ESG FIRMS IN A TENSE WORLD

ESG RATINGS AND EQUITY MARKET LIQUIDITY OF EUROPEAN FIRMS UNDER GEOPOLITICAL RISK

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Abstract:

This study examines whether environmental, social, and governance (ESG) performance moderates the relationship between geopolitical risk (GPR) and bid-ask spreads in European firms. Using a firm-year panel dataset of publicly listed European firms from 2005 to 2024, we combine ESG scores and relative bid-ask spreads from LSEG, and the Geopolitical Risk (GPR) index developed by Caldara and Iacoviello (2022). We estimate panel regressions with firm and year fixed effects, where the main coefficient of interest is the interaction between ESG performance and geopolitical risk. Based on prior research on ESG-related resilience during crises, we hypothesize that European firms with higher ESG scores experience a smaller bid-ask spread increase when the GPR index increases. Contrary to our hypothesis, we find a statistically significant baseline result that firms with higher ESG scores experience wider bid-ask spreads during periods of increased geopolitical risk. The result is mainly driven by the environmental and social pillars, while the governance pillar is insignificant. The finding is reproduced when geopolitical risk is captured by a top-20% high-GPR indicator, but it does not survive when geopolitical risk is restricted to a conflict-spike indicator for 2022 and 2024, and across firm-size subsamples it appears only among large firms. Overall, the evidence points to a state-contingent ESG-liquidity relationship: higher-ESG firms enjoy narrower spreads on average but experience relatively wider spreads when geopolitical risk is elevated. This pattern is the opposite of what the prevailing resilience view predicts, and it shows up most clearly among large firms and under broad measures of geopolitical stress.

Keywords:

ESG ratings, Geopolitical risk, Bid-ask spreads, Stock market liquidity, European firms

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1. Introduction

European firms have been exposed to increasing geopolitical risk in recent years, especially after the Russian full-scale invasion of Ukraine in 2022, which the North Atlantic Treaty Organization (NATO) has described as the biggest war in Europe since the Second World War (NATO, 2024). Periods of heightened geopolitical risk tend to increase illiquidity by increasing uncertainty and information asymmetry (Fiorillo, Meles, Pellegrino, and Verdoliva, 2023). However, the impact of geopolitical tensions on financial markets varies across firms. A growing literature suggests that firms with stronger environmental, social, and governance (ESG) profiles may enhance firm resilience under stress because of stronger stakeholder relationships and greater transparency. Specifically, ESG performance mitigates the adverse effect of geopolitical risk (GPR) on stock price crash risk due to better reputation and greater transparency (Fiorillo, Meles, Pellegrino, and Verdoliva, 2024).

Prior literature has examined the effects of geopolitical risk on financial markets and separately the role of ESG in strengthening firm resilience during crises. However, limited attention has been given to whether ESG affects market liquidity during periods of geopolitical risk. This paper examines whether ESG moderates the relationship between geopolitical risk and bid-ask spreads, which is the difference between the prices at which investors can buy and sell an asset. Understanding this relationship is important for both investors and firms, as Amihud and Mendelson (1986) indicate that wider bid-ask spreads increase transaction costs and lower bid-ask spreads can reduce the cost of capital.

Our paper examines the following research question:

Does ESG moderate the relationship between the Geopolitical Risk (GPR) Index and bid-ask spreads in European firms?

Europe is a suitable setting for examining the ESG impact on bid-ask spreads when geopolitical risk increases. ESG considerations play an increasingly important role in both European corporate practices (European Commission, 2025b) and the regulatory landscape, such as the European Climate Law's climate neutrality goal by 2050 (European Commission, 2021). Furthermore, the Russo-Ukrainian war continues to reshape the political and economic landscape in Europe significantly. European firms must also prepare for several other geopolitical risks such as trade wars and supply chain disruptions (European Central Bank, 2025), increasing the relevance of examining whether ESG moderates the relationship between geopolitical risk and market liquidity measured by bid-ask spreads.

Prior research suggests that strong CSR activities strengthen stakeholder relationships and reduce information asymmetry, which may provide resilience during periods of increased geopolitical risk (Albuquerque, Koskinen, and Zhang, 2019; Ding, Levine, Lin, and Xie, 2021; Egginton and McBrayer, 2019). CSR refers to corporate social responsibility and is closely related to ESG, although ESG more explicitly incorporates environmental, social, and governance dimensions (Gillan, Koch, and Starks, 2021). Therefore, findings from CSR studies are relevant for this paper. Drawing on the literature, we hypothesize that European firms with higher ESG scores experience a smaller bid-ask spread increase when the Geopolitical Risk (GPR) Index increases.

To examine this relationship, we construct a firm-level panel dataset of publicly listed European companies over the period 2005-2024, firm-level ESG data and relative bid-ask spreads as a measure of stock market liquidity from London Stock Exchange Group (LSEG), and the Geopolitical Risk (GPR) index developed by Caldara and Iacoviello (2022). Our empirical strategy is based on panel regressions with firm and year fixed effects, which allow us to control for both time-invariant firm characteristics and common macroeconomic shocks. The interaction between ESG performance and geopolitical risk is the key coefficient of interest, capturing whether ESG moderates the effect of geopolitical risk on market liquidity. Our interaction is identified from cross-sectional differences in ESG within years interacted with annual GPR levels, because year fixed effects absorb the common time-series variation. Consequently, our estimates capture the differential effects across high- and low-ESG firms, rather than the average effect of GPR on market liquidity.

