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The impact of ESG news on the volatility of the Portuguese stock market—Does it change during recessions?

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Abstract

This paper assesses how environmental, social, and governance (ESG) news influence Portuguese stock market volatility depending on the business cycle. Given the lack of an adequate index to capture the effects of ESG media on the Portuguese stock market, a News Sentiment Index is developed. This index, which captures positive and negative ESG news on companies listed in the Portuguese Stock Index (PSI-20), is then used as an external regressor in symmetric and asymmetric GARCH-type models employed to model the stock market volatility. Results show that during non-crisis periods ESG news reduce returns' volatility, and that when considering the period preceding the financial crisis the disclosure content (positive or negative) of the news matter. However, during economic downturns, neither the amount nor the content disclosure of ESG news affect volatility; thus, ESG preoccupations might no longer be paramount.

KEYWORDS
business cycle, ESG, GARCH, PSI-20, stock returns volatility

1 | INTRODUCTION

Society is demanding more corporate social responsibility (CSR) initiatives and environmental, social, and governance (ESG) accountability beyond what are the mandated requirements. Indeed, ESG investment plays an increasingly key role. Fund flows and assets under management in socially responsible intermediaries have reached unprecedented levels in recent years and even more so during the COVID-19 pandemic. The demand for sustainable and impact investing is growing. For instance, in the United States alone, in 2016, over US$8.72 trillion of professionally managed assets took into consideration ESG factors, that is, considered ESG factors alongside financial factors in the investment decision-making process, a 33% increase since 2014. Overall, the total assets managed by mutual funds specializing in sustainable investing doubled from 2019 to 2020 (Lioui & Tarelli, 2022; Luo, 2022; Naumer & Yurtoglu, 2022).

Corporate reputation is one of the most valuable intangible resources that can provide companies with a sustainable competitive advantage. The resource-based theory (RBT) suggests that changes in a firm's endowment of resources, especially intangible resources, can create sustainable competitive advantages, which lead to better performance since such resources are difficult to accumulate, replicate,

Abbreviations: AIC, Akaike Information Criterion; APGARCH, Asymmetric Power Generalized AutoRegressive Conditional Heteroskedasticity; ARCH, AutoRegressive Conditional Heteroskedasticity; BIC, Bayesian Information Criterion; CSR, Corporate Social Responsibility; CV, Coefficient of Variation; EGARCH, Exponential Generalized AutoRegressive Conditional Heteroskedasticity; ESG, Environmental, Social, and Governance; GARCH, Generalized AutoRegressive Conditional Heteroskedasticity; GJR-GARCH, Glosten-Jagannathan-Runkle Generalized AutoRegressive Conditional Heteroskedasticity; NRBV, Natural Resource-based View; NSI, News Sentiment Index; PSI-20, Portuguese Stock Index; RBT, Resource-based Theory; S&P500, Standard & Poor's 500; TGARCH, Threshold Generalized AutoRegressive Conditional Heteroskedasticity.

develop, or imitate perfectly by competitors (Wong & Zhang, 2022). Thus, the intangible benefits offered by CSR reputation can be perceived as a resource to facilitate stakeholder commitment and are likely to improve the company's ability to outperform its rivals, either by reducing costs or by increasing revenues. In addition, this pledge toward CSR and ESG serves as signaling to stakeholders with imperfect information, ultimately enhancing performance by attracting, recruiting, motivating, and retaining core stakeholders, such as investors, financers, employees, customers, and suppliers (Sabbaghi, 2022; Wong & Zhang, 2022).

Thus, there is increasing pressure for companies to engage in positive CSR and ESG activities in order to maintain a good corporate reputation. Numerous studies examine CSR and corporate financial performance, mostly focused on the positive aspects of CSR and ESG ratings on stock returns and firm valuations. Yet, as noted by Wong and Zhang (2022), the extent to which media coverage regarding ESG issues can impact stock market performance is largely unexplored.

The role that media has in financial markets is well documented (Naumer & Yurtoglu, 2022; Tetlock, 2015). Investors use public news announcements as a mechanism to disseminate information and evaluate the future cash flows of financial assets and their riskiness. In addition, traditional financial information lacks timeliness, has limited ability to deliver firm risks, and may exclude intangible resources (Lourenço et al., 2014). Consequently, investors and financial analysts are increasingly aware of the importance of intangibles, such as CSR information, which are not directly reflected in financial statements but can be covered by the media (Wong & Zhang, 2022). Noticeably, several studies have shown that even stale news, when widely publicized, can increase short-term returns and influence the stock prices of firms in the Standard & Poor's 500 (S&P 500) (Huberman & Regev, 2001; Tetlock, 2010).

This paper assesses how ESG news influence Portuguese stock market volatility. A News Sentiment Index (NSI) is built, capturing positive, negative, and neutral ESG news on companies listed in the Portuguese Stock Index (PSI-20). The NSI is then used as an external regressor to model stock market volatility, distinguishing between crisis and non-crisis periods.

Our contributions are threefold. Firstly, to the best of our knowledge, this article is the first to evaluate how media regarding ESG can affect stock returns volatility depending on the business cycle. The analysis covers the years between 2005 and 2022 and distinguishes periods of recession from periods of economic growth, thus paying special attention to the financial crisis period and the Covid-19 period. Secondly, we add to the literature by examining the role of news media sentiment in a European and less developed market—the Portuguese stock market. As noted by Shen et al. (2022), previous research on investor sentiment and, especially, on news media sentiment focus mainly on the United States and, more recently, on China. Finally, given the lack of an adequate index to capture the effects of ESG media on the Portuguese stock market, we develop a NSI that classifies the media reports into three sentiment groups, capturing positive, negative, and neutral ESG news on companies listed in the PSI-20.

We find that ESG news impact stock market volatility in non-crisis periods, reducing it, but fail to have an impact during crisis periods. When the impact exists, it may be asymmetric, with positive news reducing volatility and negative ones increasing it.

Despite the overall benefits of implementing and communicating sustainability strategies in terms of financial performance, competitive advantage, and business reputation, the impact of good and bad CSR and ESG news on the volatility of firms' market value is still widely neglected in the literature. Yet, addressing firms' sustainable development issues and commitment to positive impact from a more theoretical point of view provides important information for firms looking for maximizing long-term value to serve the interest of all stakeholders, under all economic conditions. Accordingly, our results provide several important implications for corporate executives, portfolio managers, and stakeholders, such as investors, on the importance of ESG reputation management. If unfavorable media reporting impacts firms' market valuation, it may provide an opportunity for stakeholders to guide companies away from unwanted ESG behaviors and avoid costly negative attention. From a regulatory perspective, as suggested by Wong and Zhang (2022), aiming at a positive ESG reputation may arguably be a more effective incentive to motivate firm behavior, when compared to voluntary CSR disclosures.

