treasury market would have probably become illiquid and dysfunctional, due to forced sales by leveraged investors (see Duffie, 2020; He, Nagel and Song, 2020; Schrimpf, Shin and Sushko, 2020). In other words, unlike in previous financial crises, investors were probably more concerned with obtaining liquidity quickly than with the need to transfer their positions to safer assets. Flight-to-liquidity prevailed over flight-to-safety.

Corporate bond ETFs also shared the same fate as Treasury bonds and IG bonds, as reported by Aramonte and Avalos (2020) and Haddad, Moreira and Muir (2021). As one of the most liquid assets, bond ETFs were subject to large sales by investors resulting in their price falling below the values of their underlying portfolios (NAVs), which were more difficult to liquidate. This imbalance created arbitrage opportunities that further highlight the severity of the market distress (see Todorov, 2021).

Where did this broad demand for liquidity come from at the outbreak of the pandemic? It turned out that mutual funds certainly played an important role, as highlighted by Hespeler and Suntheim (2020) and Anand, Jotikasthira and Venkataraman (2021). In March 2020 mutual funds had to deal with sudden and massive outflows that forced them to sell their safer and more liquid assets. Some scholars had already argued that mutual funds could increase the debt market fragility with respect to strong selling pressure (see Chen, Goldstein and Jiang, 2010; Goldstein, Jiang and Ng, 2017). In the last decade, low and declining yields on fixed-income instruments have pushed bond funds to boost returns by using leverage and investing in riskier and less liquid assets (International Monetary Fund, 2019). Additionally, many funds allow their investors to take out their money whenever they want (open-end funds), thereby exposing themselves to large redemption requests in times of crisis. According to Falato, Goldstein and Hortaçsu (2021) and Ma, Xiao and Zeng (2021), vulnerability to outflows and high concentration of illiquid assets were the dangerous combination that put mutual funds in difficulty when the COVID-19 pandemic broke out and forced them to obtain cash through fire sales.

With respect to dealers' behaviour, evidence provided by O'Hara and Zhou (2021) shows that dealers did not fulfil their task of providing liquidity to the market but rather switched from buying bonds to selling bonds, exacerbating the liquidity crisis and favouring the growth of transaction costs. Dealers justified their behaviour with the budget constraints imposed on them after the previous financial crisis[2], but even when the Fed intervened to ease these constraints, there were no significant improvements in market liquidity. This means that the lack of liquidity support by dealers cannot be

[2] The global financial crisis of 2008 led to stricter regulations regarding banks' minimum capital requirements. The approval of the Volcker Rule in the U.S. and the Basel III leverage ratio pushed bank-affiliated dealers to reduce the balance sheet space available for market making, with negative effects on the corporate market liquidity (see Breckenfelder and Ivashina, 2021).

considered the only cause of the liquidity crisis, but the hypothesis of strong and persistent selling pressure remains valid, as stated by Kargar *et al*. (2020) and Haddad, Moreira and Muir (2021).

The disruption of the debt market called for a series of interventions by central banks. Several papers (Nozawa and Qiu, 2021; Boyarchenko *et al*., 2021; Gilchrist *et al.*, 2021; Khametshin, 2021) analyse the impact and effectiveness of central bank actions to stabilize debt markets. For example, Gilchrist *et al.* (2021) study the Fed's SMCCF on 23 March 2020 and its expansion on 9 April. The announcement of these interventions had an immediate effect on the markets leading to the sudden drop in credit spreads, even though the Fed purchases had not started yet. Zaghini (2021) studies the effect of the Corporate Sector Purchase Programme (CSPP) and Pandemic Emergency Purchase Programme (PEPP), introduced by the European Central Bank (ECB) respectively in March 2016 and March 2020, on the cost of funding of corporations. He shows that purchase programmes reduced yields at issuance of eligible bonds between late February and mid-March 2020, but afterwards their effect faded. In addition, the author finds no evidence of a portfolio rebalancing channel acting in favour of non-eligible HY bonds. On the contrary, the CSPP and the related rebalancing channel had a greater and longer lasting effect on the cost of funding in the first year after the launch of the CSPP in 2016, as shown by Zaghini (2019). Mäkinen, Mercatanti and Silvestrini (2022) analyse the impact of the CSPP on the yield spreads of eligible and non-eligible bonds, concluding that the mere announcement affected both types of bonds, although with different magnitude and time profile. This conclusion is confirmed by Li *et al.* (2020), who do not find any statistically significant difference in the impact of the CSPP on eligible and non-eligible bonds in the primary market, besides the magnitude and time profile. According to De Santis and Zaghini (2019) the CSPP contributes also to an increase in the bond issuance of eligible corporations, although with a lag from the announcement.

Furthermore, we take into consideration the growing importance of corporate sustainability. With respect to such issue, an extensive literature on the relationship between ESG scores and the financial performance of firms is developing (see Pedersen *et al*., 2021; Ferriani, 2022; Bernardini *et al*., 2021; Barth, Hübel and Scholz, 2022; Naumer and Yurtoglu, 2020; Okimoto and Takaoka, 2021; Lisin *et al.*, 2022; Faiella and Malvolti, 2020; Liberati and Marinelli, 2021; Mendiratta, Varsani and Giese, 2021). Pedersen *et al.* (2021) explain how the increasingly widespread adoption of ESG affects portfolio choice and equilibrium asset prices. Ferriani (2022) documents the existence of a statistically and economically significant ESG premium, i.e. better rated companies access debt at a lower cost. Barth, Hübel and Scholz (2022) report that higher ESG ratings mitigated the credit risk of US and European firms from 2007 to 2019. Okimoto and Takaoka (2021) also find that better ESG performance is negatively related with credit spreads in the Japanese bond market, but its impact varies amongst the different pillars of the ESG scores and the credit ratings. Research by Naumer and Yurtoglu (2020) investigates the role of ESG related news on costs of financing (represented by CDS spreads) for a sample of large European and US firms from 2006 to 2016. Their results show that favourable (unfavourable) news are associated with lower (higher) CDS spreads.

3. The COVID-19 pandemic and credit spreads

A bond credit spread is the difference in yield between a corporate bond and a risk-free security of the same maturity. In this paper such a difference is approximated by the asset swap (ASW) spread[3]. We consider euro-denominated bonds issued by euro area non-financial corporations included in the

[3] An ASW is the derivative contract that allows an investor to overlay the fixed interest rate of a bond with floating rates. The ASW buyer pays fixed coupons to the ASW seller equal to the fixed rate coupons received from the bond. In return the ASW buyer receives regular payments of 6-month EURIBOR plus (or minus) an agreed fixed spread. The maturity of the swap is the same as the maturity of the bond. In this way, the investor hedges the interest rate risk without transferring the credit risk of the bond. The ASW spread is the agreed fixed spread mentioned above.

ICE BofA euro corporate investment grade and ICE BoFA euro corporate high yield indices, largely representative of the total bond issues traded in the markets[4].

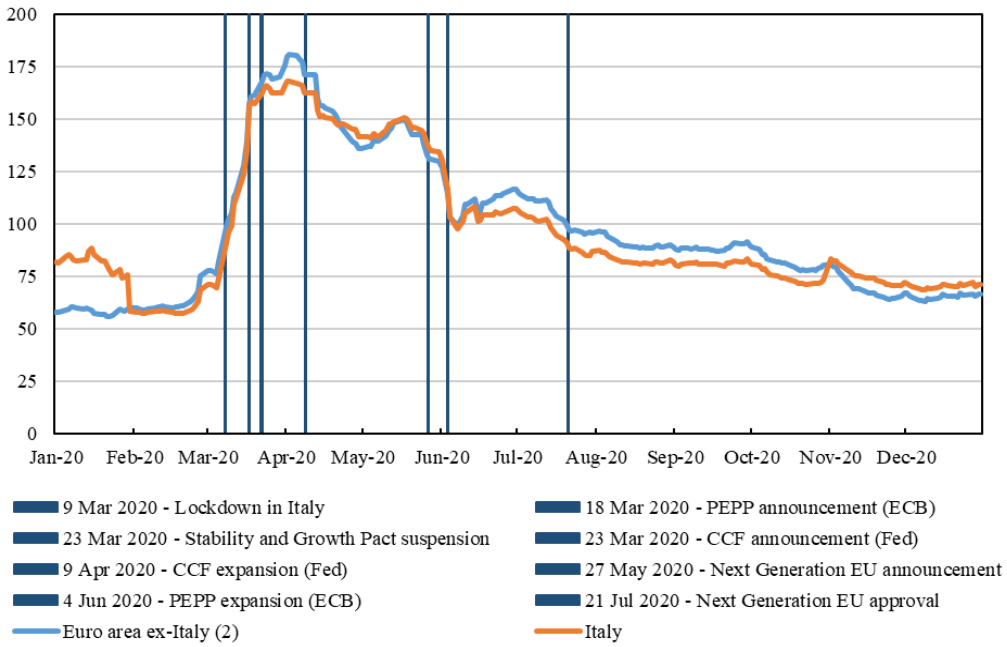
In the last few years, the largest ASW spread fluctuations occurred in March 2020, when investors became aware of the dramatic effects of the COVID-19 pandemic on corporate revenues (Figures 1 and 2). Italian lockdown was followed by the first rise in spreads and subsequent national lockdowns led to other spikes in spreads.