The baseline result indicates a positive and statistically significant interaction between ESG and geopolitical risk (coefficient 0.003, $p < 0.01$), driven by the environmental and social pillars (interaction coefficients of 0.002 and 0.004, both significant at the 1% level). However, the governance interaction is small and insignificant. The findings suggest that firms with higher ESG scores experience wider bid-ask spreads during periods of increased geopolitical risk. The result is the opposite of what our hypothesis predicts, implying that ESG does not mitigate liquidity deterioration, but may instead be associated with increased trading frictions under geopolitical uncertainty. The interaction is robust to the continuous GPR index, the top-20% high-GPR indicator, and a high-ESG dummy, and appears most clearly among large firms; it weakens when geopolitical risk is restricted to the conflict-spike years 2022 and 2024 or to smaller firms, where statistical power is also lower. Overall, the evidence points to a state-contingent ESG-liquidity relationship: higher-ESG firms enjoy narrower spreads on average but experience relatively wider spreads when geopolitical risk is elevated - a pattern that is the opposite of what the prevailing resilience view predicts.

The mixed findings in the ESG literature suggest that ESG may not consistently enhance firm resilience during periods of crisis (Bae, El Ghoul, Gong, and Guedhami, 2021). Benefits associated with stakeholder loyalty and reputation may operate over long time periods and may not contribute to short-term trading frictions. Section 5 discusses possible mechanisms behind the positive interaction, including ESG-rating disagreement and the role of investor attention.

Several limitations should be considered when interpreting the results. First, the analysis relies exclusively on LSEG ESG scores, while prior research documents substantial divergence across ESG rating providers (Berg, Kölbel, and Rigobon, 2022). Second, ESG performance is not randomly assigned, and high-ESG firms may differ from other firms in ways that also affect liquidity. Finally, the result weakens in the conflict-spike and small-firm specifications, where statistical power is also lower. Our findings therefore indicate that ESG may function as an uncertainty signal in stressed states, rather than only as the transparency signal emphasized in the prior literature on crisis resilience.

Related literature

Our paper contributes to the literature on ESG and stock market liquidity. Previous papers suggest that stronger CSR disclosure reduces information asymmetry (Egginton and McBrayer, 2019) and high ESG ratings improve liquidity through narrower bid-ask

spreads (He, Feng, and Hao, 2023). Furthermore, prior research documents that bid-ask spreads are priced in expected returns (Amihud and Mendelson, 1986) and bid-ask spreads reflect adverse selection costs (Glosten and Milgrom, 1985). These papers study average liquidity levels, and ESG is treated as a static firm characteristic. This paper extends the literature by testing the conditional liquidity response, whether the cross-sectional ESG-spread gradient changes with geopolitical risk.

We also add to the literature on ESG and crisis resilience. Previous literature indicates that firms with stronger CSR activities exhibit greater resilience during crisis periods through lower systematic risk by product differentiation (Albuquerque et al., 2019), strong stakeholder bonds (Ding et al., 2021), and increased trust (Lins, Servaes, and Tamayo, 2017). However, Bae et al. (2021) provide a counterweight to these papers by challenging the idea of CSR as a crisis protection, as their study finds no evidence of CSR improving stock returns during the COVID-19 pandemic. Most prior papers focus on stock returns or profitability and use single-crisis settings. This study examines whether annual bid-ask spreads vary differentially across firms with different ESG scores when geopolitical risk is elevated, using the GPR index as a continuous measure of geopolitical stress.

Furthermore, we contribute to the literature on geopolitical risk and financial markets. Previous studies argue that geopolitical and political uncertainty affect macroeconomic outcomes (Caldara and Iacoviello, 2022), stock prices, and risk premia (Pástor and Veronesi, 2013). In addition, the prior literature demonstrates that geopolitical risk lowers stock liquidity but does not incorporate ESG (Fiorillo et al., 2023) and that ESG performance mitigates the effect of the GPR Index on stock price crash risk (Fiorillo et al., 2024). The papers examine the effect of geopolitical risk on stock prices or macroeconomic outcomes and have not tested whether ESG moderates liquidity effects during geopolitical threats. Our contribution to the literature is to test whether ESG moderates the liquidity transmission of the GPR Index.

Finally, our paper adds to the literature on ESG measurement and disagreement. Previous research documents substantial disagreement across major ESG providers (Berg et al., 2022) and that greater ESG disclosure increases disagreement between ESG rating agencies (Christensen, Serafeim, and Sikochi, 2022). The studies are not integrated with the GPR-liquidity channel. Our paper contributes to the disagreement literature by using these tensions to interpret our findings: the positive cross-sectional ESG-GPR interaction suggests that ESG may act as an uncertainty variable in stressed states rather than a transparency variable.