The rest of the paper is organized as follows. Section 2 presents a literature review of the effects of investor sentiment on financial markets, the role of tone and asymmetric sentiment effects, as well as the benefits of engaging in a proactive sustainability strategy. Section 3 presents the NSI developed and describes the data and methods for the empirical study. Section 4 shows the results obtained, and Section 5 provides the discussion of the results and conclusions.

2 | THEORETICAL BACKGROUND

The information environment of the market has a profound impact on asset prices. The stock market is never completely efficient since investors are subject to certain biases, and prices cannot fully reflect all the information in time. As a result, the media arises as a significant channel of dissemination of financial market information, playing an important role in market efficiency (Du et al., 2022; Shen et al., 2022; Tetlock, 2007, 2010; Zhang & Zhang, 2021).

Indeed, media articles help reduce information asymmetry, which could significantly enhance the informativeness of the company's stock price and improve market pricing efficiency and stock liquidity. However, financial markets are also impacted by investor sentiment and attention regarding the firms participating in those markets. Investors' attitudes change whether facing good news or bad news and so different media articles' sentiments and narratives may also originate different reactions from investors, overall affecting stock returns and volatilities. In addition, developing and implementing proactive sustainability strategies can create competitive advantages, which also contribute to market performance and pricing efficiency.

This section provides insights on the several aspects that connect financial markets with CSR and ESG media as an outlet to signal

sustainability intentions and commitment. Namely, the effects of investor sentiment on market returns and volatility are assessed, as well as how the delivery method and disclosure content influence this sentiment. In addition, the benefits of engaging in a proactive sustainability strategy are explored from the point of view of the RBT, showing that a good reputation can also improve market performance. Finally, the impact that both CSR and ESG can have on several types of risk, as well as its value during economic downturns, is also explored.

The literature on the effects of investor sentiment and attention on financial markets is extensive. For instance, Baker and Wurgler (2006) argue that investor sentiment has larger effects on securities whose valuations are highly subjective and difficult to arbitrage. Andrei and Hasler (2015) provide evidence that stock return variance and risk premia increase with both news and uncertainty, that is, news and uncertainty are key determinants of asset prices. Huang et al. (2015) develop an investor sentiment index to predict the aggregate stock market, concluding that the predictive power of the index arises from investors' biased opinions about future cash flows. Jiao et al. (2020) find that social media and traditional news media coverage have opposite effects on subsequent volatility and turnover, with coverage by traditional media outlets predicting decreases in volatility and turnover and coverage by social media predicting increases in volatility and turnover. Du et al. (2022) provide evidence that stocks with high media coverage have lower returns than those without media coverage.

Besides the delivery method, the disclosure content is also important. Shen et al. (2022) show that more news reports with positive tones predict higher future market returns and a less volatile market condition. In addition, the authors also provide evidence that there are asymmetric sentiment effects on the stock market, with a tendency to overreact to negative news. This is in line with Tetlock (2007), which shows that negative media sentiment exerts downward pressure on the stock market index. Kothari et al. (2009) show that favorable disclosures reduce various firm risk measures, such as cost of capital, and that disclosures from business press sources are perceived with more credibility by investors. In addition, the authors also claim that the stock market punishes negative news more, tending to discount positive news. Finally, Heston and Sinha (2017) show that the stock prices of firms with positive sentiment will rise within a week, while negative sentiment will lead to a decline in stock prices in the next quarter. Overall, the conclusion is clear: Sentiment has important effects on firms and on the aggregate stock market. This is especially true when considering stocks that are difficult to arbitrage or value (Baker & Wurgler, 2007).

Engaging in a proactive sustainability strategy that goes beyond regulatory requirements is another driver of performance. When firms apply policies and practices that meet the stakeholders' needs in addressing current societal challenges and integrate sustainable value propositions into their strategy, their competitiveness increases. Indeed, firms' competitiveness reflects their capacity to create and sustain competitive advantages, which in turn can be used to increase growth and performance (Marín et al., 2012; Yang et al., 2019). As suggested by Adomako and Tran (2022), firm competitiveness mediates the relationship between sustainable strategy and financial performance.

Actually, the RBT suggests that changes in a firm's endowment of resources, especially intangible ones, can create sustainable competitive advantages, which lead to superior performance as such resources are difficult to accumulate, replicate, develop, or imitate perfectly by competitors (Wong & Zhang, 2022; Zhang et al., 2021). Moreover, the natural resource-based view (NRBV) claims that firms should invest in pursuing a proactive attitude in environmental management in order to acquire a sustainable competitive advantage and benefit from a good reputation and overall better performance (Barney et al., 2010; Hart, 1995). In fact, the more a firm engages in environmental sustainability activities, the greater it will be held in good esteem (Adomako & Tran, 2022).

Thus, a favorable CSR reputation is considered a valuable intangible resource that helps shareholders better evaluate the firm's value, providing a long-term advantage to companies and signaling conformity with societal expectations (Lourenço et al., 2014). Thus, value-relevant CSR information, although non-financial by nature, can reduce information asymmetry and uncertainty regarding factors influencing firm value, which in turn decreases the cost of capital. In addition, positive CSR behavior has many other benefits, such as the ability to engage socially conscious customers who care about ESG issues, the contribution to minimizing the risk of government regulations, the alignment with non-governmental organizations, or the appeal to socially responsible investors who may be willing to pay a premium for firms engaging in CSR (Wong & Zhang, 2022). In turn, the inclusion of ESG features into the corporate strategy and/or the allocation of capital investment, represents a dynamic and effective measure for achieving sustainable performance (Chen et al., 2022; Chollet & Sandwidi, 2018; Gillan et al., 2021; Lioui & Tarelli, 2022; Sabbaghi, 2022; Wong & Zhang, 2022).

In fact, both CSR and ESG can impact several types of risk, such as systematic risk, regulatory risk, supply chain risk, product and technology risk, litigation risk, reputational risk, and physical risk (Gillan et al., 2021). For instance, following a resiliency claim, Bénabou and Tirole (2010) show that firms with distinct CSR or ESG attitudes can have different systematic risk exposures either due to their resilience during crisis periods or because of a specific CSR/ESG risk factor. In addition, Albuquerque et al. (2018) argue that firms with a strong CSR/ESG profile face a relatively low price elasticity of demand, due to a product differentiation strategy that CSR/ESG provides them, which results in lower systematic risk.

