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Sustainable Investments and ESG factors

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1. Introduction

In recent years the transition towards a model of sustainable economic development has assumed central importance for the financial system. The inclusion of environmental, social and governance aspects (ESG – Environmental, Social and Governance) is taking an important role in the investment and issuance process, encouraging innovation and the growth of sustainable finance, which sees the application of the concept of sustainable development to financial activities.

The energy crisis and the Russia-Ukraine war are two factors that can contribute to accelerating the energy transition to reduce dependence on Russian gas imports and more generally on fossil fuels. The war resulted in rising energy prices, further pushing European countries to reduce their dependence on Russian oil and gas supplies.

Regulators are increasingly focused on transparency regarding sustainable investments. Financing the transition to a low-carbon economy is crucial today, given the impact that climate change continues to have on economies, businesses and communities globally. To finance decarbonisation across sectors, innovative solutions will be needed, the development of which will require large amounts of capital. In this context, the sustainable bond market has become of considerable importance to find the financial resources necessary to fill a financial gap of 4,100 billion dollars by 2050².

ESG bond issues (Green bonds, Social bonds and Sustainability bonds) have shown an exponential increase in recent years. This growth has drawn impetus from the indications of the European Action Plan (2018) and the EU Green Deal 2019, which "given the insufficiency of public funds" aim to "fill the financing gap through the mobilization of private capital". Sustainable bonds can therefore represent a useful tool to achieve this target. ESG factors play an important role in their investment decisions. Regulatory authorities, rating agencies and the stakeholders' globally are showing a growing interest in ESG issues, leading to new requirements in measurement and management processes and increased reporting needs. This constant flow of new regulations is bringing new compliance challenges to banks.

The aim of this work is to highlight the importance that ESG (Environmental, Social and Governance) factors have on the economic system. Sustainability is an increasingly relevant topic and factors related to the environment, sustainability and governance have become increasingly important to investors, who use corporate social responsibility scores as a guide to avoid high financial risks or questionable business practices.

The integration of ESG criteria in the financial sector is taking on an increasingly important role. In a context where environmental and social concerns are gaining more and increasing attention, investing sustainably has become a key objective for many investors. ESG factors allow for greater knowledge of financial risks: financial and non-financial companies that do not adequately manage their environmental impacts are exposed to greater risks. Companies with a strong ESG profile are less vulnerable to systematic market shocks and therefore have lower systematic risk. The challenge of sustainable development gives ESG factors an increasingly important role in evaluating investment opportunities and risks. The concentration of a part of the portfolio in instruments built in compliance with ESG standards provides a natural protection to the challenge of the green transition of the economy.

In impact investing, investors not only seek to obtain a financial return by optimizing risks, but also set objectives linked to the social and environmental impact that companies aim to achieve. This approach assumes that companies must pursue broader objectives than just generating economic value. According to many economists and observers, an evolution is underway that aims to overcome the idea that shareholders' well-being is limited to profits and growth of market value. It is considered, however, that activities aimed at shareholders' well-being generating profits and those inspired by ethical principles are not inconsistent, but, on the contrary, are destined to become inseparable, especially for investors who adopt a long-term perspective.

Companies, banks, states, other public bodies and supranational bodies that issue green bonds to attract new investors, in addition to possibly reducing the cost of financing, have a positive impact in terms of image.

2. ESG risks - New EBA guidelines

EU countries have committed to achieving the goal of climate neutrality by 2050 by meeting their commitments under the Paris Agreement. The European Green Deal is the EU's strategy to achieve the goal by 2050.

The impacts of physical events and the necessary transition to a low-carbon, resource-efficient and sustainable economy are impacting the financial sector. Climate risks (physical and transition) could negatively impact all the traditional categories of financial risks to which banking institutions are exposed. Furthermore, social factors, such as human rights, health or working conditions, and governance factors such as executive leadership or bribery and corruption can also lead to financial impacts on institutions' counterparties or invested assets and represent sources of financial risk.

The EBA (European Banking Authority) has established an "Action Plan on Sustainable Finance" (December 2019) to determine the sustainability characteristics of banking activities, where it encourages incorporating ESG issues into assessments, using, among other things, GAR (Green Asset Ratio) indicator, which represents the percentage of "green" loans in the bank's balance sheets, as well as the inclusion of ESG risks within the RAF (Risk Appetite Framework). On 18 April, the European Banking Authority (EBA) itself concluded a public consultation on recent directives for the management of risks related to the environment, society and governance (ESG). In reference to the new guidelines (hereinafter GL) issued by the banking authority itself, banks will have to be able to

¹ The thoughts and information expressed herein are solely those of the author and do not in any way bind the institution he belongs to.

² Bank of Italy (2024), Was Covid-19 a wake-up call on climate risks? Evidence from the greenium; Economic and Financial Issues 832, March

adequately identify, measure, manage and monitor ESG risks through robust data processing processes and a combination of methodologies. In particular, financial institutions will need to adopt a robust approach that can mitigate ESG risks, both in the short term and with a time horizon of at least 10 years, and apply a series of risk management tools, including dialogue with counterparties. Furthermore, banks themselves will also need to monitor ESG risks through effective internal reporting frameworks and a set of retrospective and forward-looking ESG risk metrics and indicators. This is necessarily with a view to guaranteeing the security and solidity of institutions in the short, medium and long term.