2. Data

2.1 Data Sources and Sample Construction

This study examines whether firms with stronger environmental, social, and governance (ESG) performance experience smaller deterioration in stock market liquidity during periods of elevated geopolitical risk. In line with the hypothesis, the empirical analysis tests whether firms with higher ESG scores experience a smaller increase in bid-ask spreads when geopolitical risk is elevated. To investigate this relationship, we construct a firm-level panel dataset of publicly listed European companies over the period 2005-2024. The sample is restricted to firms with a market capitalization of at least €100

million. This floor is partly imposed by the LSEG export, which limits the universe of firms returned in a single screen, but it is also analytically motivated. Firms below this threshold tend to trade infrequently and exhibit very wide and noisy bid-ask spreads that would dominate the dependent variable, and they have weaker ESG disclosure and rating coverage. The restriction therefore reduces measurement error in both the liquidity and ESG dimensions, but it also limits the generalizability of the results, since the small-cap segment is excluded from the sample. We discuss the external-validity implications in Section 5.

The dataset combines information from three main sources. First, firm-level ESG data are obtained from LSEG. These data include the overall ESG score as well as the individual environmental, social, and governance pillar scores. The LSEG ESG score is based on publicly disclosed corporate information and provides a standardized measure of firm-level ESG performance (LSEG, 2024). However, ESG ratings are subject to measurement concerns. Berg et al. (2022) document substantial disagreement across ESG rating providers, while Christensen et al. (2022) show that greater ESG disclosure may increase disagreement between ESG rating agencies. Since this study relies exclusively on LSEG scores, the results may be sensitive to the choice of ESG provider, and we cannot directly test how robust the findings are to an alternative rating source.

Second, stock market liquidity measures are constructed using bid and ask prices for individual firms, also obtained from LSEG. The bid and ask prices are used to calculate the relative bid-ask spread, a commonly used measure of equity market liquidity. Wider bid-ask spreads indicate higher transaction costs and lower liquidity. The use of bid-ask spreads as a liquidity measure is supported by the market microstructure literature, where spreads capture the cost of immediate execution and the trading frictions faced by investors. Amihud and Mendelson (1986) show that bid-ask spreads are economically important because they affect expected returns, while Glosten and Milgrom (1985) show that spreads can arise from adverse selection and information asymmetry.

Third, geopolitical risk is measured using the Geopolitical Risk (GPR) index developed by Caldara and Iacoviello (2022). The GPR index is constructed through textual analysis of newspaper articles and captures the frequency of articles discussing adverse geopolitical events and associated threats. Caldara and Iacoviello (2022) define geopolitical risk as covering the threat, realization, and escalation of adverse events related to wars, terrorism, military tensions, and international crises. The index has subsequently been used in studies examining the financial market effects of geopolitical uncertainty, including Fiorillo et al. (2023), who study geopolitical risk and stock liquidity, and Fiorillo et al. (2024), who examine the role of ESG performance in moderating the effect of geopolitical risk on stock price crash risk.

The GPR index is available at daily and monthly frequencies, whereas the ESG and liquidity data used in this study are obtained at an annual frequency. To align the geopolitical risk measure with the annual firm-level panel structure, monthly GPR observations are aggregated into annual averages. All twenty calendar years 2005-2024 contain twelve monthly GPR observations in the source file, so no year enters the panel with a partial GPR average. This approach captures the average level of geopolitical risk faced by firms within each year. However, the use of annual data also reduces the ability to capture short-term liquidity responses to geopolitical events. Since geopolitical shocks may affect market liquidity over shorter horizons, the annual frequency of the dataset may

obscure within-year variation in both geopolitical risk and bid-ask spreads. This limitation should be considered when interpreting the results.

In addition to the main variables, the dataset includes several firm-level control variables that may influence stock market liquidity. These controls are trading activity, measured by turnover; firm size, measured by market capitalization and total assets; profitability, measured by return on assets; and financial leverage. Including these controls is important because firms with stronger ESG scores may also be larger, more profitable, more transparent, and more actively traded, all of which may independently affect bid-ask spreads.

The datasets are merged using firm identifiers and calendar year. Following the merge, we apply two cleaning steps before the regression sample is finalized. First, we drop firm-years with implausible quote data: bid prices that are zero or negative, ask prices that are zero or negative, ask prices below the bid (crossed quotes), and relative spreads that fall outside the unit interval [0, 1). Second, observations with missing values on any variable used in the baseline specification - the relative bid-ask spread, the LSEG ESG score, the annual GPR index, log turnover, log market capitalization, log total assets, return on assets, and leverage - are removed. To limit the influence of extreme values, the relative bid-ask spread and return on assets are then winsorized at the 1st and 99th percentiles of the resulting regression sample. Winsorization caps rather than trims the tails, preserving the number of firm-year observations. After merging, filtering, and winsorizing, the final regression sample consists of approximately 3,400 unique firms over the period 2005-2024, yielding roughly 18,000 firm-year observations used in the baseline regression.