In line with this, some literature has been dedicated to discussing whether CSR activities are value-enhancing during times of crisis. Lins et al. (2017) provide evidence that firms with high CSR/ESG values performed better than firms with low ESG/CSR during the 2008–2009 financial crisis. Chintrakarn et al. (2021) show that CSR investments do not drop during financial crises. Thus, consistent with the risk-mitigation view, managers invest in CSR during crises to reduce their risk exposure. Catalão-Lopes et al. (2016) demonstrate that corporate giving or charity, a dimension of CSR, is affected by the

economic cycle and impacts revenues. While firms abstain from giving under crisis conditions, a few years after the downturn, firms respond by investing more in charity, which in turn plays a role in overall economic recovery. Bae et al. (2021) argue that, during the pandemic-related crisis, the relationship between CSR and stock returns is more significant when CSR is consistent with a firm's institutional environment. Yet, the authors conclude that CSR prior to the COVID crisis was not effective at protecting shareholder wealth from the adverse effects of the stock market crash. Indeed, amid the COVID-19 pandemic, the demand for ethical businesses increased as consumers became more aware of the associated environmental and social issues. As noted by Chen et al. (2022), from a social perspective, a company is not only accountable to shareholders but also to its customers, employees, community, and government. Indeed, some authors suggest that ESG will shape the post-COVID-19 world, since it can mitigate firms' financial risks under an unprecedented health threat (Broadstock et al., 2021).

However, as noted by Sabbaghi (2022), there is a lack of research investigating the impact of good and bad CSR and ESG news on the volatility of firms, even though the overall role of media in financial markets has been considerably explored. Exceptions include the work of Wong and Zhang (2022), which shows that firms with little or no negative media coverage (thus, a good reputation) are more likely to experience a greater price reaction from negative ESG news, since intense media coverage may reveal unexpected information on the affected company or focus market participants' attention on CSR activities that would otherwise go undetected or be considered negligible. Also, the work developed by Zhang and Zhang (2021) finds evidence of a negative association between CSR engagement and stock illiquidity, and between illiquidity volatility and media tone, suggesting that the variations in liquidity are information-driven; non-disclosing firms may be later subject to higher illiquidity risk, and the market response to media tone is asymmetric.

As for literature regarding the effect of good and bad ESG news on the volatility of firms' stock market returns depending on the business cycle, to the best of our knowledge, it is non-existent. Thus, this article provides the first empirical investigation of the possibly asymmetric effects of ESG news on stock market volatility depending on whether the economy is in a recession or not, applied to a European small country (Portugal). To do so, a NSI was developed and then used as an external regressor to assess the impact of good and bad ESG news on stock market volatility.

3 | DATA AND METHODS

The PSI-20 is a benchmark stock market index that tracks the performance of the companies with the largest market capitalization and share turnover on the Euronext Lisbon stock exchange. We will use the closing daily levels for companies present in the PSI-20 as a representation of the Portuguese stock market. Both closing levels and news data were collected from Bloomberg.

We study the effect of an external regressor—an ESG NSI tracking the current media sentiment toward ESG—on capturing volatility in this market. To calculate the returns, we use the closing levels of the PSI-20 index.

The full sample covers the period from January 3, 2005 to January 31, 2022 (see Figure 1 for the evolution of real GDP growth in this period) for the returns of PSI-20 (so that we actually had to use the December 31, 2004 quote for computing the first return). Then, we divided the analysis into subperiods, to capture the impact of ESG NSI on stock returns depending on the business cycle.

The first subperiod includes data from January 3, 2005 to November 30, 2007, a period of continuous growth in Portuguese GDP. This is in line with Rua (2017), which established a reference business cycle chronology for Portugal and estimated that November 2007 was indeed a turning point (a peak in economic activity).

The second subperiod covers data from December 3, 2007 to June 30, 2014, a period of sharp decline in economic activity following the financial crisis. The cut-off date of June 30, 2014 was selected as it was the closure of the Economic and Financial Assistance Program (*Programa de Assistência Económica e Financeira*), a financial assistance program agreed on May 2011 between the Portuguese authorities, the European Union, and the International Monetary Fund

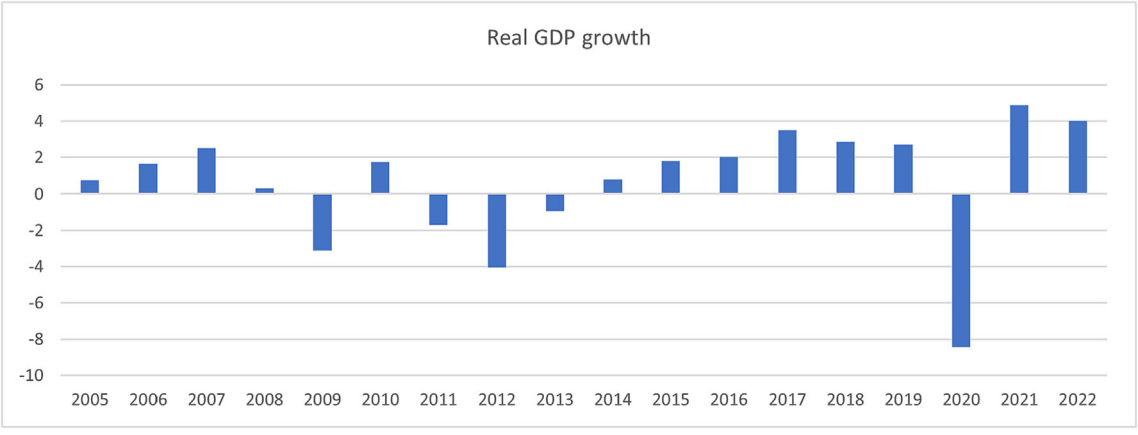

FIGURE 1 Portugal's GDP growth rate. *Source*: IMF world economic outlook.

(IMF). The strategy of this program was to restore confidence in international financial markets and promote competitiveness and sustainable economic growth.

The third subperiod covers data from July 1, 2014 to February 28, 2020, a period of economic growth that ended with the spread of the COVID-19 pandemic. In fact, Portugal had the first confirmed cases of COVID-19 on March 2, 2020.

Finally, the fourth subperiod covers the pandemic era from March 2, 2020 to January 31, 2022, a period of troubled economic growth. Even though we could have used more recent data, we chose to limit it until the end of January 2022, so that the index returns would not be influenced by the war in Ukraine.

3.1 | NSI

Given the lack of an adequate index to capture the effects of ESG media on the Portuguese stock market, a NSI was constructed. To do so, a set of key subjects were selected so that a piece of news would be classified according to each ESG subcategory. Listing all these subjects and subcategories enabled the identification of critical data points across the three ESG categories. Table 1 displays the subcategories and subjects considered.