ESG risk management methodologies and processes will need to be integrated into existing frameworks, consistent with overall business and risk strategies. According to the GLs, the risk management and mitigation tools deemed necessary are:

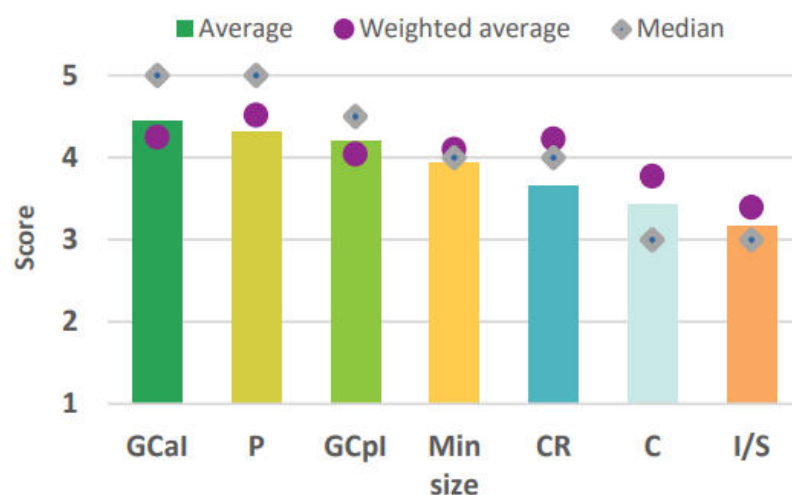
- engagement with counterparties aimed at improving their ESG risk profile by focusing on the most important counterparties;
- adapt the contractual terms and conditions and/or, where appropriate, the pricing based on the exposure of ESG risks and the risk strategy;
- integrate ESG risks into risk limits;
- diversify portfolios based on relevant ESG criteria (sector, geographic area, etc.) and reallocate them towards exposures with a better ESG risk profile.

In addressing ESG risk, banks will need to use a holistic approach, integrating it into the current processes and metrics used to manage individual risk profiles. ESG risk, in fact, does not represent a 'stand-alone' type of risk, but exerts an influence on the financial and non-financial risks present in a bank at various levels. Therefore, risk management methods and processes need to be modified, considering the complex cause-effect relationships between risk types. This involves risk measurement and assessment techniques in run-the-bank and change-the-bank processes, as well as in stress testing applications. In addition to integrating ESG factors into the risk management framework, banks must consider related issues in product design, pricing and business strategies/decisions. From this perspective, in fact, adequate consideration of ESG risks within a wide range of change processes is of vital importance to promote profitability.

3. Use of Sustainable Bonds

ESG bonds are increasingly at the center of investing globally and GSS+ (green, social and sustainability-linked) debt markets are growing rapidly. Sustainability has become an integral part of many areas of daily life. Interest in sustainable investments comes from both institutional investors and retail savers. The risk profile of green bonds is positively influenced by the fact that the issuers are often innovative companies with more developed environmental policies and therefore less exposed to ESG risks. Decisions to invest in sustainable bonds are dictated by many factors (figure 1): on the one hand, the characteristics of actual environmental sustainability and, on the other hand, the financial characteristics, in particular the pricing of the bond (P), the size of the issue and its consequent presumed liquidity, the rating assigned to the bond (CR), the denomination currency (C), the type of issuer and the economic sector to which it belongs (I/S). Based on the survey carried out by the Climate Bonds Initiative (CBI 2019) among European asset managers, the weight of the 'green' and financial aspects tends to be equivalent overall and this is consistent with the investor's search for a balance between sustainability objectives and return and risk objectives. It is significant that larger investors tend to attribute greater importance than others to financial it is meaningful and, conversely, those with smaller assets under management look more at sustainability criteria.

Figure 1- Choice criteria for purchasing green



Abbreviations:

GCal = green credentials at issuance, *P* = pricing, *GCpl* = green credentials post-issuance, *Min size* = minimum size of issue/liquidity, *CR* = credit rating constraints, *C* = currency preferences, *I/S* = issuer/sector constraints

Source: CBI (2019)

There are four main categories of sustainable bonds to support socio-environmental initiatives:

- Green Bond (creation of a single sustainability project);
- Social Bonds (linked to new projects/refinancing existing projects with positive social impact);
- Sustainability Bond (projects that pursue both social and environmental goals);
- Sustainability-Linked Bond (projects linked to the achievement of specific sustainability objectives).

Investors' interest in sustainable bonds in recent years has been very high. One of the reasons for this interest is related to the expectation of better economic results due to lower energy consumption, lower environmental risks and the greater resilience of entrepreneurial activities in the medium-long term: the investor perceives a reduced asset risk. The results of various researches confirm this empirical evidence (one among all Frider, G., T. Busch and A. Bassen, 2015).

Sustainable bonds are subject to the financial risks typical of the conventional bond instrument through an evaluation of its financial characteristics, in particular, the yield in relation to the duration of the instrument and the riskiness of the issuer's riskiness.