2.2 Variable Construction

2.2.1 Liquidity Measure

The primary dependent variable in the analysis is the relative bid-ask spread, which is used as a proxy for stock market liquidity. Bid-ask spreads measure the cost of executing trades in financial markets. A larger spread indicates higher transaction costs and lower market liquidity. This interpretation follows the market microstructure literature, where bid-ask spreads capture trading frictions and transaction costs faced by investors (Amihud and Mendelson, 1986). Spreads may also reflect adverse selection and information asymmetry between informed and uninformed traders (Glosten and Milgrom, 1985).

The relative bid-ask spread is calculated as:

$$Spread_{it} = \frac{Ask_{it} - Bid_{it}}{(Ask_{it} + Bid_{it})/2}$$

where Ask_{it} and Bid_{it} represent the ask and bid prices for firm *i* in year *t*, taken from the LSEG annual export. Using the relative spread rather than the absolute spread makes the liquidity measure comparable across firms with different share price levels. Higher values of $Spread_{it}$ indicate lower liquidity.

Before the spread enters the regression sample we apply two further cleaning steps. We drop firm-years for which either quote is missing or non-positive, for which the ask is below the bid, or for which the computed relative spread is negative or greater than or equal to one. These filters remove a small number of clearly erroneous quote pairs without

affecting the bulk of the distribution. We then winsorize the relative spread at the 1st and 99th percentiles of the final regression sample to limit the influence of extreme outliers, following common practice in the literature (e.g. Bae et al., 2021, who similarly winsorize returns and financial variables at the 1% level). Winsorization caps tail values at the corresponding percentile rather than discarding the observation, so the firm-year remains in the sample.

The liquidity data used in this study are obtained at an annual frequency. As a result, the spread measure captures annual firm-level differences in liquidity rather than short-term changes around specific geopolitical events. This is a limitation because bid-ask spreads may fluctuate substantially within a year, especially during periods of market stress. However, given the annual structure of the available firm-level data, the relative bid-ask spread provides a consistent firm-year measure of trading frictions across the full sample.

2.2.2 ESG Measures

The key explanatory variable in the analysis is the ESG score obtained from LSEG. The ESG score is a composite measure of firm-level environmental, social, and governance performance. The score ranges from 0-100, where higher values indicate stronger ESG performance (LSEG, 2024).

In addition to the aggregate ESG score, the analysis also considers the three underlying ESG pillar scores: environmental score, social score, and governance score. Including the pillars allows the analysis to examine whether the relationship between ESG performance, geopolitical risk, and liquidity is driven by specific ESG dimensions. This distinction is relevant because prior research suggests that different ESG dimensions may have different implications for firm resilience. For example, Fiorillo et al. (2024) find that the mitigating role of ESG in the relationship between geopolitical risk and stock price crash risk is mainly driven by the environmental and social pillars.

Coverage of the aggregate ESG score is slightly broader than coverage of the individual pillars: the LSEG export contains a small share of firm-years for which the headline ESG score is reported but at least one of the underlying pillar scores is missing. As a result, the pillar-level regressions are estimated on samples that are marginally smaller than the baseline ESG specification. We report the gap explicitly in Section 2.3 and verify in unreported results that the baseline coefficient on the aggregate ESG score is unchanged when the estimation is restricted to firm-years with non-missing pillar values.

The use of ESG ratings also introduces an important measurement concern. ESG scores are not purely objective measures of corporate sustainability performance, and different rating providers may evaluate the same firm differently. Berg et al. (2022) document substantial divergence across ESG ratings, while Christensen et al. (2022) show that greater ESG disclosure may increase disagreement between rating agencies. Since this study relies exclusively on LSEG ESG scores, the results may be sensitive to the specific rating provider used, and we treat this as an external-validity caveat in the discussion.

2.2.3 Geopolitical Risk

Geopolitical risk is measured using the Geopolitical Risk (GPR) index developed by Caldara and Iacoviello (2022). The index is constructed through textual analysis of

newspaper articles and captures the frequency of articles discussing adverse geopolitical events and threats. Caldara and Iacoviello (2022) define geopolitical risk as the threat, realization, and escalation of adverse events related to wars, terrorism, military tensions, and international crises.

The GPR index is available at daily and monthly frequencies (Caldara and Iacoviello, 2022). Since the ESG and liquidity data used in this study are obtained at an annual frequency, the monthly GPR observations are aggregated into annual averages. The annual GPR measure is therefore defined as:

$$GPR_t = \frac{1}{12}\sum_{m=1}^{12} GPR_{m,t}$$

where $GPR_{m,t}$ is the monthly GPR index in month *m* of the year *t*. Each calendar year in the sample (2005-2024) has the full twelve months of GPR observations available, so the annual mean is always taken over the same number of months. Higher values of GPR_t indicate higher average geopolitical risk during the year.

This aggregation creates a consistent annual measure that can be merged with the firm-year panel. However, it also reduces the ability to capture short-term market reactions to geopolitical events. This limitation is important because geopolitical shocks may affect bid-ask spreads over shorter horizons than one year. The annual GPR measure should therefore be interpreted as capturing the average geopolitical risk environment each year rather than the immediate market response to specific geopolitical events.