With respect to the overall trend, it is well known that central banks played an active role in contrasting the COVID-19 crisis. The ECB and the Fed's timely monetary policy decisions in March 2020 stabilized markets and slowed the increase in ASW spreads (see Gilchrist *et al.*, 2021). The Fed announced on March 23 the creation of the Primary Market Corporate Credit Facility (PMCCF) and the Secondary Market Corporate Credit Facility (SMCCF). The goal of these interventions was to support market liquidity and availability of credit for non-financial companies through the purchase of ETFs and IG bonds. The SMCCF began buying ETFs on May 12 and bonds on June 16. The corporate credit facilities (CCF) reassured investors that companies would have been able to roll over their maturing bonds and to issue new debt. On March 18 the ECB had already intervened with the announcement of the Pandemic Emergency Purchase Programme (PEPP) with an initial envelope of €750 billion[5]. This first intervention by the ECB favoured a slowdown in the growth of credit spreads in government and corporate debt markets[6]. ASW spreads of HY bonds began a steep decline starting on March 23, when both the Fed's CCF and the suspension of EU Stability and Growth Pact (SGP)[7] were announced. The reaction from IG bonds was less immediate. Nonetheless they experienced a sharp slowdown in credit spread widening turning into a steady decline in early April. The slower decline in the credit spread for IG bonds could be justified by a large and persistent selling pressure from investors, who probably continued to liquidate their safer assets, even if with less intensity, because of their immediate need for liquidity, rather than concerns about issuers' solvency. Further monetary policy interventions were made in the following months, favouring a further decline in the ASW spreads. Specifically, the Fed on April 9 and the ECB on June 4 announced an expansion of the purchase programs. The Fed also included in the SMCCF the purchase of bonds issued by companies recently downgraded from IG to speculative grade, the so-called 'fallen angels'.

[4] Qualifying securities for the indices must have at least 18 months to final maturity at the time of issuance, at least one year remaining term to final maturity, a fixed coupon schedule and a minimum amount outstanding of EUR 250 million.
[5] PEPP was defined by the ECB as "a temporary asset purchase program of private and public sector securities to counter the serious risks to the monetary policy transmission mechanism and the outlook for the euro area posed by the outbreak and escalating diffusion of the coronavirus, COVID-19".
[6] All asset categories eligible under the existing asset purchase programme (APP) are also eligible under the PEPP, as well as a waiver of the eligibility requirements has been granted for securities issued by the Greek Government.
[7] SGP is an agreement among EU Member States establishing a set of rules designed to ensure that EU countries pursue sound public finances and coordinate their fiscal policies.

Figure 1

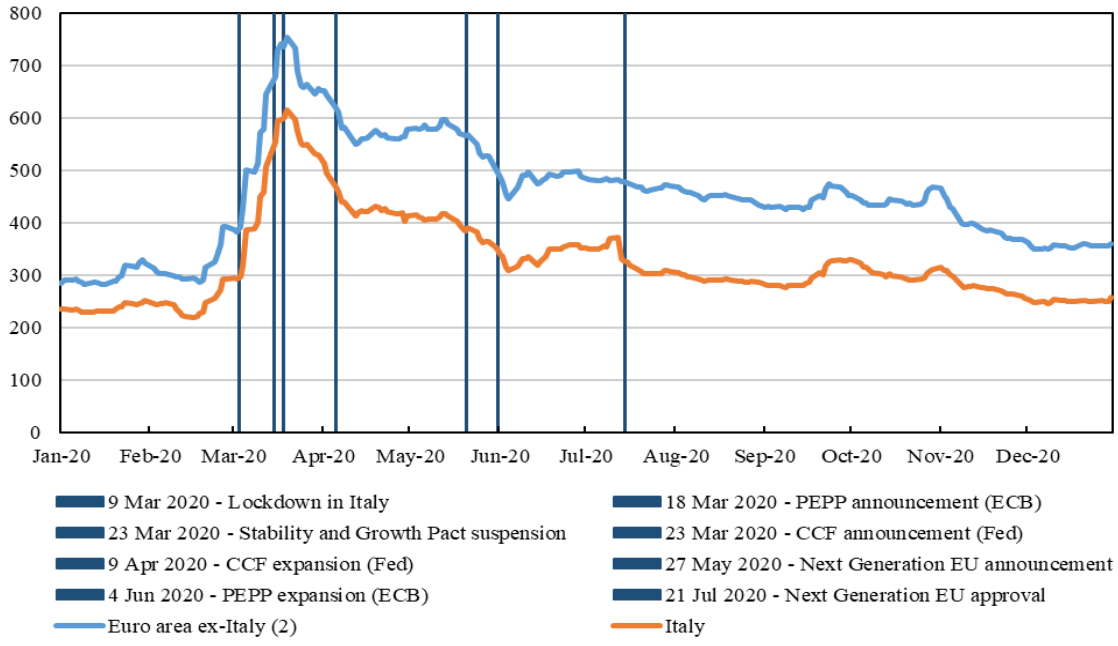
ASW spreads of IG bonds (1)
(daily data; basis points)



Source: Based on ICE Bank of America Merrill Lynch (BofAML) data.
(1) Asset swap spreads of investment grade bonds weighted by the market capitalization of individual securities issued by euro area non-financial corporations. – (2) The BofAML indices for the euro area have been recalculated to exclude Italy.

Figure 2

ASW spreads of HY bonds (1)
(daily data; basis points)

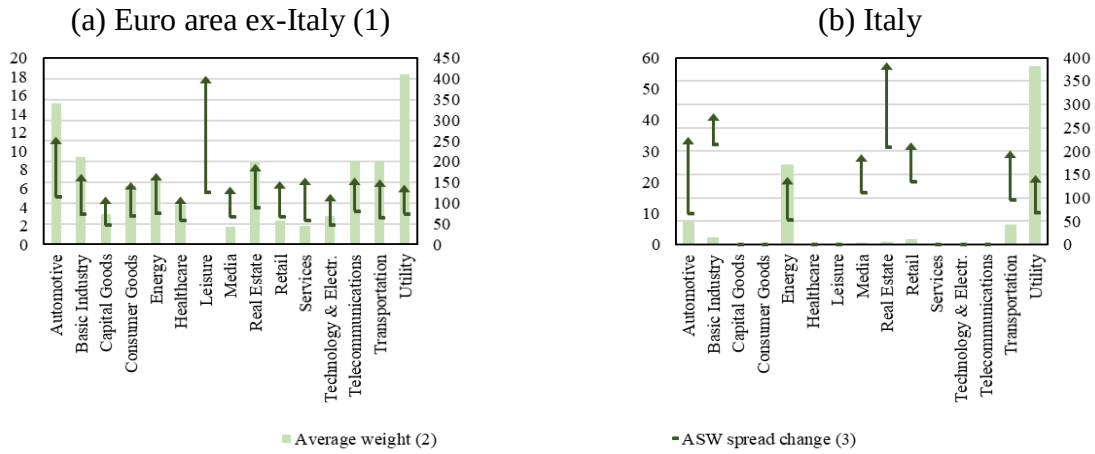


Source: Based on ICE Bank of America Merrill Lynch (BofAML) data.
(1) ASW spreads of high yield bonds weighted by the market capitalization of individual securities issued by euro area non-financial corporations. – (2) The BofAML indices for the euro area have been recalculated to exclude Italy.

The overall trend hides different responses to the pandemic across sectors. Such sectoral differences largely explain cross-country divergences. In particular, the spread between Italian and euro area corporates decreased on average over 2020 (in the case of HY bonds it became more negative), despite the fact that Italy was one of the countries hardest hit by the pandemic. Italy's indices are, in fact, highly concentrated in utilities for IG and in telecommunications for HY bonds; these are sectors that, by virtue of their business area, have been hit less hard than others by the pandemic (Bank of Italy, 2020; ECB, 2020). By contrast, the euro area market is characterised by a greater share of bonds issued in the hardest hit sectors, such as automotive and basic industry ones (Figures 3 and 4).

Figure 3

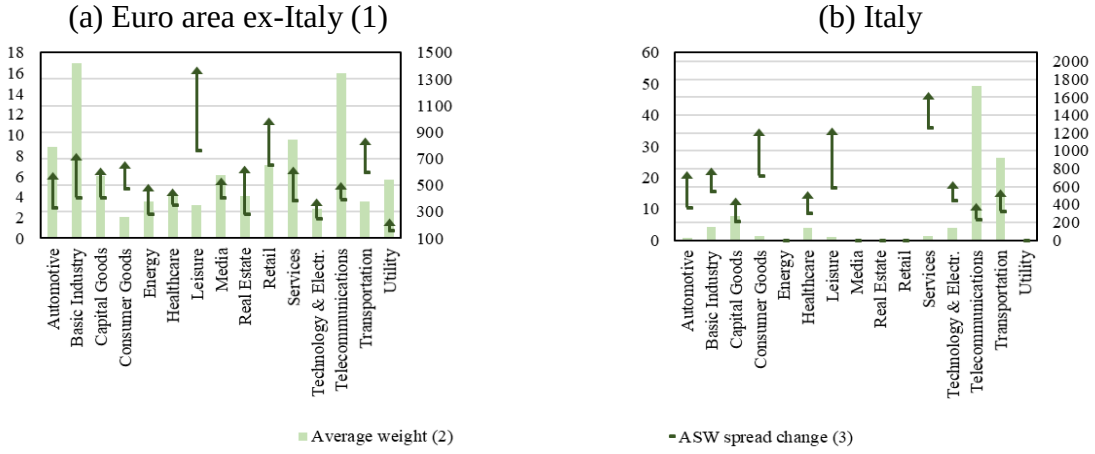
Sector composition and change in ASW spreads of IG bonds
(per cent; basis points)



Source: Based on ICE Bank of America Merrill Lynch (BofAML) data.
(1) ASW spreads and weights for the euro area have been recalculated to exclude Italy. – (2) Average sector weight computed on March 2020 daily market prices. – (3) The arrows indicate the growth of ASW spreads from 1st to 30th March 2020. Right-hand scale.