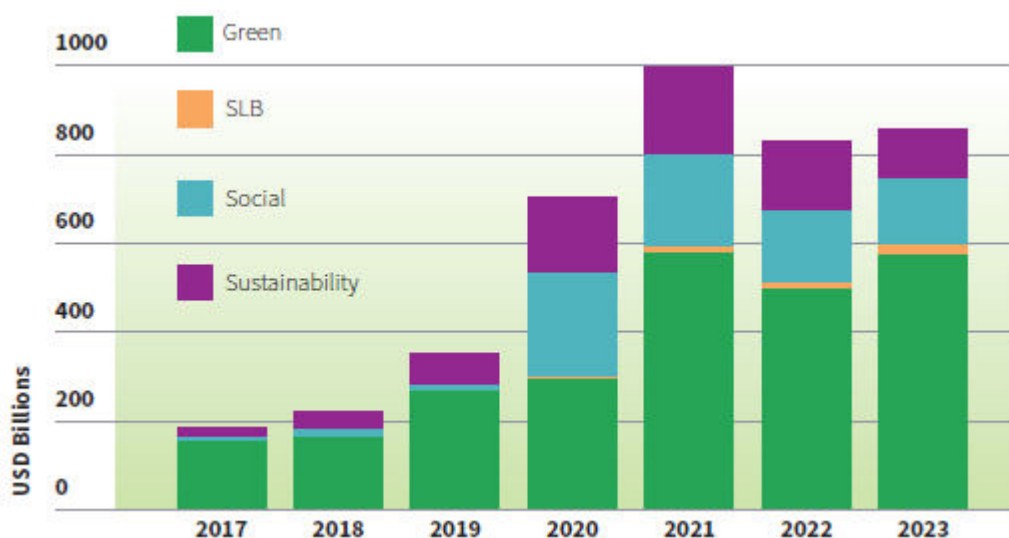
In 2023 (figure 2), Sustainable Bonds reached a volume equal to approximately 871.6 billion dollars, 3% more than the 2022 figure equal to approximately 842.8 billion dollars. Of these, two thirds (67.5%) are represented by green bonds which reached a volume equal to approximately \$587.6 billion reflecting a 15% year-over-year increase. Conversely, there was a decline in annual volumes of Social and Sustainable Bonds of 7% and 30%. The SLB (Sustainability-linked bond) segment recorded a notable 95% increase in volumes reaching \$22.9 billion in 2023 compared to \$11.7 billion in 2022.

In 2023, green bond issuance saw an increase compared to the previous year.

The issuance of sustainable bonds will reach a value of 1,000 billion dollars in 2024, growing slightly compared to 2023³.

ESG bonds are increasingly at the center of investing globally. According to European Commission estimates, around 600 billion emissions will be needed until 2030 to finance the sustainable transition. The largest green issue was launched by the Italian government in 2023 with an operation value of 10 billion euros (Treasury source).

Figure 2- Sustainable bond issues



Source: Climate Bonds⁴

The financial literature identifies three reasons underlying the motivations of companies to use this form of financing:

- The Signaling effect:** it gives the issuer a better reputation and, consequently, greater appreciation by the market. Companies that pay more attention to sustainability issues are considered by the market to be less risky and more profitable as they are more attentive to the efficiency of production processes and more open to innovation.
- Green washing:** the possibility, in the absence of specific regulation, to deceive the market by obtaining a reputational benefit but without a concrete environmental objective. The existence of a signaling effect, referred to in point i) above, explains why some companies may be tempted to pass themselves off as "green" when they are not. In the absence of specific regulation, the attribution of the adjective "green" to the bond is essentially linked to the issuer's declaration regarding the use of the proceeds of the bond. A check-of the actual commitment in terms of sustainability can be carried out through the analysis of the environmental rating attributed to companies that issue green bonds. Studies have verified that there is an increase in this rating post-issuance of a green bond also associated with a significant reduction in CO2 but only for issuers who have obtained certification from an independent third party.
- Cost of capital:** the opportunity to raise funds at a lower cost, given the market's willingness to purchase these securities at a premium to comparable non-green bonds. The more sustainable companies have lower cash flow volatility and greater protection from systematic risks, thus justifying the existence of a discount on the yield of the debt issued. In a Capital Asset Pricing Model

³ Sustainable Bond Issuance To Approach \$1 Trillion In 2024, S&P Global Ratings.

⁴ CBI (2023), Global State of the Market Report, Sustainable Debt Global State of the Market

(CAPM) model (Ruefli et al., 1999), a company's beta has two important functions. First, beta measures companies' exposure to systematic risk (i.e., a lower beta means less systematic risk) and, second, it translates the equity risk premium into the required rate of return for the individual company. Therefore, lower systematic risk means that a company's equity has a lower beta value, and therefore investors demand a lower rate of return. This translates into a lower cost of capital for that company. Finally, a lower cost of capital leads directly to the last stage of the transmission mechanism: in a DCF model, a company with a lower cost of capital also enjoys a higher valuation.