2.2.4 Control Variables

The analysis includes several firm-level control variables that may affect stock market liquidity. Including these controls is important because firms with higher ESG scores may systematically differ from firms with lower ESG scores. For example, high-ESG firms are often larger, more visible, more profitable, and more transparent (Gillan et al., 2021), which may independently affect bid-ask spreads.

Trading activity is measured using turnover. More actively traded stocks are generally expected to have narrower bid-ask spreads because higher trading volume reduces inventory risk and facilitates order matching (Stoll, 1978). Firm size is measured using both market capitalization and total assets. Larger firms are typically more visible to investors and analysts, which may reduce information asymmetry and improve liquidity (Amihud and Mendelson, 1986). Profitability is measured by return on assets (ROA), and financial leverage is included to control for differences in financial risk.

The control variables are defined as follows:

$$Turnover_{it} = \log(Turnover_{it} + 1)$$

$$MarketCap_{it} = \log(MarketCapitalization_{it})$$

$$Assets_{it} = \log(TotalAssets_{it})$$

$$ROA_{it} = \frac{NetIncome_{it}}{TotalAssets_{it}}$$

$$Leverage_{it} = \frac{TotalDebt_{it}}{TotalAssets_{it}}$$

where all variables are measured for firm i in year t. Log transformations are used for turnover, market capitalization, and total assets to reduce skewness and make the variables more comparable across firms of different sizes. Turnover is logged as log(Turnover + 1) to accommodate firm-years with zero reported turnover, which would otherwise be undefined under a plain log. Market capitalization and total assets are strictly positive in the regression sample, and the log transformation is applied directly. Return on assets is computed only for firm-years with strictly positive total assets and is set to missing otherwise. Leverage is taken from the LSEG export as Total Debt as a percentage of Total Assets, so the variable is already expressed in percentage points (e.g. a value of 25 corresponds to a debt-to-assets ratio of 25 percent).

The final set of variables enters the descriptive statistics in Section 2.3.

2.3 Descriptive Statistics

Table 1 presents descriptive statistics for the variables used in the empirical analysis. The table reports the mean, standard deviation, minimum, median, and maximum for the main dependent variable, explanatory variables, and firm-level controls. All firm-year statistics are computed on the regression sample, after the quote-validity filters and the 1st/99th-percentile winsorization of the relative bid-ask spread and ROA. The sample contains 19,960 firm-year observations for all variables except the environmental and social pillar scores, which are each observed for 19,956 firm-years.

Table 1. Descriptive Statistics for Relative Bid-Ask Spread (Liquidity Measure), ESG Scores (0–100, Including Environmental, Social, and Governance Pillars), Annual Geopolitical Risk Index, and Firm-Level Controls (Log Turnover, Log Market Capitalization, Log Assets, Return on Assets, and Leverage) for European Firms, 2005–2024

	Mean	SD	Min	Median	Max
spread_rel	0.005	0.008	0.000	0.002	0.050
gpr_index	104.009	24.255	77.294	98.553	157.583
esg_score	53.157	20.220	0.627	54.451	95.664
e_score	50.581	26.748	0.000	52.087	99.063
s_score	55.806	23.229	0.368	57.703	98.470
g_score	51.984	22.732	0.385	53.071	98.753
log_turnover	14.447	2.454	0.077	14.597	25.923
log_mktcap	21.719	1.605	15.266	21.664	27.564
log_assets	22.237	1.956	15.569	22.074	28.701
roa	0.042	0.073	−0.261	0.038	0.276
leverage_pct	0.246	0.180	0.000	0.227	2.568

The relative bid-ask spread is reported here in raw proportional units (e.g., 0.0050 = 50 basis points). In the regression tables that follow, the same variable is multiplied by 10,000 and expressed in basis points so that coefficients appear on an interpretable scale.

ESG and pillar scores are on a 0–100 scale, the Geopolitical Risk Index is on the Caldara-Iacoviello scale, log turnover, log market capitalization, and log assets are in natural-log units, return on assets is a ratio, and leverage is a percentage.

Bid-ask spreads and return on assets are winsorized at the 1st and 99th percentiles of the regression sample to limit the influence of outliers.

The sample is the regression sample: firm-years with non-missing values for all variables used in the baseline specification.

The average relative bid-ask spread in the sample is 0.005, with a median of 0.002 and a standard deviation of 0.008. This indicates that most firms in the sample have relatively low bid-ask spreads, but the distribution is right-skewed, with some firms experiencing substantially higher trading costs even after winsorization. This variation is important for

the empirical analysis, since the relative bid-ask spread is the main measure of stock market liquidity.

The average ESG score is 53.157, while the environmental, social, and governance pillar scores have mean values of 50.581, 55.806, and 51.984, respectively. The standard deviations of the ESG variables indicate substantial cross-sectional variation in ESG performance across firms. This variation allows the analysis to examine whether firms with stronger ESG profiles experience different liquidity outcomes during periods of elevated geopolitical risk. The number of observations differs somewhat across the overall ESG score and the individual pillar scores, reflecting that some firms have an aggregate ESG score but are missing one or more pillar-level observations. As a result, the pillar-level regressions are estimated on slightly smaller samples than the baseline ESG specification.