Exclusionary criteria were employed in the selection process to ensure that the pieces of news selected were only from the ESG-related events reflecting the immediate investors' reaction to a piece of news. All news items for which keywords appeared with other significant corporate events were excluded (e.g., earnings announcements). Moreover, when a piece of the same news was published in more than one source, only the press release, which was published first, was selected. All articles' summaries were analyzed to ensure that all pieces selected are unambiguously related to ESG. Finally, all articles that included a retrospective description of an event, presented its background, subsequent actions, or/and an author's opinion, were also excluded.

TABLE 1 ESG subcategories and subjects.

Category	Subcategory	Subject
Environmental	Emissions	Emissions, waste, biodiversity, environmental.
	Innovation	Product innovation, green revenues.
	Resource use	Water, energy, environmental supply chain.
Social	Community	Community.
	Human rights	Human rights.
	Product responsibility	Responsible marketing, product quality, data privacy.
	Workforce	Diversity and inclusion, career development, working conditions, health and safety.
Governance	CSR strategy	CSR strategy, ESG reporting.
	Management	Structure, compensation.
	Shareholder	Shareholder rights, takeover defenses.

Abbreviations: CSR, corporate social responsibility; ESG, environmental, social, and governance.

The methodology followed to build the NSI was based on Borovkova et al. (2017). Accordingly, the index is defined as

$$NSI_t = \sum_{k=1}^{10} w_{k,t} p_{k,t}, \quad (1)$$

where $p_{k,t}$ is the sentiment score for the *k-th* company at time *t*. This sentiment score expresses the outlook regarding the relevant asset: positive sentiment (equal to 1), negative sentiment (equal to −1), or neutral sentiment (equal to 0). We considered the sentiment score to be neutral on days without any news. The number of companies included in the NSI is 10, and $w_{k,t}$ is the weight assigned to company k at time *t* based on its relative weight on this subset of the PSI-20 index. Thus, more importance is given to news on companies with a higher presence in the index. Accordingly, the weights were distributed as follows, for the companies considered: Altri SGPS (3,9%), EDP (13,3%), EDP Renováveis (16,7%), Galp Energia (10,8%), BCP (11,6%), Jerónimo Martins (20,1%), Mota Engil (1,3%), REN (10,1%), Semapa (2,4%), and Sonae (9,8%). The companies selected are the ones listed in the PSI-20 during the whole period under analysis (January 1, 2005 to January 31, 2022). These companies are representative and highly influence the Portuguese stock market index, have ESG features incorporated in their strategies, and are often the subject of pieces of news. Finally, the NSI is a daily index, which follows exactly the same period as the PSI-20 sample used, that is, there is a NSI value for all trading days between January 3, 2005 and January 31, 2022.

Figure 2 shows the evolution of the NSI across the period studied, taking into consideration the four subperiods analyzed. We can see that the lack of ESG-related news is common, since the index takes the value 0 several times. Another factor worth noting is the absence of this null value in the most recent observations, which could be expected given the increasing demand for sustainable and impact investment and behavior.

3.2 | PSI-20 returns

Modeling returns and volatility are the key ingredients in valuing assets. Volatility that persists, standing for a measure of risk, calls for generalized autoregressive conditional heteroskedasticity (GARCH)-type models, eventually considering asymmetry. Further, of particular relevance in this paper, volatility may depend on external variables, as we present in Section 4.

Table 2 shows statistics on each period of analysis for the PSI-20 returns, the dependent variable. The mean of the logarithmic returns for the total sample is close to zero. Skewness is negative in all periods, meaning that more often we observe (eventually small) positive returns than (eventually large) negative returns. This also means

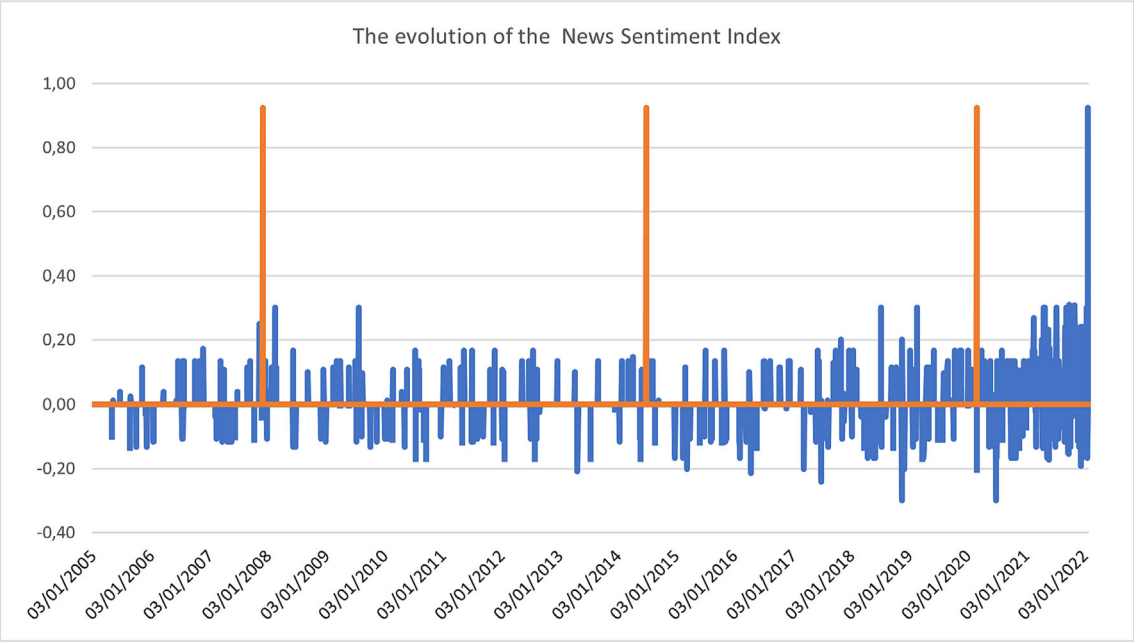

FIGURE 2 The evolution of the News Sentiment Index (NSI).

TABLE 2 Summary statistics for Portuguese Stock Index (PSI-20) logarithmic returns.