Figure 4

Sector composition and change in ASW spreads of HY bonds
(per cent; basis points)

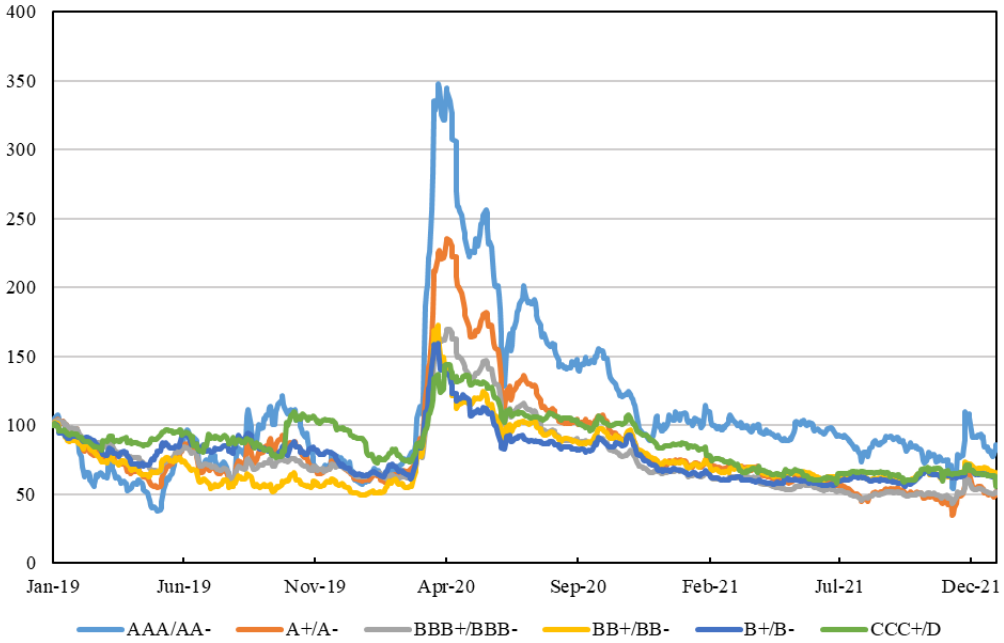


Source: Based on ICE Bank of America Merrill Lynch (BofAML) data.
(1) ASW spreads and weights for the euro area have been recalculated to exclude Italy. – (2) Average sector weight computed on March 2020 daily market prices. – (3) The arrows indicate the growth of the asset swap spread from 1st to 30th March 2020. Right-hand scale.

Another major characteristic of the corporate bond spread behaviour during the pandemic was the somewhat counterintuitive differential dynamics of IG and HY bonds. If the increase in credit risk had been the only reason for the spread growth, there would have been a greater increase in spreads for riskier bonds, but this was not the case (Figure 5). In fact, the relative growth of ASW spreads was higher for IG bonds than for HY, showing a strong tendency for investors to sell IG bonds.

Figure 5

ASW spreads by rating (1)
(daily data; index numbers(2))



Source: Based on ICE Bank of America Merrill Lynch (BofAML) data.
(1) Asset swap spreads are weighted by the market capitalization of individual securities issued by euro area non-financial corporations. (2) 1-Jan-2019 = 100.

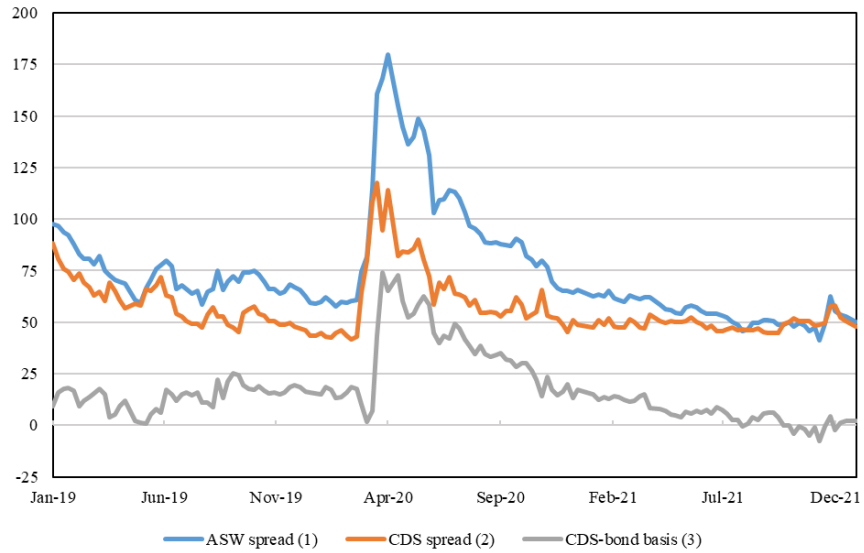
This behaviour confirms the hypothesis of liquidity shock that could have been caused by investors' need to obtain cash quickly, as suggested by Haddad, Moreira and Muir (2021) for the US corporate bond market. Many institutions investing in corporate bonds tried to close their positions in order to mitigate financial difficulties. They began to sell large amounts of IG bonds, as the safest bonds are also the easiest to liquidate. At the same time balance sheet constraints hampered arbitrageurs' efforts to take advantage of market dislocation. A measure of the severity of such dislocation is provided by the departure of ASW spreads from CDS spreads. In principle ASW spreads should be equal to the credit default swap (CDS) spreads because they both depend on the probability of default of the companies; in reality their difference is almost never null, due to the different microstructure of the two markets, related in particular to the level of liquidity (see Amadei *et al*., 2011; Boyarchenko *et al*., 2021). In Figures 6 and 7 we see both the trend of ASW spreads and 5-year CDS spreads[8], with the 'basis' given by the difference between ASW and CDS spreads. The surge in ASW spreads of

[8] We have chosen iTraxx Europe index and iTraxx Crossover index 5-year maturity to track CDS spreads. The iTraxx Europe index comprises 125 equally-weighted European names with investment grade credit ratings. The iTraxx Crossover index comprises the 75 most liquid sub-investment grade entities. A 5-year maturity has been selected because it is approximately equal to the average maturity of the bonds included in the dataset. In contrast to the bond dataset, the CDS indices also include financial and non-euro area corporations.

HY bonds was almost the mirror image of CDS spreads. Instead, in the IG space the increase in ASW spreads was not followed by an increase of CDS spreads of the same magnitude.

Figure 6

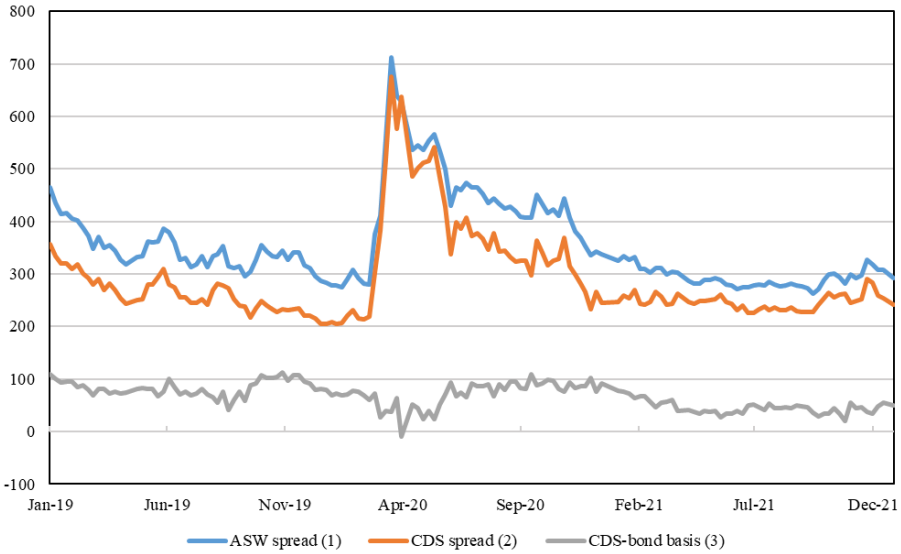
CDS-bond basis of IG bonds
(daily data; basis points)



Source: the asset swap spread is based on ICE Bank of America Merrill Lynch (BofAML) data. The CDS spread is based on iTraxx Europe index.
(1) Asset swap spreads weighted by the market capitalization of individual securities issued by euro area non-financial corporations. – (2) 5-year credit default swap spread. – (3) The CDS-bond basis is calculated as the difference between the asset swap spread and the CDS spread.

Figure 7

CDS-bond basis of HY bonds
(daily data; basis points)



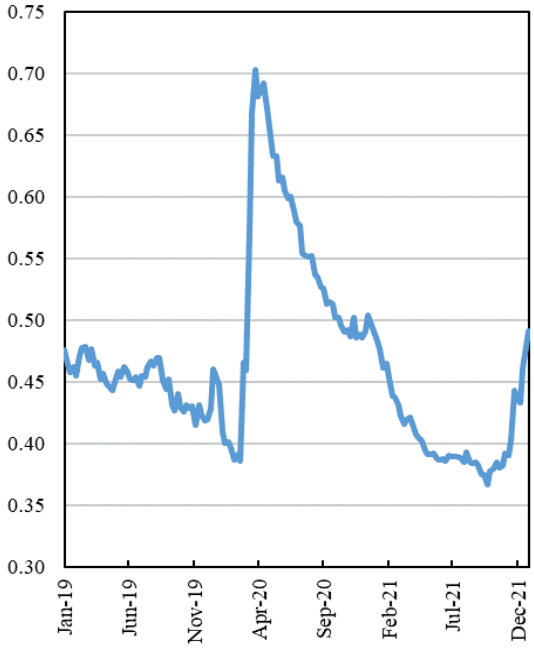
Source: the asset swap spread is based on ICE Bank of America Merrill Lynch (BofAML) data. The CDS spread is based on iTraxx Crossover index.
(1) Asset swap spreads weighted by the market capitalization of individual securities issued by euro area non-financial corporations. – (2) 5-year credit default swap spread. – (3) The CDS-bond basis is calculated as the difference between the asset swap spread and the CDS spread.

Focusing on the euro area, the hypothesis of a liquidity shock is also supported by the fact that bid-ask spreads widened in March 2020 (Figures 8a and 8b)[9], as dealers in various financial assets were increasingly unable or unwilling to absorb the sharply increasing supply of securities, also because of balance sheet constraints (ECB, 2020). Following the announce of the PEPP on March 18, there was a sharp slowdown in spreads and they continued to decline after the announcement of the suspension of the SGP. The effects of European policy measures were magnified by the announcement of the bond purchases by the Fed on March 23, as shown in Figures 1 and 2.