The annual GPR index has a mean value of 104.009 and ranges from 77.294 to 157.583 over the sample period. Since the GPR index is aggregated to annual frequency, it varies only across years and not across firms, leaving twenty unique values for 2005-2024. This means that the GPR variable has substantially less variation than the firm-level variables. In the regression analysis, year fixed effects absorb the direct effect of annual GPR. Therefore, the empirical analysis focuses on the interaction between GPR and ESG, which captures whether the relationship between ESG and bid-ask spreads differs across years with different levels of geopolitical risk.

The control variables also show considerable variation across firms. The mean logarithm of turnover is 14.447, indicating substantial differences in trading activity across the sample. The mean logarithm of market capitalization is 21.719, while the mean logarithm of total assets is 22.237, reflecting variation in firm size. The average return on assets is 4.2%, suggesting moderate profitability across the sample, while average leverage is approximately 24.6% of total assets.

Table 1B reports the pairwise Pearson correlations between the relative bid-ask spread, the annual GPR index, the aggregate ESG score and its three pillars, and the firm-level controls, computed over the regression sample on pairwise complete observations. The matrix gives the reader a first view of the raw bivariate associations and a multicollinearity diagnostic before the regressions in Section 4. Two patterns are worth flagging in advance. First, the firm-size proxies, which are log market capitalization, log total assets, and log turnover, are mechanically highly correlated with one another and negatively correlated with the relative bid-ask spread, in line with that larger and more actively traded firms are more liquid. Second, the four ESG variables (aggregate score and three pillars) are positively but not perfectly correlated with one another, which justifies estimating the pillar regressions separately rather than entering the pillars jointly. Correlations between the GPR index and the firm-level variables are small in absolute terms, consistent with GPR varying only at the year level.

Table 1B. Pairwise Pearson Correlations Between the Relative Bid-Ask Spread, the Annual Geopolitical Risk Index, ESG Scores (Aggregate and Environmental, Social, and Governance Pillars), and Firm-Level Controls for European Firms, 2005–2024

	spread_rel	gpr_index	esg_score	e_score	s_score	g_score	log_turnover	log_mktcap	log_assets	roa	leverage_pct
spread_rel	1	.	.	.	.	.	.	.	.	.	.
gpr_index	.05	1	.	.	.	.	.	.	.	.	.
esg_score	−.28	.05	1	.	.	.	.	.	.	.	.
e_score	−.26	.02	.85	1	.	.	.	.	.	.	.
s_score	−.25	.06	.90	.72	1	.	.	.	.	.	.
g_score	−.20	.03	.72	.42	.45	1	.	.	.	.	.
log_turnover	−.51	−.11	.43	.41	.37	.31	1	.	.	.	.
log_mktcap	−.43	−.11	.52	.51	.47	.33	.74	1	.	.	.
log_assets	−.33	−.10	.51	.56	.44	.34	.62	.77	1	.	.
roa	−.09	−.04	−.04	−.04	−.02	−.05	.11	.19	−.11	1	.
leverage_pct	−.01	.01	.08	.07	.09	.03	.03	−.05	.02	−.18	1

This table reports pairwise Pearson correlation coefficients between the relative bid-ask spread (the liquidity measure), the annual Geopolitical Risk Index, the LSEG aggregate ESG score and its environmental, social, and governance pillars, and the firm-level controls (log turnover, log market capitalization, log assets, return on assets, and leverage).

Correlations are computed on the regression sample (firm-years with non-missing values for all variables used in the baseline specification), using pairwise complete observations.

All variables are at the firm-year level except the Geopolitical Risk Index, which varies only at the year level.

Bid-ask spreads and return on assets are winsorized at the 1st and 99th percentiles of the regression sample to limit the influence of outliers.

Overall, the descriptive statistics show meaningful variation in liquidity, ESG performance, and firm characteristics across the sample. At the same time, the annual structure of the data limits the ability to capture short-term market reactions to geopolitical events. The results should therefore be interpreted as evidence on annual firm-level differences in liquidity responses, rather than immediate liquidity reactions around specific geopolitical shocks.

3. Methodology

3.1 Empirical Framework

This study examines whether ESG performance moderates the relationship between geopolitical risk and stock market liquidity. The empirical framework is based on firm-year panel regressions and follows prior research studying the relationship between geopolitical risk, ESG, and firm-level financial outcomes. Fiorillo et al. (2024), for example, examine whether ESG performance moderates the effect of geopolitical risk on stock price crash risk, while this study focuses on stock market liquidity measured by bid-ask spreads.

The empirical setting differs from a standard panel model in one important respect. The GPR index varies by year but not by firm. Since the regressions include year fixed effects, the direct effect of GPR is absorbed by the year fixed effects and cannot be separately estimated. The empirical analysis therefore does not test whether geopolitical risk increases bid-ask spreads on average. Instead, it tests whether firms with different ESG performance experience different liquidity outcomes in years with higher geopolitical risk. The coefficient of interest is therefore the interaction between ESG and GPR, identified from cross-sectional differences in ESG within years interacted with annual GPR levels.