The other reasons towards green bonds are to be found in the new needs of financial intermediaries who have strategies linked to the decarbonisation and sustainability of their own investments and those of their customers; on the other hand in the new indications of the regulators who have dictated stringent rules to be respected. Last but not least, the Bank of Italy, which has precisely indicated what are the risks that are linked to global warming, in particular for credit activities ("Supervision expectations on climate and environmental risks").

In February 2023, the European Union reached a provisional agreement on the creation setting up of a European standard, called the European Green Bond Standard (EGBS). According to this agreement, all proceeds from the EuGB will have to be invested in economic activities aligned with the EU taxonomy. For sectors not yet covered by the EU taxonomy and for some very specific activities, there will be a flexibility of 15%, in order to ensure the usability of the European green bond standard from the beginning of its existence. Subsequently, to support the growth of green bonds and promote the transition, the European Union (2023) adopted a regulation that will come into force on 21 December 2024 (EU Regulation 2023/2631) known as the European Green Bond Standard (EuGb). Green bonds are useful tools for financing investments in green technologies, energy and resource efficiency, as well as green transport infrastructure and research-focused infrastructure. Issuers will be able to demonstrate that they finance green projects in line with the EU taxonomy. Investor confidence in green investments will be strengthened thanks to a framework that reduces the risks posed by greenwashing, ultimately stimulating capital flows into environmentally sustainable projects. To avoid greenwashing in the green bond market, the regulation also includes some voluntary disclosure requirements for other green bonds and sustainability-related bonds issued in the EU. The proceeds from European green bonds must be used to finance economic activities that have a lasting positive impact on the environment (those identified as sustainable by the taxonomy regulation 2020/852/EU). Until the taxonomy is fully operational, issuers of an EU certified green bond must ensure that at least 85% of the funds raised by the bond are allocated to "sustainable" economic activities. The remaining 15% can be allocated to other economic activities, provided that the consumer information rules are respected.

In the near future, the supply of green bonds will likely be supported by investor demand. The European green bond standard (Eugbs) will be able to contribute to the growth of this demand, provided that large public and non-public actors (national governments, banks) follow the standards introduced by the regulation, giving credibility to the entire system.

4. Greenium and the factors that influence it

Green bonds are the dominant type of issue in the sustainable bond market. They are characterized by a greenium, i.e. a premium price compared to comparable brown ones, consistent with the theory of investor preference and the incorporation of the protection offered by environmental risk factors into the bond price. For corporate bonds, the market recognizes the discount only in the presence of a certification issued by a third-party and independent body regarding the greenness of the issue.

The presence of greenium can be verified by taking both the primary and secondary markets as a reference (tab. 1). In the first case, greenium consists of a lower coupon or a higher issue price compared to conventional securities with similar characteristics, which leads to a lower return for investors in sustainable instruments and a lower cost of money for investors. green broadcasters. In the secondary market, the presence of greenium takes the form of lower spreads (calculated with reference to a risk-free rate curve) compared to conventional bonds of the same duration, rating and issuer. The lower financial return could in fact be justified by the search for non-financial objectives linked to environmental sustainability aspects.

Table. 1- Results of empirical studies on greenium

| authors | Period under observation | Market segment | Objectives of the study | Main results |
|------------------------------|--------------------------|------------------|--|--|
| Baker et al (2018) | 2010-2016 | Primary market | Existence of greenium on US local government green bond issuances versus brown counterparts | US local government green bonds are issued at a negative premium of approximately 7 basis points over similar conventional bonds. |
| Hachenberg, Schiereck (2018) | October 2015- March 2016 | Secondary market | Existence of price differentials (daily i-spread) between a sample of green bonds and a comparable sample of brown bonds | On average, the differences in yield between green and brown bonds are limited (- 1 bp); they are more evident for the A rating class while AAA ones discount positive premiums compared to non-green bonds. |
| Karpf, Mandel (2018) | 2010-2016 | Secondary market | Comparison of yield curves of bonds issued by US local governments, both brown and green | The yield curves of green bonds are located below the respective brown bond curves, with yield differences increasing as time increases. However, after taking into account the credit quality of the issuer and the technical characteristics of the two bond classes, green bonds show a positive premium of around 7bps |