Period	Observations	Mean	Skewness	Excess kurtosis	Standard deviation	Coefficient of variation
January 3, 2005–January 31, 2022	4374	−0.00007	−0.40694	7.74700	0.01221	171.33000
January 3, 2005–November 30, 2007	748	0.00073	−0.39154	5.49800	0.00675	9.24390
December 3, 2007–June 30, 2014	1682	−0.00039	−0.04633	5.98010	0.01433	36.68900
July 1, 2014–February 28, 2020	1450	−0.00025	−0.59925	3.34770	0.01110	45.24000
March 2, 2020–January 31, 2022	494	0.00031	−1.16250	11.47300	0.01379	43.97300

that outliers appear to be negative returns. Looking into each period, we notice two distinct behaviors between the crisis periods, with the strongest negative skewness in the Covid-19 time, whereas during the financial crisis and macroeconomic adjustment period we have nearly zero skewness. Looking at the excess kurtosis (i.e., above three, the value for the normal distribution), we can acknowledge the leptokurtic characteristic of the returns, meaning that the distribution has a fatter tail and a higher peak around the mean when compared to a normal distribution. Positive values indicate the possible presence of AutoRegressive Conditional Heteroskedasticity (ARCH) effects, meaning volatility persistence, a measure of market risk. For the full sample and in each of the four subperiods under analysis, we observe positive values, with the highest values occurring in the crisis periods, notably in the fourth period. As for the standard deviation, there is little difference between periods, with all values rounding to 0.01, but both crisis periods have a higher standard deviation when compared to the others. The coefficient of variation (CV) tells us the dispersion of data around the mean. All periods under analysis exhibit values above one, meaning that the standard deviation exceeded the mean value, increasing across periods almost in a monotonic way, pointing out to higher dispersion of market returns, particularly since the financial crisis period.

Altogether, summary statistics point out toward relevant volatility persistence in all periods, particularly in the two crisis periods, and also point out that the financial crisis time differs from the Covid-19 time, with opposite sign mean returns and the lowest versus the highest negative skewness. The differences between non-crisis periods in the behavior of the PSI-20 returns may be associated with the different market perceptions of policies and their impact in each of these periods.

Figure 3 shows the logarithmic returns from the PSI-20 index across time, separating the four periods analyzed. It is notable that the greatest spikes occur in the two crisis periods.

3.3 | Methods

The models chosen to capture the stock market volatility were symmetric and asymmetric GARCH, since this approach performs well under crisis periods (Lim & Sek, 2013). As for the choice of the (p,q) combination, different models were tested to understand which one would show more strength of prediction and explanation. At the end, the (1,1) combination, most common in the literature, gives the lowest values for the information criteria used to assess the fit, namely the

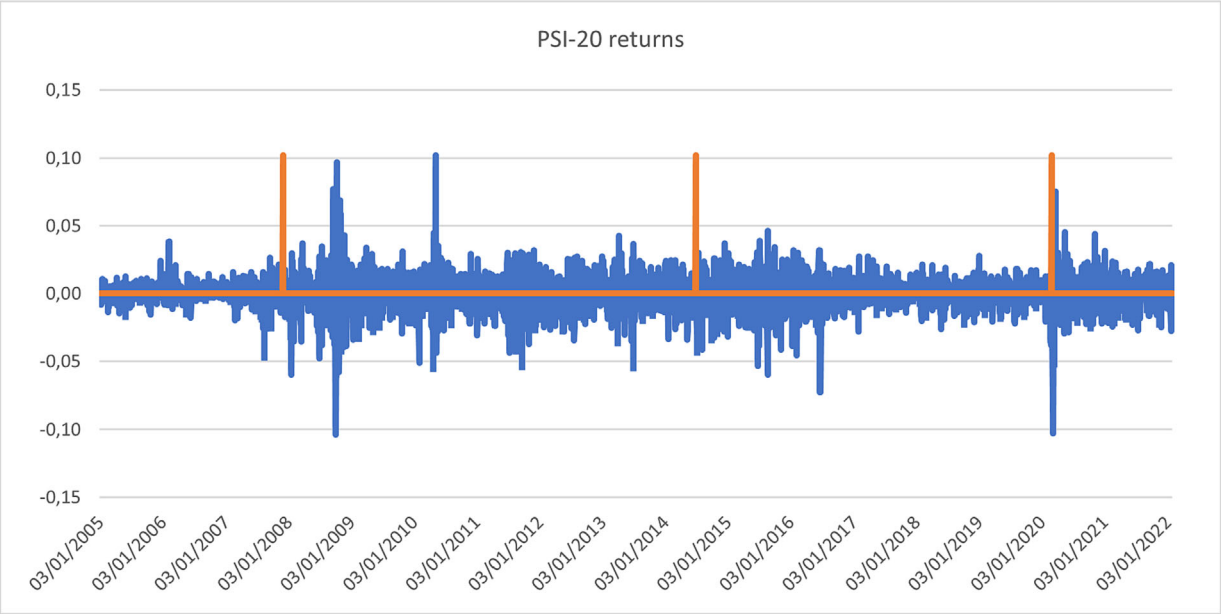

FIGURE 3 Portuguese Stock Index (PSI-20) returns.

Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC). Hence, the (1,1) combination is the best model to capture stock returns volatility (Hansen & Lunde, 2005; Liu & Hung, 2010).

After establishing the stationarity of both PSI-20 returns and ESG News series, given the results from testing for unit root with the Augmented Dickey-Fuller test, we proceed to estimate the conditional mean equation by Least Squares (equation 1), ending up with an AR(1) process with one lag, after diagnostic check for absence of autocorrelation using the Ljung-Box statistic. The ARCH Lagrange Multiplier test of Engle (Engle, 1982) did confirm the need for modeling the variance, namely its time-varying behavior.

Conditional mean process, AR(1):

$$R_t = \phi_0 + \phi_1 * R_{t-1} + \varepsilon_t,\ \varepsilon_t \sim N\left(\mu, \sigma_t^2\right). \quad (2)$$

We then used Maximum Likelihood to estimate jointly the conditional mean AR(1) and the conditional volatility equation, which specification varies according to the GARCH models used, and taking robust variance–covariance estimates for assessing significance (Bollerslev & Wooldridge, 1992).

Since our objective is to assess the effect of ESG News, we included the ESG NSI as external regressor, to help with the prediction and modeling of volatility. By using this index, the impact on volatility of good and bad ESG news is explored. Again, to compare the fit of our models, we apply the standard information criteria that are based on the model final prediction error, the AIC and BIC, and also Hannan-Quinn (HQ).

Notice that we introduce ESG News in the conditional volatility process with a lag of one (t-1), which informs about the predictive role of this variable for volatility (that is, how it helps to predict risk behavior). Further, we add the absolute value of ESG News at t-1, which, besides providing information about the size of the news effect, irrespective of sign, also provides important information about possible asymmetry of ESG news effect on volatility once we take together the level and the absolute value effects. This latter modeling choice is similar to that of the Exponential GARCH (EGARCH) model. In sum, (i) the level of ESG news is taken at t-1, so the timing allows for concluding about Granger causality on volatility; (ii) the level of ESG News (at t-1) provides the sign effect, as it may be positive or negative; (iii) the absolute value of ESG News (at t-1) informs about the size of news effect on volatility; and (iv) combining the effects of the level of ESG News (at t-1) and of the absolute value, we may conclude about possible asymmetric effects of positive versus negative news on volatility.