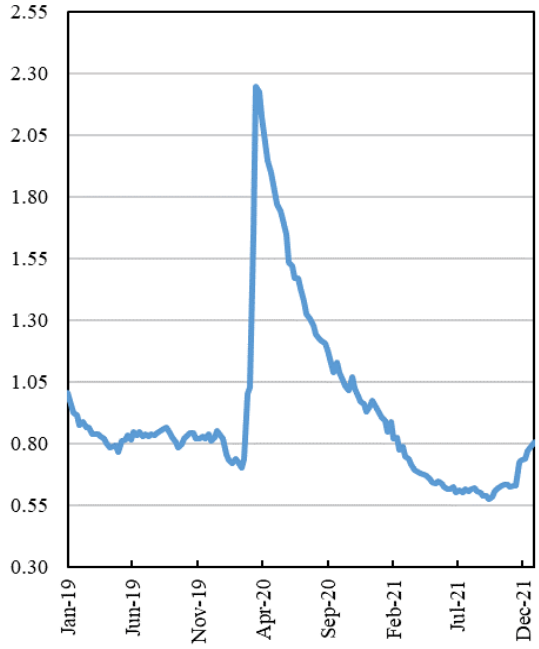
Figure 8

Bid-ask spreads (1)
(daily data; per cent)

(a) Investment grade



(b) High yield



Source: Based on data from Bloomberg.
(1) Bid-ask spreads are calculated as a percentage of the mid prices.

4. Analysis of panel data

In order to better analyse the determinants of the ASW spreads and confirm some of the deductions made in the previous paragraph, we have carried out a panel data regression. The starting sample is the same as described before: bonds issued by euro area non-financial corporations included in ICE BofA euro corporate investment grade and ICE BoFA euro corporate high yield indices[10]. The time period considered is between April 2015 and December 2021 with a monthly frequency (the last Friday of each month). We have considered only the bonds issued by companies headquartered in Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands and Spain, while we excluded small euro area countries due to the limited number of issuers in their financial markets[11].

[9] We have collected bid and ask prices from Bloomberg to assess the liquidity of the bonds. Bid-ask spread has been calculated as a percentage of the mid price.
[10] Our dataset includes only senior bonds to make the sample more homogeneous.
[11] The euro area countries excluded from the analysis are Croatia, Cyprus, Estonia, Greece, Latvia, Lithuania, Luxembourg, Malta, Portugal, Slovakia and Slovenia.

The population of the bonds has been also subject to right and left censoring of 1.5% to drop extreme outliers in the ASW spreads. We have ended up with 2,919 bonds and 101,817 observations.

The model has been specified including the potential determinants of credit spreads suggested by previous studies (see De Santis, 2016 and Krylova, 2016). We have taken into account bond characteristics, which measure credit risk and liquidity risk, and macroeconomic factors, which represent the systemic risk. Furthermore, we have tried to measure the impact of the monetary policy purchase programmes (CSPP and PEPP) carried out by the Eurosystem from 2016. Following common practice in the literature, we compute the log of ASW spreads as measure of credit spreads and dependent variable of the model.

The information on the characteristics of the corporate bonds (rating, coupon, duration, outstanding amount, sector and country) is taken from ICE, except the bid-ask spreads from Bloomberg; the macroeconomic data (GDP, inflation, VSTOXX index and yield curve slope) are from Bloomberg; the bonds purchased under the CSPP and PEPP are publicly available on ECB website.

Credit ratings are a measure of the creditworthiness of an issuer and are commonly used to assess the credit risk of a bond. A lower rating implies a higher risk of loss for bond investors who, consequently, require a larger credit risk premium. Therefore, the worsening of the rating should be associated with an increase in credit spreads. The rating of bonds is included in the regression using dummy variables.

A coupon is the annual interest rate paid on a bond expressed as a percentage of its face value. Investors in less creditworthy bonds require higher and earlier compensation for risk that, all other things being equal, results in higher coupons. Additionally, as yields have decreased during the last years, high coupons are often associated with illiquid bonds issued in previous years when rates were higher. Therefore, we can expect a positive estimated coefficient to come out of the regressions, at least for HY bonds.

Duration is a measure of how long it takes, in years, to recover the bond price by the bond total cash flows[12]. An investor considers the risk of default to be lower in the short term than in the long term, except for the more distressed bonds whose price converges to the recovery rate as default becomes more certain, regardless of the remaining time to maturity. Therefore, on average a higher duration is usually associated with a greater uncertainty about an issuer's future creditworthiness, making the expected relationship between duration and credit spread positive.

Regarding the outstanding amount of a bond, generally a larger amount is associated with a higher liquidity. Furthermore, the biggest and most robust issuers generally can afford a greater outstanding amount. Both these aspects would suggest a negative relationship between outstanding amount and credit spread. However, it is also true that a high outstanding amount may also reveal a large use of financial leverage and an increasing credit risk of the issuer itself that would lead to an increase in credit spreads. Therefore, the expected sign of the estimated coefficient is less obvious.

In order to detect the impact that sector attribution has on credit spreads, industry dummies have been added to the regression[13]. Sectors that have been more resilient during crises and that have kept ASW

[12] We use the effective duration that measures the duration of bonds with embedded options, as callable bonds are also included.

[13] Initially we also included the country dummy variables to analyze any cross-country heterogeneity, but the resulted differences depend mostly on the rating and market sectoral composition of a country rather than on the specific country. Indeed, it should be considered that many issuers domiciled in one country operate or generate most of their revenues in other countries.

spreads on average lower than other sectors, such as utilities, should display this pattern also in the estimated coefficients of the regression.

The bid-ask spread has been included as a proxy of the bond's liquidity. An increasing bid-ask spread means that the bond is becoming less liquid and investors will invest in less liquid assets at a higher premium compared to similar more liquid asset. This leads to an increase in credit spreads and suggests a positive relationship between bid-ask spread and credit spread.

We have used expected GDP growth, inflation, the VSTOXX Index and slope of the yield curve as proxy of the systemic risk.

We have taken from Bloomberg the GDP and inflation forecasts for the current and the following year provided by several professional forecasters [14]. Following Dovern, Fritsche and Slacalek (2012), we build the forecast one year ahead by interpolating the GDP and inflation forecasts for the current and the following year. For example, if the GDP forecasts for the current and the following year are collected in May 2020, the forecast one year ahead is given by the weighted average of the 2020 and 2021 GDP forecasts, where weights are respectively equal to 7/12 (number of months until the end of 2020) and 5/12 (number of months between January 2021 and May 2021).

Expected 1-year ahead GDP growth provides an assessment of the economic climate in individual countries for the following one-year period. We assume a negative relationship between the expected GDP growth and credit spread because a better assessment of the economic environment leads to a reduction in the probability of default and lower credit spreads.

Expected 1-year ahead inflation is the rate of increase in prices for the following one-year period. The effect of inflation on credit spreads depends on the causes that lead to the rise in prices. If inflation is driven by a strong economic growth, the rise in prices is generally associated with an increase in the risk-free rate and a narrowing of credit spreads. On the other hand, inflation can also occur in conditions of economic stagnation, due to an increase in input costs. In this case, the rise in prices reduce the profitability of firms, which lead to an increase in credit spreads.

The slope of the yield curve[15] is an indicator that provides further information on the state of the economy. A decrease in the slope of the interest rate curve is generally associated with a weakening of the economy that leads to an increase in credit spreads. Consequently, we expect a negative relationship between the slope and credit spread.

The VSTOXX index provides a measure of market uncertainty. Since credit spreads tend to rise with increasing uncertainty, the VSTOXX index should be positively related to credit spreads.

The period analysed has been characterized by unconventional policy interventions by the ECB, which include the purchase of non-financial corporate bonds (CSPP and PEPP). Only securities that meet defined criteria can be purchased and the large majority of these securities are IG bonds accordingly to the classification of index providers, although not all IG-classified bond are eligible. These interventions can be considered as additional exogenous systemic factors that might have influenced credit spreads. To capture their effects, we have included two dummy variables, one for the CSPP and the other for the PEPP, which identify the bonds purchased during the implementation of the programmes. We expect that ECB purchases result in a decline in ASW spreads. Instead of considering these dummies alone, in order to assess whether the direct effects on purchased bonds

[14] The GDP forecast uncertainty and the inflation forecast uncertainty, approximated by the standard deviation, have been initially considered, as done by De Santis 2016. However, they have proven non-significant and redundant.
[15] Slope of the yield curve is given by the difference between 10-year zero-coupon euro swap rate and 3-month Euribor.

have been persistent over time we made the CSPP and PEPP dummies interact with time dummies over the twelve months after the beginning of the programmes - respectively June 2016 and April 2020 - as done by Zaghini (2019 and 2021) for the primary market. Furthermore, to capture any effect of the CSPP over the year after the pandemic outbreak, we have considered the interaction of CSPP dummy with monthly dummies over the year after the COVID-19 outbreak. We have added also "pure" monthly dummies over the year after the beginning of the CSPP and the pandemic outbreak to detect any spillover effect on unpurchased bonds: the purchase programmes may have crowded out other investors in the eligible bond segment pushing them towards other securities and in particular towards non-eligible bonds, favouring a decreasing credit spread also in that segment. Given that in each month the differential effect between the CSPP purchased and the rest of the bonds is taken into account by an ad hoc variable (the interaction of the CSPP and PEPP dummies with time dummies), the changes in the coefficient on the monthly dummies should measure the effect of the programme on non-purchased bonds only[16]. It is important to highlight that Zaghini focuses on the primary bond market because his goal was to assess the impact of the ECB programmes on the actual cost of funding. We have adopted a similar approach to control for the effect of the purchase programmes on secondary market, although in the secondary market the credit spreads are also influenced by the selling pressure of investors who need liquidity.

Finally, we have included a March 2020 dummy to capture any possible residual effect of the pandemic at its outbreak in March 2020.

The panel regressions are estimated using the estimator described in Correia (2017) with industry fixed effects. We have adjusted standard errors for correlations across country and across time using clustered standard errors along country and time dimensions (Cameron, Gelbach and Miller, 2011; Thompson, 2011). As done by De Santis (2016), we have run three different regressions, one for all rating classes and the other two for IG and HY bonds respectively[17]. The decision to separate IG and HY bonds is motivated by their structural differences, mainly related to different regulations. For example, the exposure of some institutional investors, such as regulated banks and life insurance companies, to low-rated bonds is limited or completely restricted.

Table 1 shows the results of the three regressions.

An increase in coupon and duration implies a higher credit spread, as expected. The outstanding amount is also significant, despite the conceptual difficulty of identifying an expected relationship between outstanding amount and credit spread.