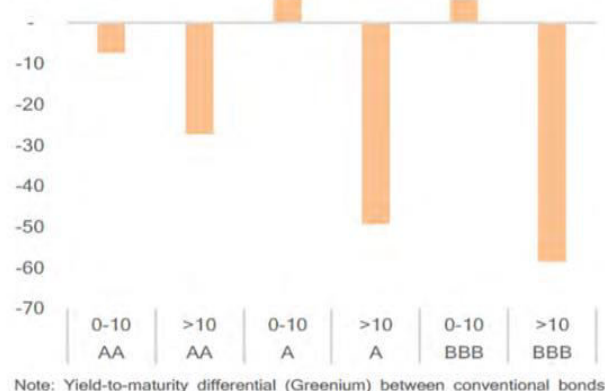
| | | | | |
|-----------------------|------------|----------------|--|---|
| CBI (2019) | 2019 | Primary market | Identify the existence of an issue spread with respect to the yield curve of outstanding securities (both brown and green) as it happens for brown securities | 2/3 of green issues are placed on the yield curve of the securities in circulation; the green bonds that benefit from a discount at issuance are referable to supranational issuer |
| Fatica e al. (2019) | 2007-2018 | Primary market | Determinants of the yield at issuance | Only supranational issuers (with 80 bps) and corporates (20 bps) benefit from the greenium; not so the issues of financial companies. Being a "serial" issuer of GB leads to greater savings |
| Larcker, Watts (2019) | 2013-2018 | Primary market | Comparison of 640 Green and non-Green issues with the same issue date, maturity, rating and issuer (US local authority) | Trivial difference in the required yield (0.45 bps). In 85% of cases the difference is zero. There is no greenium and this does not depend on green washing problems |
| Zerbib (2019) | 2013-2018 | Primary market | Comparison between over 1000 green issues and a sample of "synthetic" bonds with the same characteristics net of the "green" label and a different degree of liquidity, which is specifically controlled | Greenium present but limited, about -2 bps for the entire sample. The negative difference is more pronounced for financial institutions issues and for bonds of lower credit quality |
| Gatti, Florio (2020) | 2007- 2015 | Primary market | Determinants of the Issue Spread, distinguishing between bonds with second party review and bonds applying GBP | Issue spreads have increased following the introduction of GBP, but at the same time the number of bonds issued with medium/low ratings has increased (which could explain the unexpected increase); having a second party review allows for savings in terms of issue spreads. |

Source: Monetary Observatory (2020)

An investment in sustainable activities and projects by companies would have positive effects in terms of fewer environmental and social risks, including legal and reputational ones.

In a recent study carried out by ESMA, the actual yields of green bonds with traditional ones were compared both by rating class and by maturity (figure 3). The graph below shows that the existence of a discount on the effective yield exists and is positively correlated with the maturity of the bond, with particular reference to the long term and negatively correlated with the issuer's rating.

Figure 3 – Green vs conventional bond yields - Greenium concentrated in longer maturities



Source: Esma

Note: Yield to Maturity differential (Greenium) between conventional bonds from green bond issuers and green bond, by residual maturity (in years) and creting rating in bps. Data as at November 2021

Bank of Italy has carried out an empirical analysis on the existence of the so-called greenium. Furthermore, the hypothesis was tested that Covid-19 has increased attention (wake-up call) towards the risks linked to extreme shocks, such as those potentially induced by climate change. The results show the presence of a greenium on a sample of international bonds for the period 2017-2022, also attributable to the strong demand for green bonds from investors. The pandemic shock acted as a wake-up call for climate risks only

temporarily, resulting in an expansion of greenium that disappeared after the emergency. In this context, in order to be able to analyze the supply and demand of green bonds during the covid and post-covid period, the Bank of Italy used a methodology based on a disequilibrium model (Fair and Jae (1972) and Maddala and Nelson (1974)) to estimate supply and demand for green bonds. Unlike an equilibrium model where the compensation rule is implemented, in the disequilibrium model the price of securities is an exogenous variable and possible misalignments between supply and demand could lead to an aggregate excess of demand or supply. By applying an imbalance model in the analysis carried out, an excess of demand may be seen on the secondary market for green bonds.

Below are the equations used to estimate QS demand and QD supply:

$$1) Q^s_{i,h,s,t} = f^s(X^s_{i,h,t}, X^{s,D}_{i,h,s,t}) + \varepsilon^s_{i,h,s,t}$$

$$2) Q^D_{i,h,s,t} = f^D(X^D_{i,h,t}, X^{s,D}_{i,h,s,t}) + \varepsilon^D_{i,h,s,t}$$

Equation 1 and 2 indicate how supply and demand both depend on specific variables. In particular, $X^s_{i,h,t}$ are supply-specific factors just as $X^D_{i,h,t}$ are demand-specific factors.

The equation below indicates the observed quantity of the green bond as the lesser of the quantity demanded and the quantity supplied.

$$3) Q_{i,h,s,t} = \min(Q^s_{i,h,s,t}, Q^D_{i,h,s,t})$$

With reference to the supply and demand shocks reported above, $\varepsilon^s_{i,h,s,t}, \varepsilon^D_{i,h,s,t}$ (equation 1.2) it is assumed that the latter are not correlated.

Table 2 reports the descriptive statistics of the observed sample (2017-22 period) of green bond