We present the volatility specifications employed—GARCH, Exponential GARCH (Nelson, 1991), Glosten-Jagannathan-Runkle (GJR-GARCH; Glosten et al., 1993), Threshold GARCH (TGARCH; Zakoian, 1994), and Asymmetric Power GARCH (APGARCH; Ding et al., 1993)—following GRETL software formulation (which is used in the estimation and inference).

The conditional variance processes employed are the following:

- GARCH(1,1)

$$\sigma_t^2 = \varpi + \alpha_1 * \varepsilon_{t-1}^2 + \beta_1 * \sigma_{t-1}^2 + \vartheta_1 * \mathrm{ESGNews}_{t-1} + \vartheta_2 * |\mathrm{ESGNews}_{t-1}|$$

- EGARCH(1,1)

$$ln\left(\sigma_t^2\right) = \omega + \alpha_1 * |\varepsilon_{t-1}| + \gamma * \varepsilon_{t-1} + \beta_1 * \ln\left(\sigma_{t-1}^2\right) + \vartheta_1 * ESGNews_{t-1} + \vartheta_2 * |ESGNews_{t-1}|$$

where $\omega = \varpi - \sqrt{\frac{2}{\pi}} * \alpha_1$

TABLE 3 Estimates from generalized autoregressive conditional heteroskedasticity (GARCH) models. Note: *p*-values are in the brackets.

	AR(1) GARCH(1,1)	AR(1) EGARCH(1,1)	AR(1) GJR-GARCH(1,1)	AR(1) TGARCH(1,1)	AR(1) APGARCH(1,1)
Full sample, January 3, 2005–January 31, 2022					
ϕ_0	0.000447 (0.001)	0.000185 (0.083)	0.000181 (0.173)	0.000148 (0.000)	0.000148 (0.262)
ϕ_1	0.071745 (0.000)	0.084237 (0.000)	0.086492 (0.000)	0.085625 (0.000)	0.085627 (0.000)
ϖ	0.000002 (0.004)	−0.460220 (0.000)	0.000003 (0.001)	0.000004 (0.000)	0.000004 (0.000)
α_1	0.132080 (0.000)	0.205018 (0.000)	0.102847 (0.000)	0.111475 (0.000)	0.111495 (0.000)
β_1	0.860287 (0.000)	0.967119 (0.000)	0.865455 (0.000)	0.883564 (0.000)	0.883507 (0.000)
γ		−0.108180 (0.000)	0.357850 (0.000)	0.559510 (0.000)	0.558798 (0.000)
δ					1.003080 (0.000)
ϑ_1	−0.000017 (0.442)	−0.17713 (0.415)	−0.000017 (0.382)	−0.000012 (0.363)	−0.000012 (0.233)
ϑ_2	0.000014 (0.398)	0.01092 (0.948)	0.000015 (0.351)	0.000006 (0.547)	0.000006 (0.458)
Akaike	−27583.740	−27716.317	−27674.653	−27715.617	−27713.618
Hannan-Quinn	−27567.973	−27698.297	−27656.634	−27697.597	−27693.346
Schwarz	−27539.057	−27665.252	−27623.588	−27664.551	−27656.169
Sub-sample, January 3, 2005–November 30, 2007					
ϕ_0	0.000978 (0.000)	0.000858 (0.000)	0.000879 (0.000)	0.000884 (0.000)	0.000909 (0.000)
ϕ_1	0.089432 (0.036)	0.071851 (0.000)	0.085747 (0.051)	0.070113 (0.059)	0.070491 (0.048)
ϖ	0.000001 (0.004)	−0.427381 (0.021)	0.000002 (0.002)	0.000002 (0.003)	0.000002 (0.002)
α_1	0.064314 (0.052)	0.166901 (0.000)	0.057303 (0.042)	0.080369 (0.001)	0.077256 (0.003)
β_1	0.913322 (0.000)	0.969393 (0.000)	0.894441 (0.000)	0.905463 (0.00)	0.904844 (0.000)
γ		−0.078760 (0.048)	0.434837 (0.082)	0.528720 (0.014)	0.520420 (0.020)
δ					1.140130 (0.000)
ϑ_1	−0.000045 (0.010)	−3.106290 (0.001)	−0.000065 (0.004)	−0.000055 (0.001)	−0.000059 (0.001)
ϑ_2	−0.000036 (0.039)	−1.979110 (0.004)	−0.000027 (0.123)	−0.000032 (0.002)	−0.000032 (0.004)
Akaike	−5481.493	−5496.921	−5491.687	−5496.905	−5495.168
Hannan-Quinn	−5469.040	−5482.689	−5477.455	−5482.673	−5479.157
Schwarz	−5449.181	−5459.992	−5454.758	−5459.977	−5453.624
Sub-sample, December 3, 2007–June 30, 2014					
ϕ_0	0.000137 (0.623)	−0.000292 (0.173)	−0.000289 (0.305)	−0.000329 (0.000)	−0.000318 (0.241)
ϕ_1	0.060407 (0.029)	0.084053 (0.005)	0.087597 (0.002)	0.088470 (0.000)	0.087651 (0.001)
ϖ	0.000008 (0.004)	−0.592237 (0.000)	0.000011 (0.001)	0.000011 (0.000)	0.000011 (0.000)
α_1	0.133018 (0.000)	0.185333 (0.000)	0.092993 (0.000)	0.102840 (0.000)	0.102123 (0.000)
β_1	0.828265 (0.000)	0.948740 (0.000)	0.819243 (0.000)	0.860131 (0.000)	0.853443 (0.000)
γ		−0.129123 (0.000)	0.556591 (0.000)	0.783599 (0.000)	0.757968 (0.000)
δ					1.166490 (0.000)
ϑ_1	−0.000081 (0.517)	−0.318635 (0.603)	−0.000070 (0.616)	−0.000044 (0.486)	−0.000049 (0.521)
ϑ_2	0.000001 (0.995)	−0.139360 (0.803)	−0.000024 (0.823)	−0.000003 (0.950)	−0.000006 (0.926)
Akaike	−9890.295	−9938.122	−9939.781	−9946.591	−9945.198
Hannan-Quinn	−9876.221	−9922.039	−9923.698	−9930.507	−9927.104
Schwarz	−9852.300	−9894.700	−9896.359	−9903.169	−9896.348
Sub-sample, July 1, 2014–February 28, 2020					
ϕ_0	0.000117 (0.607)	−0.000172 (0.420)	−0.000153 (0.503)	−0.000203 (0.369)	−0.000206 (0.000)
ϕ_1	0.087593 (0.003)	0.111484 (0.000)	0.097576 (0.001)	0.114887 (0.000)	0.116445 (0.000)
ϖ	0.000006 (0.007)	−0.493241 (0.001)	0.000005 (0.002)	0.000005 (0.001)	0.000005 (0.001)
α_1	0.148377 (0.000)	0.166205 (0.000)	0.096459 (0.005)	0.096640 (0.000)	0.095607 (0.000)
β_1	0.817071 (0.000)	0.959398 (0.000)	0.851419 (0.000)	0.886339 (0.000)	0.889462 (0.000)
γ		−0.110973 (0.000)	0.390896 (0.009)	0.671132 (0.000)	0.697502 (0.000)