As regards ratings, to avoid collinearity we have omitted the dummy referring to the highest ratings (AAA/AA+). The coefficients are all significant and tend to increase with the worsening of the rating.

For sectors, we have omitted utilities. Most of the coefficients have been found to be non-significant, probably because the effect on the credit spread has already been largely captured by the ratings and other idiosyncratic factors.

[16] Amongst the unpurchased bonds, unlike our analysis, Zaghini (2019) distinguishes between eligible and non-eligible bonds to asses a potential different effect on these two segments. This investigation is out of scope of this paper; the monthly dummies should capture the average rebalancing channel effect on unpurchased eligible and non-eligible bonds.
[17] Notice that these models cannot be compared with each other: each of them is estimated on a different sample of securities and has its own specification, relating to a different set of regressors. The conclusions that can be drawn are subordinate to the sample and the model specification under examination; in some cases the results seem to agree between each other, while in others differences are found. Nonetheless, in both circumstances it would not be correct to generalize the conclusions. The monetary policy dummies are considered only for the regression on the whole sample (IG and HY) because the bonds purchased in the CSPP almost coincide with the IG universe.

An increase in bid-ask spreads and, therefore, a worsening in the liquidity of bonds leads to an increase in credit spreads. This confirms that the credit spread includes, in addition to the credit risk premium, a liquidity risk premium and, therefore, it seems also to be a sensitive indicator of changes in market liquidity.

Macroeconomic variables also appear to have explanatory power, although we have obtained mixed results in the regressions on IG and HY bonds. The VSTOXX is positive and significant in all three regressions. As expected, an increase in market volatility is associated with a worsening of the credit spread, as investors in times of uncertainty require a higher risk premium. On the contrary, the coefficient of the expected inflation is not significant, indicating that the impact of inflation on credit spreads may be irrelevant or ambiguous. The main difference between IG and HY bonds concerns the results obtained for the slope of the interest rate curve and the expected GDP growth. In fact, the coefficients of these variables are significant only for IG bonds. It appears that credit spreads of IG bonds are more susceptible to macroeconomic changes than those of HY bonds. Probably, when evaluating a HY bond, investors mainly look at the intrinsic characteristics of the bond, while for the safer IG bonds the importance of macroeconomic factors is greater.

By including the bid-ask spread and macroeconomic factors in the regressions, the effect of the pandemic outbreak on the credit spread vanishes completely, as it can be seen from the non-significance of the March 2020 dummy. The evaporating liquidity in the market, the volatility spike and concerns on the economic environment are the main drivers of the credit spread surge.

Regarding the monetary policy purchase programmes, in line with the results of Zaghini (2019 and 2021), the effect of the CSPP on purchased bonds was entirely concentrated on the first five months after its start, while it disappears in the following months and also after the COVID-19 outbreak[18]. The purchases made under the PEPP have not added any particular effect; as said before, the announcement of the PEPP and the other monetary policy interventions was enough to favour a slowdown on the credit spreads during the pandemic, probably captured by the systemic variables (for example the VSTOXX sharply declined after the announcement)[19]. Finally, the monthly dummies have been found non-significant in most cases: the rebalancing effect could be more difficult to materialize in the secondary market of HY bonds because of their high illiquidity[20].

[18] Zaghini (2021) found that purchase programmes reduced yields of eligible bonds in the primary market between late February and mid-March 2020, but afterwards their effect faded.
[19] This is in line with the findings by Haddad, Moreira and Muir (2021) on the US corporate bond market: the announcements of the Fed to step into corporate bond markets and purchase securities had large effects, while actual purchases had no effect.
[20] The CSPP dummies over the year after the pandemic outbreak, the PEPP dummies and the monthly dummies are not reported in Table 1 for the sake of clarity and conciseness.

Table 1

Panel regression (1)

Variables	**(a) All** (2)	**(b) Investment grade**	**(c) High yield**
Coupon	0.04***	0,022	0.081***
	(0.0096)	(0.014)	(0.0089)
Duration	0.086***	0.073***	0.096***
	(0.0052)	(0.0094)	(0.0064)
Amount outstanding	0.0001**	0.0001***	0.00017**
	(0.000029)	(0.000026)	(0.00007)
Bid-ask spread	0.37***	0.58***	0.34***
	(0.070)	(0.15)	(0.049)
AAA/AA-	-	-	
A+	0.35***	0.36***	
	(0.65)	(0.068)	
A	0.47***	0.47***	
	(0.038)	(0.043)	
A-	0.59***	0.6***	
	(0.080)	(0.083)	
BBB+	0.93***	0.94***	
	(0.066)	(0.067)	
BBB	1.24***	1.25***	
	(0.069)	(0.074)	
BBB-	1.6***	1.6***	
	(0.076)	(0.088)	
BB+	2.21***		-
	(0.084)		
BB	2.42***		0.24***
	(0.084)		(0.032)
BB-	2.7***		0.51***
	(0.11)		(0.071)
B+	3.02***		0.81***
	(0.11)		(0.053)
B	3.13***		0.85***
	(0.12)		(0.077)
B-	3.25***		0.95***
	(0.11)		(0.07)
CCC+/D	3.37***		1.05***
	(0.098)		(0.081)
Automotive	0.3***	0.34***	-0.12
	(0.084)	(0.074)	(0.14)
Basic Industry	-0.088*	-0.13**	-0.17**
	(0.044)	(0.041)	(0.07)
Capital Goods	0,018	0,048	-0.21**
	(0.037)	(0.054)	(0.08)
Consumer Goods	-0.12	-0.14	-0.13
	(0.079)	(0.11)	(0.093)
Energy	0.22***	0.21***	0,094
	(0.044)	(0.045)	(0.12)
Healthcare	-0.11**	-0.081*	-0.35***
	(0.042)	(0.039)	(0.068)
Leisure	0,15	0,06	-0.027
	(0.1)	(0.18)	(0.1)
Media	-0.049	-0.089	-0.23***
	(0.038)	(0.069)	(0.063)
Real Estate	0.47***	0.46***	0.37***
	(0.044)	(0.046)	(0.11)
Retail	0,044	0,0033	-0.06
	(0.033)	(0.035)	(0.075)
Services	0,0019	0,037	-0.18**
	(0.035)	(0.3)	(0.07)
Technology & Electronics	-0.063	-0.064	-0.25***
	(0.070)	(0.079)	(0.047)
Telecommunications	-0.1***	-0.1***	-0.25*
	(0.029)	(0.027)	(0.11)
Transportation	0,045	0,057	-0.23**
	(0.072)	(0.077)	(0.078)
Utility	-	-	-

Table 1
(continued)

Variables	(a) All (2)	(b) Investment grade	(c) High yield
VSTOXX Index	0.02***	0.02***	0.014***
	(0.0044)	(0.047)	(0.0024)
Expected GDP growth	-0.065***	-0.072***	0,0043
	(0.011)	(0.012)	(0.011)
Expected inflation rate	-0.086*	-0.1*	0,012
	(0.043)	(0.054)	(0.069)
Yield curve slope	-0.3***	-0.31***	-0.15*
	(0.084)	(0.093)	(0.069)
March 2020 (3)	-0.082	-0.07	-0.27**
	(0.16)	(0.17)	(0.1)
CSPP*2016M6	-0,38***		
	(0,09)		
CSPP*2016M7	-0,76***		
	(0,11)		
CSPP*2016M8	-0,6***		
	(0,088)		
CSPP*2016M9	-0,48***		
	(0,044)		
CSPP*2016M10	-0,36***		
	(0,099)		
CSPP*2016M11	-0,19		
	(0,15)		
CSPP*2016M12	-0,17		
	(0,11)		
CSPP*2017M1	0,1		
	(0,11)		
CSPP*2017M2	-0,4*		
	(0,21)		
CSPP*2017M3	-0,02		
	(0,11)		
CSPP*2017M4	-0,24*		
	(0,11)		
CSPP*2017M5	-0,11		
	(0,094)		
CSPP*2017M6	-0,07		
	(0,083)		
Constant	2.09***	2.12***	4***
	(0.14)	(0.16)	(0.11)
Observations	101.817	84.286	17.531
Adj. R-squared	0,77	0,61	0,67
Clusters: Time and Country (4)	YES	YES	YES

Source: Based on data from ICE Bank of America Merrill Lynch (BofAML) and Bloomberg.
(1) This table shows the estimated coefficients and the robust standard errors. Rating and sector attributions are included using dummy variables. P-value: ***p<0.01, **p<0.05, *p<0.1. Sample period: April 2015 – December 2021. – (2) Both investment grade and high yield bonds are included. – (3) Time dummy capturing the COVID-19 crisis effect on credit spreads in March 2020. – (4) Adjusted standard errors for correlations across countries and across time using clustered standard errors along country and time dimensions.

Table 2 displays the elasticity of each significant independent quantitative variable[21], which indicates how much, in percentage terms, the conditional mean of the ASW spread changes in response to a 1% increase in the independent variable, keeping the others fixed. Because the model is log-linear, the elasticity is not constant but it depends on the independent variable's value; the elasticities in the table are computed considering the average value of each independent variable[22]. Not surprisingly,

[21] The average change of the ASW spread moving from a class rating to the other is easily obtainable from the average ASW spread of each class rating reported in Table A-1.
[22] In a so-called "log-linear model" (notice the term is also used in other contexts, although referring to different models for other kinds of response variables *Y*), given the hypothesis that the errors and the independent variables are independently distributed, the elasticity of the conditional mean of the dependent variable *Y* with respect to *X* is equal to βX, where β is the regression coefficient associated to *X*. Differently from a "log-log model" specification, which is

duration is the most impactful variable (0.45% in the "All" regression), followed by the VSTOXX Index (0.40% in the "All" regression) which is the variable that best explains the economic environment. This means for example that, for an average-duration bond, a 1% increase on its value increases the conditional mean of the ASW spread by 0.45%, *ceteris paribus*. Their impacts increase up to 2.78% and 1.16% respectively when we consider the maximum duration and VSTOXX values in the sample. The effects of the coupon and amount outstanding are less pronounced, with a maximum impact equal to 0.47% and 0.30% respectively. In the "IG" regression the elasticities are similar to those of the "All" regression. By contrast, for high yield bonds, coupon and bid-ask spread have a greater impact, while the effects of VSTOXX Index and expected GDP growth are weaker, confirming that for these bonds idiosyncratic characteristics prevail on average on systemic factors.