3.2 Baseline Model Specification

The baseline specification is estimated using the following firm-year panel regression:

$$Spread_{it} = \alpha_i + \lambda_t + \beta_1 ESG_{it}^c + \beta_2 GPR_t^c + \beta_3 (GPR_t^c \times ESG_{it}^c) + \gamma X_{it} + \varepsilon_{it}$$

where $Spread_{it}$, is the relative bid-ask spread for firm *i* in year *t*. ESG_{it}^c is the centered ESG score, and GPR_t^c is the centered annual GPR index. X_{it} is a vector of firm-level control variables, including log turnover, log market capitalization, log total assets, return on assets, and leverage. α_i denotes firm fixed effects, λ_t denotes year fixed effects, and ε_{it} is the error term. Because GPR_t^c varies only across years, its direct effect is absorbed by year fixed effects and cannot be separately estimated. The coefficient of interest is therefore β_3, the interaction between ESG and GPR. Throughout the specifications in this section, $Spread_{it}$ denotes the relative bid-ask spread expressed in basis points; the raw spread is multiplied by 10,000 prior to estimation so that the coefficients appear on an interpretable scale.

The ESG and GPR variables are centered by subtracting their respective sample means. Centering does not affect the fit of the regression or the statistical significance of the interaction term, but it improves interpretation. With centering, the coefficient on the centered ESG score can be read as the association between ESG and bid-ask spreads when GPR is at its sample mean. The interaction coefficient, β_3, captures whether the relationship between ESG and bid-ask spreads changes when geopolitical risk is higher.

Based on the hypothesis, the expected sign of β_3 is negative. A negative coefficient would indicate that firms with higher ESG scores experience smaller increases in bid-ask spreads when geopolitical risk rises. In other words, stronger ESG performance would mitigate liquidity deterioration during periods of elevated geopolitical risk. A positive coefficient would instead indicate that higher-ESG firms experience wider bid-ask spreads when GPR is higher.

Firm fixed effects control for time-invariant firm characteristics, such as business model, industry positioning, and persistent differences in disclosure practices. Year fixed effects control for common macroeconomic and financial shocks affecting all firms each year. Standard errors are clustered at the firm level to account for serial correlation within firms over time (Petersen, 2009).

3.3 ESG Pillar Specifications

To examine whether the baseline relationship is driven by specific ESG dimensions, the aggregate ESG score is replaced by the environmental, social, and governance pillar scores. The pillar specifications follow the same structure as the baseline model:

$$Spread_{it} = \alpha_i + \lambda_t + \beta_1 Pillar_{it}^c + \beta_2 GPR_t^c + \beta_3 (GPR_t^c \times Pillar_{it}^c) + \gamma X_{it} + \varepsilon_{it}$$

where $Pillar_{it}^c$ refers to the centered environmental, social or governance score. This allows the analysis to assess whether the moderating role of ESG is concentrated in one specific pillar rather than in the aggregate ESG score. As in the baseline model, the direct effect of GPR_t^c is absorbed by year fixed effects, so the coefficient of interest is the interaction term β_3.

3.4 High-GPR and Conflict Spike Specifications

The baseline specification uses the continuous annual GPR index. As an alternative, the analysis also estimates specifications using indicator variables for periods of elevated geopolitical risk. This approach tests whether the ESG-liquidity relationship differs specifically during high-risk years rather than changing linearly with the annual GPR index.

The high-GPR specification is:

$$Spread_{it} = \alpha_i + \lambda_t + \beta_1 ESG^c_{it} + \beta_2 HighGPR_t + \beta_3 (HighGPR_t \times ESG^c_{it}) + \gamma X_{it} + \varepsilon_{it}$$

where $HighGPR_t$ is an indicator variable equal to one in years where the annual GPR index is in the top 20% of the sample distribution, and zero otherwise. The threshold is computed as the 80th percentile of the twenty annual GPR values in the sample and identifies the years with the highest geopolitical-risk environment.

In addition, a conflict spike specification is estimated to examine whether the ESG-liquidity relationship differs during years associated with particularly elevated geopolitical tensions. The variable $ConflictSpike_t$ is an indicator equal to one for 2022 and 2024, and zero otherwise. These years are selected ex ante based on major armed-conflict episodes affecting Europe and represent the largest annual GPR realizations in the sample.

The specification is estimated as:

$$Spread_{it} = \alpha_i + \lambda_t + \beta_1 ESG^c_{it} + \beta_2 ConflictSpike_t + \beta_3 (ConflictSpike_t \times ESG^c_{it}) + \gamma X_{it} + \varepsilon_{it}$$

As with the continuous GPR specification, the direct effects of $HighGPR_t$ and $ConflictSpike_t$ are absorbed by year fixed effects because these variables only vary across years. The coefficients of interest are therefore the interaction terms. A negative coefficient would indicate that higher-ESG firms experience relatively smaller liquidity deterioration during high-GPR or conflict spike years. The two specifications are reported side-by-side in Table 3: the high-GPR dummy provides a data-driven definition of extreme-risk years, while the conflict-spike dummy provides an event-based definition tied to the most acute geopolitical episodes affecting Europe in the sample period.