TABLE 3 (Continued)

	AR(1) GARCH(1,1)	AR(1) EGARCH(1,1)	AR(1) GJR-GARCH(1,1)	AR(1) TGARCH(1,1)	AR(1) APGARCH(1,1)
δ					0.902651 (0.003)
ϑ_1	−0.000051 (0.094)	−0.649574 (0.137)	−0.000028 (0.277)	−0.000021 (0.257)	−0.000020 (0.245)
ϑ_2	−0.000076 (0.076)	−0.988394 (0.047)	−0.000065 (0.108)	−0.000042 (0.087)	−0.000038 (0.092)
Akaike	−9269.879	−9304.537	−9294.522	−9308.608	−9306.787
Hannan-Quinn	−9256.089	−9288.777	−9278.761	−9292.848	−9289.056
Schwarz	−9232.924	−9262.303	−9252.287	−9266.374	−9259.273
Sub-sample, March 2, 2020–January 31, 2022					
ϕ_0	0.000701 (0.124)	0.000163 (0.365)	0.000136 (0.790)	0.000130 (0.006)	0.000138 (0.786)
ϕ_1	−0.006959 (0.887)	0.014106 (0.000)	0.027786 (0.593)	0.004162 (0.000)	0.028197 (0.594)
ϖ	0.000011 (0.184)	−0.823644 (0.016)	0.000013 (0.198)	0.000013 (0.103)	0.000013 (0.206)
α_1	0.194503 (0.053)	0.272022 (0.003)	0.145230 (0.044)	0.157972 (0.010)	0.143458 (0.042)
β_1	0.740982 (0.000)	0.930518 (0.000)	0.755027 (0.000)	0.800660 (0.000)	0.751389 (0.000)
γ		−0.147613 (0.003)	0.409880 (0.002)	0.540400 (0.000)	0.401833 (0.009)
δ					2.071220 (0.013)
ϑ_1	−0.000005 (0.921)	−0.074083 (0.864)	0.000002 (0.965)	−0.000009 (0.797)	0.000003 (0.958)
ϑ_2	0.000009 (0.848)	−0.159798 (0.698)	−0.000016 (0.717)	−0.000006 (0.853)	−0.000016 (0.717)
Akaike	−2982.577	−2990.638	−2995.165	−2990.392	−2993.176
Hannan-Quinn	−2971.028	−2977.439	−2981.966	−2977.192	−2978.327
Schwarz	−2953.160	−2957.018	−2961.545	−2956.771	−2955.353

- GJR-GARCH(1,1)

$$\sigma_t^2 = \varpi + \alpha_1 * (|\varepsilon_{t-1}| - \gamma * \varepsilon_{t-1})^2 + \beta_1 * \sigma_{t-1}^2 + \vartheta_1 * \text{ESGNews}_{t-1} + \vartheta_2 * |\text{ESGNews}_{t-1}|$$

- TGARCH(1,1)

$$\sigma_t = \varpi + \alpha_1 * (|\varepsilon_{t-1}| - \gamma * \varepsilon_{t-1}) + \beta_1 * \sigma_{t-1} + \vartheta_1 * \text{ESGNews}_{t-1} + \vartheta_2 * |\text{ESGNews}_{t-1}|$$

- APGARCH(1,1)

$$\sigma_t^\delta = \varpi + \alpha_1 * (|\varepsilon_{t-1}| - \gamma * \varepsilon_{t-1})^\delta + \beta_1 * \sigma_{t-1}^\delta + \vartheta_1 * \text{ESGNews}_{t-1} + \vartheta_2 * |\text{ESGNews}_{t-1}|$$

4 | RESULTS

Table 3 exhibits the estimates from the GARCH models for the whole period (full sample) and for the four sub-sample periods. The different conditional variance processes employed are presented in the columns.

The best model in each sample period was selected based on standard information criteria and the APARCH(1,1) model helps choosing between TGARCH(1,1) and GJR(1,1). The EGARCH(1,1) model is the one used as common window to assess the results. This GARCH type model, besides capturing symmetry, is the best or second best specification according to information criteria and avoids problems from parameter restrictions, which are violated by the GJR-GARCH(1,1) model, the one that best fitted the period from March 2, 2020 to January 31, 2022. The alternative models, with particular relevance for the asymmetric ones, deliver the same qualitative results across all periods.

Starting with the full sample (January 3, 2005–January 31, 2022), which fails to capture heterogeneity, the results show that the news pieces do not have a role in volatility (ϑ_1 and ϑ_2 are statistically non-significant). Yet, the appropriate model includes asymmetry. The best in this period is the EGARCH(1,1), with a volatility persistence of 0.967. The size of the shocks matter, and larger shocks have higher impact on volatility (α_1 is significant and positive), with negative ones having a higher effect on increasing volatility than positive ones ($\gamma < 0$).

When analyzing the results for the pre-financial crisis period (January 3, 2005–November 30, 2007), results show that pieces of news have a role in returns' volatility. Indeed, more pieces of news lead to a volatility decrease. In addition, the disclosure content of the news matter. In line with Sabbaghi (2022), positive pieces of news trigger a decrease in volatility (and have the strongest effect in absolute terms), whereas negative pieces of news lead to an increase in volatility. The appropriate model includes asymmetry. The best model in this sample is the EGARCH(1,1), with a volatility persistence of 0.969. The size of the shocks matter, with negative ones having a higher effect on increasing volatility than positive ones.