Table 2

Elasticity of statistically significant independent variables

Indipendent variable	**Elasticity** *(absolute percentage value)*		
	All	IG	HY
Coupon	0.10	0.05	0.35
Duration	0.45	0.41	0.33
Amount outstanding	0.07	0.07	0.09
Bid-ask spread	0.19	0.26	0.27
VSTOXX Index	0.40	0.42	0.29
Expected GDP growth	0.13	0.14	0.01
Yield curve slope	0.23	0.24	0.11

5. ESG considerations

The increased public attention on sustainability has pushed legislators to introduce new regulations on corporate disclosure and it has been also influencing the flow of public investments to support the ecological transition. Corporate revenues will be increasingly affected by sustainability issues, first of all by the effects that climate change will have on the economy.

The sustainability issues have been also affecting investor behaviour. The number of investors who decide to integrate sustainability factors into their portfolio strategies is growing and this trend is also made evident by the steady growth of green bonds issued on the market. One of the main tools used for this integration is the ESG score, which synthetically measures the sustainability profile of an issuer. Specifically, the ESG score evaluates companies on the basis of three pillars: governance, environmental and social sustainability.

According to Pedersen *et al.* (2021), the impact of the ESG performance on the expected returns of an asset depends on which kind of investor prevails on the market amongst three types: type-U (ESG-unaware) investors, unaware of ESG scores and simply seeking to maximize their unconditional mean-variance utility; type-A (ESG-aware) investors also having mean-variance preferences, but they use assets' ESG scores to update their views on risk and expected returns; type-M (ESG-

characterized by constant elasticity, in order *to* provide a synthetic value of the elasticity here it is common choice to use the sample average of X as a synthetic representation of X itself, given that X is non-constant and varies among units (robust alternatives for non-symmetric X variables could be the sample median, or interest-specific sample quantiles). The elasticity estimated in this way proxies the average impact of X on the conditional mean of Y; the sign of the impact is provided by β alone.

motivated) investors, who use ESG information and also have preferences for high ESG scores. The type-M investors seek a portfolio with an optimal trade-off between a high expected return, low risk, and high average ESG score. Therefore, in the corporate bond market, the type-M investors could accept bonds with worse risk-return profile (bonds with higher ASW spreads than others for the same risk) if they have better ESG score.

Ferriani (2022) examines two distinct channels by which the ESG scores can have implication on credit spreads. The non-pecuniary channel accounts for the impact of investors' preference towards sustainability; this makes investors willing to acknowledge a premium to highly-rated ESG firms on the basis of non-pecuniary considerations. The risk-channel relates to the ability of more sustainable firms to hedge against climate shocks or unexpected deteriorations in the environmental or the social dimension of corporate activity. The relation between ESG scores and asset returns can be shaped by investors' conviction that ESG factors capture some source of risk that is not fully account for by traditional credit metrics, so that more sustainable assets ultimately deliver better risk-adjusted returns. As an example, this may occur because firms with higher ESG scores are less exposed to capital and operational losses associated with a stricter environmental regulation, adverse climate events, strikes, corruption cases.

To analyse the implications of ESG scores on credit spreads, we have relied on ESG scores assigned by three different providers: MSCI, Refinitiv and Bloomberg. Bloomberg provides only scores of the three profiles (E, S and G), MSCI and Refinitiv also estimate an overall ESG score. Furthermore, we only have at disposal the latest up-to-date MSCI scores, while in the case of Refinitiv and Bloomberg, yearly past scores are also available. The score of MSCI and Bloomberg ranges from 0 to 10, while the Refinitiv's score from 0 to 100; the higher the score, the better the respective measured sustainability profile. The usage of different providers can help to analyse and mitigate the reliability and scarcity issues typically affecting these types of data. Indeed, ESG scores can be heavily model-dependent and they are often missing for smaller firms.

Tables 3a and 3b show the coverage and the average of the latest up-to-date (2021) ESG scores of the bonds issued by euro area non-financial corporations included in ICE indices (investment grade and high yield indices) as of January 3, 2022, grouped by credit ratings. MSCI has the best coverage ratio, following by Bloomberg and Refinitiv; none of them covers the whole sample. The average E, S and G scores of Refinitiv and Bloomberg and the overall scores of Refinitiv tend to be positively correlated with the credit ratings, whilst, in the case of MSCI, this is mostly true only for the ESG overall scores.

Table 3

ESG score statistics

(a)

	Environmental score							Social score						
	Number of bonds covered				Average			Number of bonds covered				Average		
Rating	**MSCI**	**Refinitiv**	**Bloomberg**	**Total**	**MSCI**	**Refinitiv**	**Bloomberg**	**MSCI**	**Refinitiv**	**Bloomberg**	**Total**	**MSCI**	**Refinitiv**	**Bloomberg**
AAA	6	5	5	7	6.0	87.0	7.2	6	5	5	7	5.5	97.3	3.5
AA	105	35	69	137	6.4	81.6	5.9	105	35	69	137	5.3	82.1	3.4
A	725	306	577	794	7.0	78.2	5.0	725	306	540	794	5.5	84.3	3.7
BBB	1,508	882	1,337	1,669	7.2	75.7	4.6	1,508	882	1,312	1,669	5.7	79.6	3.9
BB	309	190	259	416	6.6	70.6	4.2	309	190	260	416	4.8	76.8	4.3
B	81	28	50	204	5.7	67.0	3.1	81	28	50	204	4.7	76.0	3.6
CCC	9	1	9	52	6.3	69.7	1.3	9	1	9	52	5.2	44.5	4.0
Index	2,743	1,447	2,306	3,280	7.0	75.5	4.6	2,743	1,447	2,245	3,280	5.5	80.2	3.9

(b)

	Governance score							ESG overall score				
	Number of bonds covered				Average			Number of bonds covered			Average	
Rating	**MSCI**	**Refinitiv**	**Bloomberg**	**Total**	**MSCI**	**Refinitiv**	**Bloomberg**	**MSCI**	**Refinitiv**	**Total**	**MSCI**	**Refinitiv**
AAA	6	5	0	7	4.4	81.4	n.a.	6	5	7	7.4	90.5
AA	105	35	76	137	5.5	87.1	7.1	105	35	137	7.3	83.6
A	725	306	530	794	5.9	75.3	6.7	725	306	794	7.5	79.9
BBB	1,508	882	1,284	1,669	5.9	72.3	6.4	1,508	882	1,669	7.2	76.6
BB	309	190	280	416	5.7	68.9	6.3	309	190	416	6.4	72.7
B	81	28	64	204	5.2	67.7	5.8	81	28	204	5.3	70.8
CCC	9	1	11	52	4.9	57.9	5.0	9	1	52	6.6	55.1
Index	2,743	1,447	2,245	3,280	5.8	72.8	6.4	2,743	1,447	3,280	7.1	76.9

Source: Based on data from ICE Bank of America Merrill Lynch (BofAML), MSCI, Refinitiv and Bloomberg. Index composition as of January 3, 2022. ESG data as of 2021.

Tables 4a, 4b, 4c and 4d report the correlations amongst scores of the three providers. In some cases the scores are poorly correlated, highlighting the fact that they heavily depend on different key issues and weighting schemes adopted in the providers' models.

Table 4

ESG score correlations

(a)

Environmental score			
	MSCI	**Refinitiv**	**Bloomberg**
MSCI			
Refinitiv	-0.03		
Bloomberg	0.06	0.16	

(b)

Social score			
	MSCI	**Refinitiv**	**Bloomberg**
MSCI			
Refinitiv	0.03		
Bloomberg	0.13	-0.02	

(c)

Governance score			
	MSCI	**Refinitiv**	**Bloomberg**
MSCI			
Refinitiv	0.08		
Bloomberg	0.33	0.26	

(d)

ESG overall score		
	MSCI	**Refinitiv**
MSCI		
Refinitiv	0.19	

Source: Based on data from ICE Bank of America Merrill Lynch (BofAML), MSCI, Refinitiv and Bloomberg. Index composition as of January 3, 2022. ESG data as of 2021.

To investigate the existence and the nature of the relationship between ESG scores and credit spreads, we have conducted cross-sectional regressions starting from the same ICE indices as of January 3, 2022 and using the scores of the three providers[23]. To isolate the effect of the ESG scores, we control for the other main idiosyncratic bond characteristics, such as coupon, duration, outstanding amount, rating, sector and bid-ask spread. The ESG scores have not been included in the earlier panel regressions because, when available, they have a yearly frequency, not enough to get a satisfying balanced panel sample. Notwithstanding, to study the relevance of the ESG scores in the outbreak of the pandemic, we have run a second set of cross-sectional regressions on the ICE indices as of March 9, 2020 (the day when Italian authorities imposed the first lockdown and European investors became aware of the gravity of the situation), using the 2020 Refinitiv and Bloomberg scores, the only available.

The results of the first set of regressions are illustrated in Table 5 and they lead to the same conclusions for all three providers: the ESG score coefficients are significant and negative and, amongst the individual pillars, governance and environmental scores have a significant inverse relationship with credit spreads, while the social score appears to be of lower importance. Using the interpretation of Ferriani (2022), these results can be explained by the fact that investors have a preference towards sustainability (non-pecuniary channel) or they believe that highly-rated ESG firms are better equipped to deal with the sustainability-linked challenges and therefore they are less risky (risk-channel).

The elasticities of the statistically significant ESG variables are shown in Table 6. The ESG score has an impact higher than that of the individual pillars.

[23] We have initially included in the regression the Scope 1 + 2 carbon emissions intensity provided by MSCI, but the estimated coefficients have proven to be not significant. The samples used for the regressions are not the same because the issuers covered by the three providers are different. The samples are built according to the same criteria used in the panel regressions.