Table 2- Descriptive statistics of Green Bonds

| Year | Variable | N | Mean | SD | Median | Min | Max |
|------|-------------------|--------|-------|------|--------|--------|-------|
| 2017 | (log) Quantity | 5,417 | 1.01 | 2.19 | 1.09 | -7.,10 | 9.26 |
| | (log) Price | 5,417 | 0.32 | 1.14 | 0.21 | -2.06 | 6.50 |
| | (log) Amount | 5,417 | 6.54 | 0.97 | 6.22 | -0.18 | 10.17 |
| | Residual maturity | 5,417 | 7.73 | 2.82 | 7.22 | 3.76 | 19.88 |
| | Rating | 5,417 | 16.65 | 3.16 | 16.00 | 7.50 | 21.00 |
| 2018 | (log) Quantity | 8,856 | 0.92 | 2.15 | 1.00 | -8.27 | 6.81 |
| | (log) Price | 8,856 | -0.07 | 1.10 | -0.21 | -2.25 | 5.22 |
| | (log) Amount | 8,856 | 6.35 | 1.00 | 6.21 | -13.95 | 8.23 |
| | Residual maturity | 8,856 | 6.88 | 2.99 | 6.36 | 0.12 | 19.60 |
| | Rating | 8,856 | 16.34 | 3.32 | 15.67 | 6.50 | 21.00 |
| 2019 | (log) Quantity | 13,170 | 0.94 | 2.13 | 1.03 | -8.65 | 8.94 |
| | (log) Price | 13,170 | 0.55 | 1.19 | 0.60 | -2.21 | 5.32 |
| | (log) Amount | 13,170 | 6.42 | 0.67 | 6.35 | -0.12 | 9.94 |
| | Residual maturity | 13,170 | 6.97 | 3.46 | 6.39 | 0.95 | 19.90 |
| | Rating | 13,170 | 15.66 | 3.26 | 15.00 | 6.50 | 21.00 |
| 2020 | (log) Quantity | 14,367 | 0.78 | 2.16 | 0.80 | -10.33 | 9.11 |
| | (log) Price | 14,367 | 0.95 | 1.49 | 0.84 | -2.30 | 6.50 |
| | (log) Amount | 14,367 | 6.34 | 0.74 | 6.35 | -0.20 | 10.22 |
| | Residual maturity | 14,367 | 7.03 | 3.78 | 6.50 | 0.79 | 19.93 |
| | Rating | 14,367 | 14.91 | 3.32 | 14.33 | 5.00 | 21.00 |
| 2021 | (log) Quantity | 29,936 | 0.88 | 2.15 | 0.95 | -13.62 | 9.03 |
| | (log) Price | 29,936 | 0.42 | 1.24 | 0.35 | -2.26 | 5.55 |
| | (log) Amount | 29,936 | 6.42 | 0.73 | 6.27 | -1.73 | 10.34 |
| | Residual maturity | 29,936 | 6.64 | 3.61 | 6.07 | 0.03 | 19.95 |
| | Rating | 29,936 | 15.11 | 3.35 | 14.33 | 6.00 | 21.00 |
| 2022 | (log) Quantity | 36,133 | 0.66 | 2.21 | 0.71 | -14.49 | 9.11 |
| | (log) Price | 36,133 | -1.38 | 0.30 | -1.34 | -2.30 | 1.25 |
| | (log) Amount | 36,133 | 6.59 | 0.87 | 6.40 | -0.06 | 10.42 |
| | Residual maturity | 36,133 | 5.52 | 3.78 | 4.77 | 0.03 | 19.98 |
| | Rating | 36,133 | 15.11 | 3.35 | 15 | 6.21 | 14.32 |

Source: Bank of Italy (2024)

Table 3 shows the estimates obtained using the disequilibrium model. We consider the logarithmic values for both the quantities (AMOUNT) and the prices (PRICE) of green securities. Without considering the pandemic effect generated by Covid-19, on the supply side (Column 3) we can observe a positive and statistically significant coefficient associated with both the price (PRICE) and the amount issued (AMOUNT); similarly, the residual life and ratings of the securities also have a positive and significant impact on the supply side of green securities. On the demand side, a positive and statistically significant coefficient can be seen on both the total amount issued and the rating. Furthermore, non-linear effects on the residual life of the securities can be seen while the coefficient associated with the price appears to be statistically insignificant. With the outbreak of the pandemic, the results for the demand equation (Column 2) provide evidence of the usual relationship between prices and quantities: the coefficient associated with PRICE is always negative and statistically significant on both the demand and supply side). Furthermore, the coefficient associated with the

interaction between COVID and PRICE is significant and positive for both sides of the market (table 3, columns 2 and 4). This may depend on whether investor preferences for sustainable assets can be adequately incorporated into prices. After the Covid-19 shock, investors are willing to buy green stocks at the price set before the pandemic or to maintain the same orders in case of a price increase. Overall, the minimum quantity (equation 3) is always driven by demand over the entire sample period (figure 4).