Regarding the financial crisis period (December 3, 2007–June 30, 2014), and including the adjustment, results show that pieces of news do not have a role in returns' volatility. However, the appropriate model includes asymmetry. EGARCH(1,1) shows volatility persistence of 0.949. The size of the shocks matter, with negative ones having a higher effect on increasing volatility than positive ones. The best model in this sample is, however, the TGARCH(1,1). The APARCH model supports the TGARCH and not the GJR-GARCH, which reinforces this finding. Remarkably, the TGARCH(1,1) model yields similar results to those of EGARCH(1,1).

For the sample between crises (July 1, 2014–Feb\ruary 28, 2020), and similarly to the pre-financial crisis period, results show that pieces of news have a role in returns' volatility. Actually, more pieces of news trigger a volatility decrease. However, and contrary to the pre-financial crisis period, the disclosure content of the news does not matter. EGARCH(1,1) shows volatility persistence of 0.959. The size of the shocks matter, with negative ones having a higher effect on increasing volatility than positive ones. As in the previous case, the best model in this sample is, however, the TGARCH(1,1). The APARCH model supports the TGARCH and not the GJR-GARCH, which reinforces this finding. Remarkably, the TGARCH(1,1) model yields similar results to those of EGARCH(1,1), although with the ESG news size being significant only at 10% level.

Lastly, when analyzing the results for the COVID-19 crisis period (March 2, 2020–January 31, 2022), and similar to the financial crisis period, pieces of news do not have a role in returns' volatility. This is the only sub-sample in which different models yield slightly different results in what concerns the mean and the volatility processes. EGARCH(1,1) shows volatility persistence of 0.931. The size of the shocks matter, with negative ones having a higher effect on increasing volatility than positive ones. Nevertheless, following the information criteria, we would select the GJR-GARCH model as the best model (also pointed out by APGARCH, but not by TGARCH), but GJR-GARCH fails to have a significant key parameter ensuring non-zero unconditional variance.

Overall, one can observe that not all periods present the same results regarding the effects of ESG pieces of news. Although the role of ESG news is significant in both non-crisis periods, in one of them (the first subperiod analyzed), the disclosure content of the news does matter whereas in the other, it does not. As for crisis periods, they stand similar with a non-significant relationship between pieces of news and returns' volatility.

5 | DISCUSSION AND CONCLUSIONS

Corporate reputation is one of the most valuable intangible resources that can provide companies with a sustainable competitive advantage. The intangible benefits offered by a good reputation, obtained via CSR, can be perceived as a resource to facilitate stakeholder commitment and improve the company's ability to outperform its rivals. In addition, the inclusion of ESG features into the corporate strategy and/or the allocation of capital investment represents a dynamic and effective measure for achieving sustainable performance and complying with stakeholders' ideals and demands for CSR and transparency. Given the information asymmetry existent in financial markets, one way of obtaining information regarding the ESG performance of companies is through the media coverage of those same companies. Investors use public news announcements as a mechanism to disseminate information and evaluate the future cash flows of financial assets and their riskiness.

This paper assesses how ESG news influence Portuguese stock market volatility. Given the lack of an adequate index to capture the effects of ESG media on the Portuguese stock market, a NSI was developed. This index, which captures positive and negative ESG news on companies listed in the PSI-20, is used as an external regressor to model stock market volatility. The analysis covers the period from January 3, 2005 to January 31, 2022, distinguishing subperiods of recession from subperiods of economic growth, while paying special attention to the financial crisis period and the Covid-19 period.

The study contributes to the environmental management literature by offering, to the best of our knowledge, the first effort to evaluate how media regarding ESG can affect stock returns volatility depending on the business cycle. In addition, this paper examines the impact of news media sentiment in a European and less developed market, the Portuguese stock market, and develops an adequate NSI that classifies the media reports into three sentiment groups, capturing positive, negative, and neutral ESG news on companies listed in the PSI-20.

Regarding the methodology, the models chosen to capture stock market volatility were symmetric and asymmetric GARCH-type models, since this approach performs well under crisis periods. Moreover, since our objective was to assess the effect of ESG News, we included an external regressor, the ESG NSI, to help with the prediction and modeling of volatility. By using this index, the possibly different impact on volatility of good and bad ESG news is explored.

Results show that during non-crisis periods, ESG pieces of news have a role in the PSI-20 returns' volatility, that is, changes in stock returns may be information-driven when the economy is expanding. Reducing financial markets' information asymmetry through ESG news has the potential to impact volatility and, in line with the theoretical background presented, improve market pricing efficiency. Thus, the disclosure of ESG news arises as a determinant of PSI-20 stock prices during periods of economic growth, reducing volatility.

In addition, when considering the period preceding the financial crisis, besides the fact that more pieces of news can trigger a volatility decrease, the disclosure content of the news matters: positive ESG news reduce volatility, while negative ESG news augment volatility. This is no longer the case in the period preceding the COVID-19 pandemic, where only the number of pieces of news (regardless of their positive or negative content) has the ability to reduce volatility. Thus, market response to media tone was asymmetric before the financial crisis but turned out to be symmetric during the pandemic. This result is interesting and challenges previous literature regarding the impact

of media sentiment on stocks. One possible explanation arises from the intensity of media coverage in the last years, with significant volume and accessibility. Increasing information regarding a firm deteriorates the investors' ability to filter and focus on relevant information. Constant exposure to daily news might challenge investors' ability to focus on medium-term prospects for the underlying investment, exacerbating their information bias and making stocks tone-deaf regarding ESG news.

As for the role of ESG news during crises, results show that neither the amount nor the content disclosure of ESG news affect volatility. This is an important finding, showing that during crisis periods priorities shift and preoccupations regarding ESG are no longer as relevant as previously. This result provides evidence against the risk-mitigation view discussed in the literature background, in which ESG investment would increase during crises to reduce managers' risk exposure. According to our results, this strategy is not pertinent. Other factors, such as, for instance, financial and health factors, might prevail and the call for sustainability and good governance loses relevance during challenging times.

Our results provide several important implications for corporate executives, portfolio managers, and stakeholders, such as investors, on the importance of ESG news on market volatility. First, we provide evidence that the competitive advantages associated with ESG investing arising from the RBT might be a bull-market phenomenon. Indeed, when the economy is growing both the amount and sometimes also the content disclosure of ESG news affect volatility. Thus, companies should continually manage threats to their ESG reputation as these pieces of news, if positive-toned and in large quantities, can decrease stock volatility. Managers should invest in ESG not just from a risk-mitigation point of view but as an opportunity for growth and to take advantage of the expansion stages of the business cycle. Therefore, positive ESG actions, and consequently, news, can act as a shield for market volatility. However, during recession periods, simply investing in ESG to obtain a good reputation is not enough to prevent market volatility.

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CONFLICT OF INTEREST STATEMENT

The authors report there are no competing interests to declare.

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