Table 5

Cross-sectional regression – January 3, 2022 (1)

Variables	MSCI		Refinitiv		Bloomberg
	ESG score (2)	Sustainability Pillars (3)	ESG score (2)	Sustainability Pillars (3)	Sustainability Pillars (3)
Coupon	0.074***	0.079***	0.094***	0.094***	0.1***
	(0.014)	(0.014)	(0.016)	(0.016)	(0.012)
Duration	0.091***	0.094***	0.096***	0.096***	0.097***
	(0.0058)	(0.0059)	(0.0074)	(0.0075)	(0.0057)
Amount outstanding	0.000053	0.000039	0.00014***	0.00014***	0.00017***
	(0.000039)	(0.000039)	(0.000049)	(0.000049)	(0.000037)
Bid-ask spread	0.21***	0.18**	0.002**	0.002**	0.0016**
	(0.073)	(0.074)	(0.00093)	(0.00094)	(0.0007)
AA+/A-	-	-	-	-	-
BBB+	0.43***	0.43***	0.28***	0.28***	0.46***
	(0.043)	(0.043)	(0.062)	(0.061)	(0.046)
BBB	0.76***	0.78***	0.75***	0.76***	0.87***
	(0.043)	(0.042)	(0.055)	(0.057)	(0.043)
BBB-	1.2***	1.21***	1.16***	1.15***	1.19***
	(0.044)	(0.041)	(0.055)	(0.055)	(0.045)
BB+	2***	2.07***	1.82***	1.83***	1.95***
	(0.071)	(0.075)	(0.077)	(0.077)	(0.077)
BB	2.17***	2.26***	2.25***	2.26***	2.32***
	(0.07)	(0.07)	(0.078)	(0.078)	(0.068)
BB-	2.52***	2.5***	2.5***	2.5***	2.58***
	(0.071)	(0.072)	(0.088)	(0.088)	(0.069)
B+/CCC+	2.87***	2.92***	2.89***	2.9***	2.96***
	(0.099)	(0.094)	(0.13)	(0.14)	(0.095)
Automotive	-0.014	-0.07	0.054	0.043	0.16***
	(0.045)	(0.059)	(0.07)	(0.07)	(0.046)
Basic Industry	-0.18***	-0.23***	-0.14**	-0.15**	-0.12**
	(0.057)	(0.056)	(0.06)	(0.06)	(0.06)
Capital Goods	-0.094	-0.14*	0.18**	0.17**	0.35***
	(0.068)	(0.072)	(0.08)	(0.08)	(0.075)
Consumer Goods	-0.021	-0.16***	0.022	0.027	-0.045
	(0.049)	(0.054)	(0.052)	(0.052)	(0.064)
Energy	0.3***	0.26***	0.52***	0.51***	0.45***
	(0.048)	(0.049)	(0.067)	(0.066)	(0.058)
Healthcare	-0.29***	-0.21***	-0.12*	-0.14**	-0.083
	(0.051)	(0.054)	(0.069)	(0.067)	(0.059)
Leisure	0.18	0.17	0.27**	0.24*	0.2**
	(0.16)	(0.17)	(0.13)	(0.13)	(0.087)
Media	-0.055	0.04	-0.052	-0.07	-0.072
	(0.083)	(0.084)	(0.11)	(0.12)	(0.096)
Real Estate	0.65***	0.63***	0.74***	0.74***	0.7***
	(0.035)	(0.037)	(0.039)	(0.039)	(0.041)
Retail	-0.017	-0.092	-0.12	-0.16**	-0.068
	(0.06)	(0.062)	(0.073)	(0.074)	(0.068)
Services	-0.18***	-0.1	-0.11*	-0.13**	0.19***
	(0.062)	(0.068)	(0.057)	(0.057)	(0.073)
Technology & Electronics	-0.13**	-0.15**	-0.18**	-0.19***	-0.053
	(0.062)	(0.066)	(0.069)	(0.069)	(0.071)
Telecommunications	-0.28***	-0.13***	-0.074	-0.12**	-0.19***
	(0.049)	(0.051)	(0.046)	(0.049)	(0.051)
Transportation	-0.021	0.019	-0.03	-0.07	0.19***
	(0.067)	(0.065)	(0.12)	(0.12)	(0.074)
Utility	-	-	-	-	-
ESG score	-0.063***		-0.0074***		
	(0.0074)		(0.0016)		
Social score		-0.0034		-0.00077	-0.0035
		(0.011)		(0.001)	(0.0085)
Governance score		-0.055***		-0.0038***	-0.032**
		(0.01)		(0.00096)	(0.013)
Environmental score		-0.05***		-0.0025**	-0.026***
		(0.0077)		(0.001)	(0.0072)
Constant	2.65***	2.87***	2.68***	2.66***	2.29***
	(0.092)	(0.14)	(0.12)	(0.12)	(0.1)
Adj. R-squared	0.80	0.80	0.85	0.85	0.83
Observations	1.399	1.399	819	819	1200

Source: Based on data from ICE Bank of America Merrill Lynch (BofAML), Bloomberg, Refinitiv and MSCI.
(1) This table shows the estimated coefficients and the robust standard errors. Rating and sector attributions are included using dummy variables. P-value: ***p<0.01, **p<0.05, *p<0.1. Sample period: January 3, 2022. ESG data as of 2021. – (2) ESG score assesses the sustainability profile of the issuer. – (3) Social, Governance and Environmental scores measure sustainability pillars of the ESG performance.

Table 6

Elasticity of statistically significant independent ESG variables – January 3, 2022

Indipendent variable	**Elasticity** *(absolute percentage value)*				
	MSCI		Refinitiv		Bloomberg
ESG score	0.43	-	0.58	-	-
Environmental score	-	0.35	-	0.19	0.12
Governance score	-	0.27	-	0.29	0.20

The results of the cross-sectional regressions carried out on the day of the pandemic outbreak, reported in Table 7, largely confirm the previous findings. However, the impact of the sustainability metrics on the ASW spread has weakened in most cases (Table 8), probably because in the pandemic crisis the external context became predominant over idiosyncratic features.

Table 7

Cross-sectional regression – March 9, 2020 (1)

Variables	Refinitiv		Bloomberg
	ESG score (2)	Sustainability Pillars (3)	Sustainability Pillars (3)
Coupon	0.012	0.012	0.0082
	(0.011)	(0.011)	(0.013)
Duration	0.07***	0.07***	0.069***
	(0.0042)	(0.0043)	(0.0048)
Amount outstanding	0.00021***	0.00022***	0.00018***
	(0.000028)	(0.000027)	(0.000029)
Bid-ask spread	0.17***	0.16***	0.18***
	(0.046)	(0.046)	(0.045)
AA+/A-	-	-	-
BBB+	0.17***	0.18***	0.21***
	(0.03)	(0.03)	(0.034)
BBB	0.34***	0.36***	0.42***
	(0.031)	(0.034)	(0.035)
BBB-	0.84***	0.83***	0.88***
	(0.044)	(0.045)	(0.05)
BB+	1.32***	1.35***	1.42***
	(0.055)	(0.058)	(0.057)
BB	1.73***	1.76***	1.86***
	(0.077)	(0.08)	(0.083)
BB-	2.14***	2.15***	2.29***
	(0.089)	(0.088)	(0.12)
B+/CCC+	2.66***	2.68***	2.64***
	(0.14)	(0.14)	(0.13)
Automotive	0.48***	0.48***	0.42***
	(0.054)	(0.057)	(0.055)
Basic Industry	0.11***	0.11***	0.048
	(0.04)	(0.039)	(0.038)
Capital Goods	0.16***	0.15***	0.19***
	(0.042)	(0.043)	(0.045)
Consumer Goods	0.17***	0.2***	0.2***
	(0.045)	(0.048)	(0.046)
Energy	0.35***	0.36***	0.39***
	(0.05)	(0.05)	(0.063)
Healthcare	-0.066	-0.09**	-0.14***
	(0.045)	(0.045)	(0.048)
Leisure	0.49***	0.49***	0.045***
	(0.086)	(0.078)	(0.099)
Media	-0.087	-0.12**	-0.2***
	(0.059)	(0.056)	(0.06)
Real Estate	0.34***	0.34***	0.37***
	(0.035)	(0.034)	(0.044)
Retail	0.19***	0.16***	0.16**
	(0.052)	(0.057)	(0.061)
Services	0.00036	-0.023	0.069
	(0.07)	(0.072)	(0.085)
Technology & Electronics	0.063	0.043	0.012
	(0.04)	(0.042)	(0.05)
Telecommunications	0.097**	0.06	0.057
	(0.045)	(0.045)	(0.042)
Transportation	0.061	0.035	-0.12
	(0.08)	(0.08)	(0.11)
Utility	-	-	-
ESG score	-0.0055***		
	(0.0011)		
Social score		0.00016	-0.019**
		(0.0009)	(0.008)
Governance score		-0.0027***	-0.061***
		(0.00073)	(0.014)
Environmental score		-0.0026***	0.015
		0.00079	(0.0094)
Constant	3.68***	3.64***	3.66***
	(0.094)	(0.094)	(0.11)
Adj. R-squared	0.90	0.90	0.90
Observations	690	690	595

Source: Based on data from ICE Bank of America Merrill Lynch (BofAML), Bloomberg and Refinitiv.
(1) This table shows the estimated coefficients and the robust standard errors. Rating and sector attributions are included using dummy variables. P-value: ***p<0.01, **p<0.05, *p<0.1. Sample period: March 9, 2020. ESG data as of 2021. – (2) ESG score assesses the sustainability profile of the issuer. – (3) Social, Governance and Environmental scores measure sustainability pillars of the ESG performance.

Table 8

Elasticity of statistically significant independent ESG variables – March 9, 2020

Indipendent variable	Elasticity *(absolute percentage value)*		
	Refinitiv		Bloomberg
ESG score	0.42	-	-
Environmental score	-	0.20	-
Social score	-	-	0.07
Governance score	-	0.19	0.37

6. Conclusions

The paper investigates the potential drivers of the behaviour of credit spreads in the euro area corporate bond market, in particular in the early stages of the pandemic. Our evidence suggests that in March 2020 there was an anomalous increase in spreads of IG bonds, which in relative terms was larger than the one recorded for HY bonds. Furthermore, we find that the surge in credit spreads of IG bonds was larger than that in CDS spreads, confirming the already available empirical evidence. Since these fluctuations are not fully accounted for by the increase in the probability of default, other factors must have been at work. Our findings are consistent with the hypothesis of a liquidity shock, as confirmed also by the significant widening of the bid-ask spreads. We also find that the different sectoral composition of the bond markets contributes to explain the decreasing gap of the ASW spreads between Italy and other euro area countries.