Table 3 - Results Demand and supply

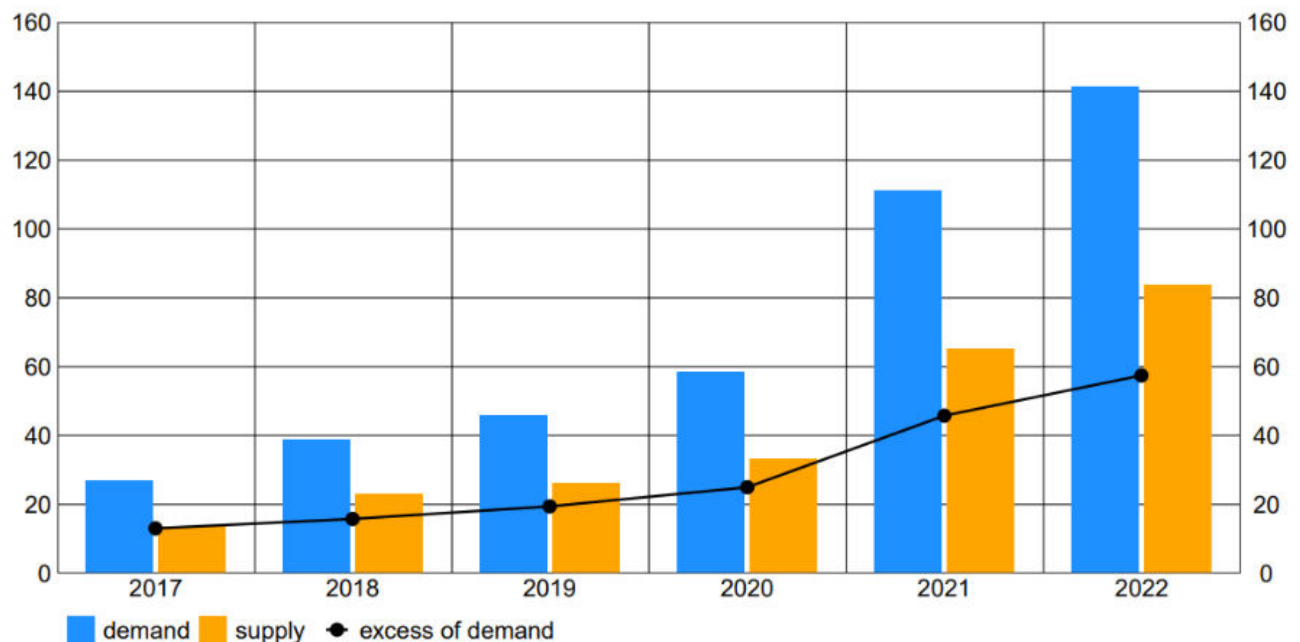
| QUANTITY | DEMAND EQUATION COVID | | SUPPLY EQUATION COVID | |
|--------------------------------|--------------------------|------------------------|--------------------------|-----------------------|
| | NO | YES | NO | YES |
| PRICE | -0.0042 (0.0046) | -0.0326*** (0.0078) | 0.0330*** (0.0058) | -0.0125 (0.0096) |
| COVID | | 0.4225 (0.7703) | | -0.0186 (0.4913) |
| COVID x PRICE | | 0.0392*** (0.0086) | | 0.0630*** (0.0106) |
| AMOUNT | 0.2105*** (0.0038) | 0.2102*** (0.0038) | 0.0974*** (0.0048) | 0.0970*** (0.0048) |
| MATURITY | -0.0097 (0.0074) | -0.0062 (0.0075) | 0.0317*** (0.092) | 0.0374*** (0.093) |
| MATURITY ² | -0.0023** (0.0009) | -0.0027*** (0.0009) | -0.0015 (0.0011) | -0.0022* (0.0011) |
| MATURITY ³ | 0.0001*** (0.0000) | 0.0002*** (0.0000) | 0.0001 (0.0000) | 0.0001** (0.0000) |
| RATING ² | 0.0010*** (0.0001) | 0.0010*** (0.0001) | 0.0023*** (0.0001) | 0.0021*** (0.0001) |
| Issuer Country x Time FE | Yes | Yes | Yes | Yes |
| Issuer Sector x Time FE | Yes | Yes | Yes | Yes |
| Currency x Time FE | Yes | Yes | Yes | Yes |
| Holder Country x Time FE | Yes | Yes | No | No |
| Holder Sector x Time FE | Yes | Yes | No | No |
| Lagged share by Holder Country | No | No | Yes | Yes |
| Lagged share by Holder Sector | No | No | Yes | Yes |
| N | 300,552 | 300,552 | 300,552 | 300,552 |
| R ² | 0.403 | 0.403 | 0.403 | 0.403 |

Standard errors in parentheses
* $p < .10$, ** $p < .05$, *** $p < .01$

Source: Bank of Italy (2024)

Excess demand increased slightly after Covid (figure 4) and increased further during 2021, while a deceleration was observed at the end of 2022.

Figure 4 - Predicting excess demand (euro billions)



Source: Bank of Italy (2024)

Green bonds are on average more liquid than traditional bonds. In order to be able to estimate the yield of green securities that takes into account both the different ratings and the stock market listing, a linear fixed effects model was used to estimate the Yield to maturity ($Y_{s,t}$) in which the dependent variable is represented by the same yield to maturity measured at the end of month t .

The explanatory variables used in the regression are: the residual duration of the security (MATURITY), the LISTED variable equal to one if the security is listed on the stock exchange, the RATING, the amount (AMOUNT), the GREEN variable and the pandemic variable out of three levels: equal to zero before March 2020, equal to one between March 2020 and March 2022 (COVID) and equal to two for the period after the first quarter of 2022 (POST COVID).

The fixed effects regression model used is shown below:

$$Y_{s,t} = Y_e \text{GREEN}_{s,t} + Y_c \text{COVID}_t + Y_p \text{POSTCOVID}_t + \theta^T X_{s,t} + \eta_{i,t} + \eta_{e,t} + \eta_{u,t} + \varepsilon_{s,t}$$

The analysis is carried out on three sectors: financial, non-financial and public. From the results obtained, a lower return can be seen, equal to 3-14 basis points depending on the sector to which it belongs (table below).