The panel analysis suggests that credit spreads are mainly sensitive to three different sources of risk: credit risk, liquidity risk and systemic risk. Specifically, there is evidence that coupon and duration are positively related to credit spreads, together with rating. A visual analysis suggests that sector membership also influences the credit spread; however, in a panel regression, sector-specific effects are mostly absorbed by the ratings. The monetary policy interventions unfolded their effects on the purchased bonds soon after the beginning of the CSPP. The bid-ask spread (a proxy for bond liquidity) is always found to be significant. This means that liquidity is a factor that must be taken into consideration when studying the behaviour of credit spreads, its importance increasing in times of market turbulences. The role of systemic risk differs between IG and HY bonds: macroeconomic factors produce significant effects on the credit spread of IG bonds, while they seem to have little influence on HY bonds, for which idiosyncratic factors prevail. Furthermore, the bid-ask spread and macroeconomic factors also include the impact of the pandemic: the evaporation of liquidity, the volatility spike and concerns about the economic environment were the main drivers of the surge in credit spreads.

Given the increasing importance of sustainability factors in defining the portfolio strategies, we explore whether the ESG performance of an issuer translates into significant effects on credit spreads. The results show that a better ESG score is related to a lower credit spread. The ESG score summarizes the issuer's behaviour in three different areas: governance, environmental and social sustainability. Our results suggest that the largest effects are associated with the environmental and governance pillars generate. The impact of the ESG metrics faded at the outbreak of the pandemic, probably because other systemic factors prevailed.

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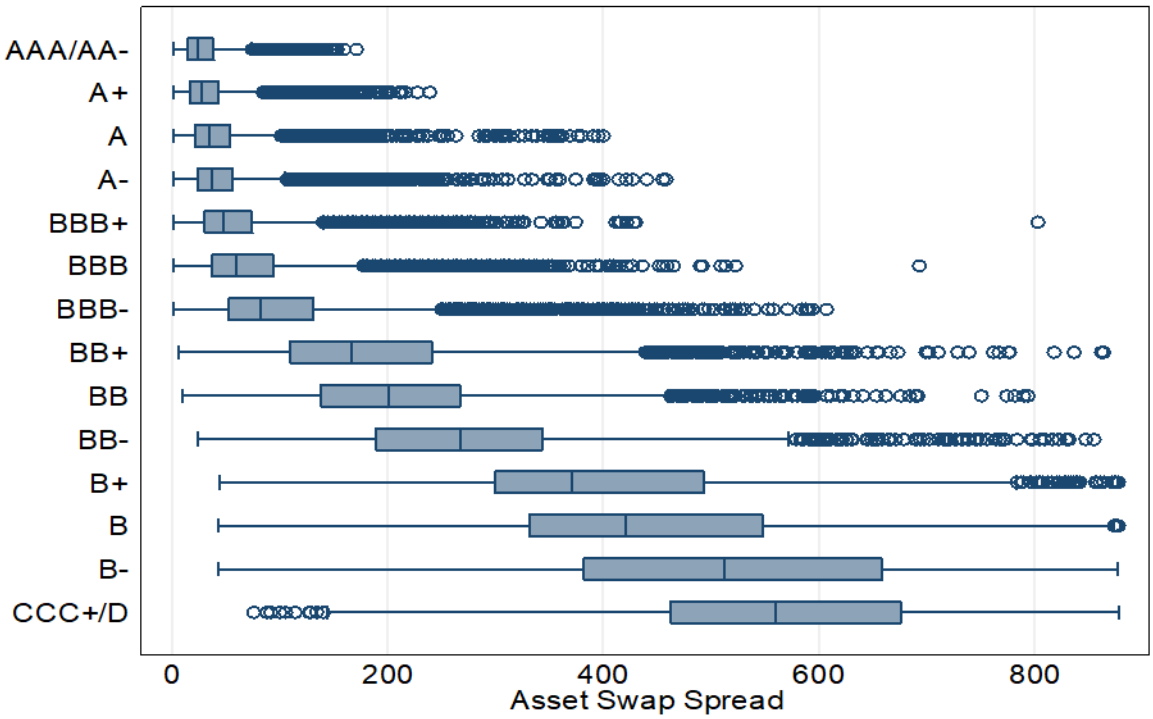
Appendix

Figure A-1

Credit spread box plots by rating (1)
(basis points)

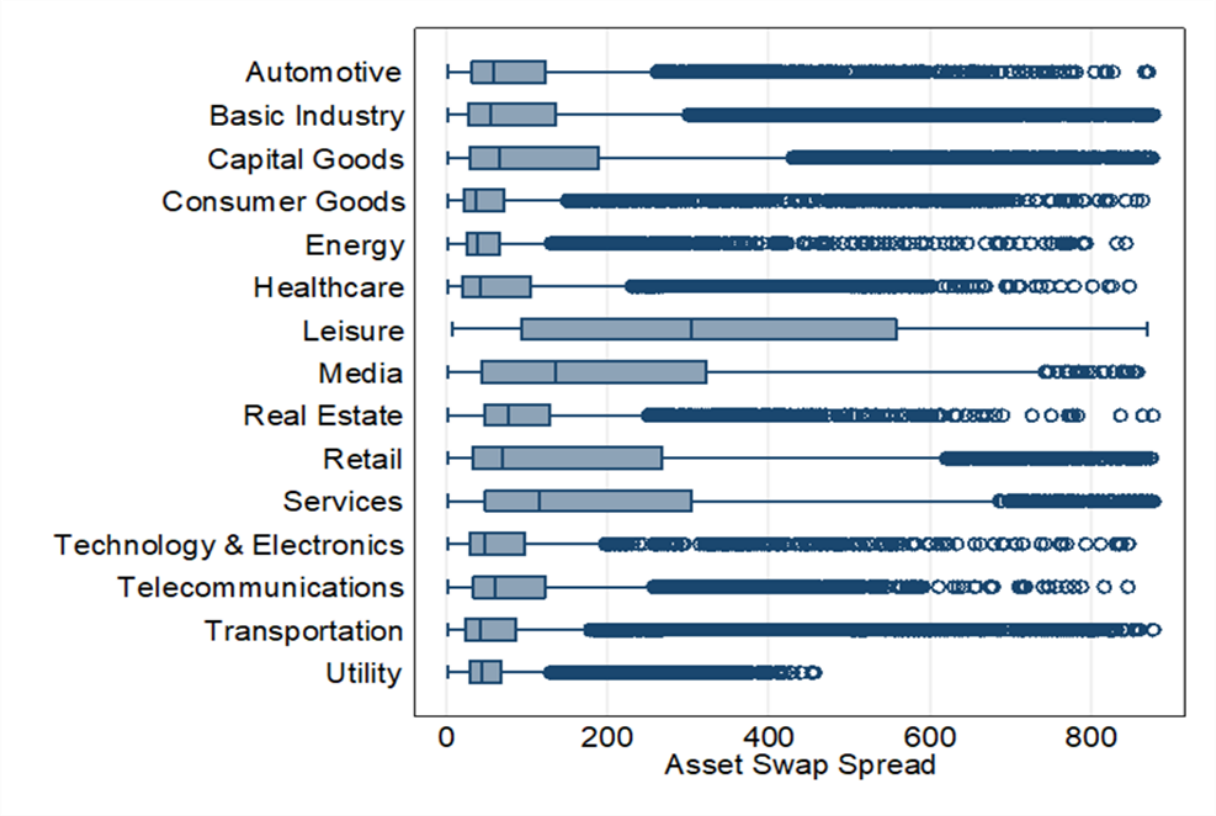


Source: Based on ICE Bank of America Merrill Lynch (BofAML) data.
(1) The whiskers of each box plot indicate the adjacent values as defined by Tukey (1977). The outliers, indicated by the dots, are the observations beside the whiskers. See box plot manual on Stata for further details.

Figure A-2

Credit spread box plots by sector (1)

(basis points)



Source: Based on ICE Bank of America Merrill Lynch (BofAML) data.

(1) The whiskers of each box plot indicate the adjacent values as defined by Tukey (1977). The outliers, indicated by the dots, are the observations beside the whiskers. See box plot manual on Stata for further details.

Table A-1

Descriptive statistics of the ASW spreads (1)

	Bonds	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
			(basis points)	*(basis points)*	*(basis points)*	*(basis points)*
AAA/AA-	149	5.687	29	22	1	171
A+	232	5.292	34	29	1	239
A	365	8.023	42	36	1	400
A-	536	14.390	46	38	1	458
BBB+	896	24.596	58	42	1	430
BBB	712	17.892	73	53	1	693
BBB-	430	8.406	103	76	1	607
BB+	258	5.456	188	110	5	864
BB	181	2.831	213	106	9	794
BB-	172	2.406	282	133	24	855
B+	124	1.441	404	164	44	878
B	204	2.834	440	174	42	878
B-	106	1.436	512	187	43	877
CCC+/D	92	1.127	562	161	75	878
Automotive	344	11.416	99	108	1	872
Basic Industry	352	11.322	118	156	1	878
Capital Goods	200	4.873	150	186	1	876
Consumer Goods	145	5.203	78	125	1	864
Energy	169	6.019	63	82	1	843
Healthcare	130	3.463	102	140	1	848
Leisure	37	912	340	249	8	870
Media	83	2.899	196	174	1	858
Real Estate	276	9.234	102	87	1	877
Retail	140	4.070	182	216	1	875
Services	139	3.182	200	195	1	878
Technology & Electronics	102	2.447	90	118	1	847
Telecommunications	202	7.533	104	111	1	846
Transportation	266	9.562	84	120	1	878
Utility	481	19.680	56	46	1	458

Source: Based on ICE Bank of America Merrill Lynch (BofAML) data.
(1) Sample period: April 2015 – December 2021.

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