A higher rating results in a lower return as it incorporates a lower risk premium, furthermore the higher the amount issued, the lower the return; this depends on higher volumes and a greater number of investors.

The coefficients of the indicator variable Green are all statistically meaningful in the three sectors of the basic model. The greenium, estimated at 5 basis points for non-financial companies, is even higher (14 basis points) for financial companies, while it is lower for the public sector (3 basis points). Next, it was observed whether the Covid-19 shock had an effect on the return.

From Tab. 4, it can be seen that the pandemic (GREEN x COVID). led to a further negative premium on green bonds issued by non-financial and financial operators (5 basis points) while there is no evidence of a further negative premium on those issued by the government sector.

However, after the end of the state of emergency, a reduction in negative greenium of 6 and 7 basis points is found, compared to the pre-pandemic period. Greenium's post-pandemic rebound indicates that investors temporarily factored in climate risks, resulting in a greenium expansion that lapsed post-emergency.

Table 4- Regression results

| | Corporations | | | Government | Corporations | | |
|-------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------|
| | Non-financial | Financial | | | Non-financial | Financial | Government |
| | (1) | (2) | (3) | (4) | (5) | (6) | |
| GREEN | -0.0475*** (0.0064) | -0.1391*** (0.0071) | -0.0298** (0.0133) | -0.0387*** (0.0137) | -0.1354*** (0.0149) | -0.0251 (0.0247) | |
| GREEN x COVID | | | | -0.0504*** (0.0163) | -0.0540*** (0.0182) | -0.0092 (0.0319) | |
| GREEN x POST COVID | | | | 0.0641*** (0.0184) | 0.0699*** (0.0197) | -0.0028 (0.0350) | |
| LISTED | -0.0349*** (0.0030) | -0.0538*** (0.0040) | 0.0074 (0.0061) | -0.0349*** (0.0030) | -0.0539*** (0.0040) | 0.0074 (0.0061) | |
| RATING | -0.3294*** (0.0026) | -0.2191*** (0.0008) | -0.2467*** (0.0022) | -0.3293*** (0.0026) | -0.2191*** (0.0008) | -0.2467*** (0.0022) | |
| AMOUNT | -0.0251*** (0.0006) | -0.0844*** (0.0011) | -0.0100*** (0.0005) | -0.0250*** (0.0006) | -0.0844*** (0.0011) | -0.0100*** (0.0005) | |
| MATURITY | 0.2841*** (0.0019) | 0.2881*** (0.0025) | 0.1909*** (0.0041) | 0.2840*** (0.0019) | 0.2880*** (0.0025) | 0.1909*** (0.0041) | |
| MATURITY ² | -0.0128*** (0.0002) | -0.0140*** (0.0003) | -0.0048*** (0.0005) | -0.0128*** (0.0002) | -0.0140*** (0.0003) | -0.0048*** (0.0005) | |
| MATURITY ³ | 0.0002*** (0.0000) | 0.0003*** (0.0000) | -0.0000 (0.0000) | 0.0002*** (0.0000) | 0.0003*** (0.0000) | -0.0000 (0.0000) | |
| Issuer x Time FE | Yes | Yes | No | Yes | Yes | No | |
| Country x Time FE | Yes | Yes | Yes | Yes | Yes | Yes | |
| Currency x Time FE | Yes | Yes | Yes | Yes | Yes | Yes | |
| N | 430,146 | 456,655 | 133,024 | 430,146 | 456,655 | 133,024 | |
| Adjusted R ² | 0.939 | 0.862 | 0.908 | 0.939 | 0.862 | 0.908 | |

Source: Bank of Italy (2024)

Conclusions

Over the years, ESG factors are playing a important role in the investment decision-making process. Sustainable finance is defined as the incorporation of ESG (environmental, social and governance) factors into investment and financing decisions with the aim of obtaining long-term returns and contributing to sustainable development.

This approach goes beyond simple economic profit because it seeks to generate a positive impact on society and the environment. Governments and supranational institutions play a key role in the growth and development of this new type of finance, they must try to encourage this type of investment to deal with all the environmental and social problems that are arising in recent years.

Important regulatory work will be necessary, new laws will be needed (clear, simple, but at the same time complete), to give the investor all the information he needs and also support throughout the entire life of the operation. In this context, in the world of sustainable finance, green bonds with a similar functioning to traditional bonds play a fundamental role due to the fact that the amount raised will be-exclusively used to finance environmental projects.

Investors are willing to give up a small part of the return compared to traditional securities because they are rewarded by the positive environmental impact. Issuers, on the other hand, can take advantage of a slightly lower cost of debt provided they finance projects with specific purposes.

A further acceleration of this phenomenon is foreseeable in the immediate future, since many banks, also encouraged by the Prudential Supervision discipline, are planning to issue green finance products in which green bonds will be a very important lever.

The global bond market will be an important source of investment to drive the climate transition. The new European Standard (EuGB) to regulate green bonds and combat greenwashing will make investors' choices more transparent and safer and will favor those companies that are able to show the effectiveness of ongoing projects with the support of methodologies and data.

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