For the high-GPR specification, the 80th-percentile threshold is selected to balance two competing concerns. With twenty annual GPR observations available, finer cuts substantially reduce the number of treated years and weaken the statistical identification of the interaction; coarser cuts dilute the contrast between elevated-risk and normal years. A top-20% cut yields four treated years (2017, 2022, 2023, and 2024) against sixteen control years, which retains sufficient variation while still isolating periods of clearly elevated geopolitical risk.

The conflict-spike specification, by contrast, focuses narrowly on the two years with the largest annual GPR realizations in the sample, both of which correspond to major armed-conflict episodes affecting Europe: 2022, the year of Russia's full-scale invasion of Ukraine, and 2024, the year of the further escalation of the Russo-Ukrainian war alongside the Israel-Gaza conflict and Red Sea attacks. The two specifications are complementary: the high-GPR dummy identifies a broader set of elevated-risk years using the GPR distribution, while the conflict-spike dummy restricts attention to the two years where elevated GPR coincides with a major armed-conflict episode.

3.5 High-ESG Specification

The analysis also examines whether firms with persistently high ESG performance exhibit different sensitivity to geopolitical risk. Firms are classified as high-ESG firms if their average ESG score over the sample period is above the 70th percentile of the cross-sectional distribution of firm-level average ESG scores, that is, the top 30% of firms by long-run ESG performance. The classification is time-invariant by construction.

The following specification is estimated:

$$Spread_{it} = \alpha_i + \lambda_t + \beta_1 GPR_t^c + \beta_2 HighESG_i + \beta_3 (GPR_t^c \times HighESG_i) + \gamma X_{it} + \varepsilon_{it}$$

where $HighESG_i$ is an indicator variable equal to one for firms classified as high-ESG, and zero otherwise. Since $HighESG_i$ is time-invariant, its direct effect is absorbed by firm fixed effects. Similarly, the direct effect of GPR_t^c is absorbed by year fixed effects because GPR varies only across years. The coefficient of interest is therefore the interaction term, β_3, which captures whether high-ESG firms experience different liquidity outcomes than lower-ESG firms when geopolitical risk is higher.

A negative coefficient would indicate that high-ESG firms experience relatively smaller increases in bid-ask spreads when geopolitical risk rises. A positive coefficient would instead indicate that high-ESG firms experience relatively wider bid-ask spreads in years with higher geopolitical risk.

3.6 Size Heterogeneity

As an additional heterogeneity test, the high-ESG specification is estimated separately by firm size. Firms are sorted into terciles based on their average log market capitalization over the sample period, with the first tercile containing small firms, the second tercile containing medium-sized firms, and the third tercile containing large firms. Within each tercile we re-estimate the high-ESG specification of Section 3.5, with one adjustment: log market capitalization is dropped from the control vector, because firms within a tercile are bucketed on (firm-average) log market capitalization and within-bucket variation in firm size is mechanically compressed. The remaining controls, log turnover, log total assets, return on assets, and leverage, are retained, and firm and year fixed effects continue to absorb time-invariant firm differences and common annual shocks.

The coefficient of interest in each tercile regression remains the interaction between GPR_t^c and $HighESG_i$, estimated separately within each size group. This test examines whether the differential GPR sensitivity of high-ESG firms varies across firms of different sizes, for instance, whether high-ESG small firms experience larger spread movements during high-GPR years than high-ESG large firms.

3.7 Identification and Limitations

The empirical strategy relies on firm and year fixed effects to reduce omitted-variable bias. Firm fixed effects control for time-invariant differences across firms, such as industry affiliation, country of headquarters, business model, and persistent differences in disclosure practices. Year fixed effects control for common shocks affecting all firms each year, including macroeconomic conditions, financial market developments, and global geopolitical events. Standard errors are clustered at the firm level throughout.

However, the analysis should not be interpreted as fully causal. ESG performance is not randomly assigned, and firms with higher ESG scores may differ systematically from firms with lower ESG scores. High-ESG firms tend to be larger, more profitable, more visible, and more transparent (Gillan et al., 2021), which are characteristics that may independently affect bid-ask spreads. Although the control variables and firm fixed effects address part of this concern, time-varying omitted variables may still bias the estimated coefficients. For example, changes in investor attention, disclosure quality, ownership structure, or international exposure may be correlated with both ESG scores and liquidity.

A further identification issue concerns the structure of the GPR variable. The GPR index varies only across years and not across firms. Since the regressions include year fixed effects, the direct effect of GPR is absorbed and cannot be separately estimated. The interaction term therefore identifies whether the relationship between ESG and bid-ask spreads differs across years with different levels of geopolitical risk. Consequently, the analysis does not estimate whether geopolitical risk increases bid-ask spreads for the average firm. Instead, it estimates whether high- and low-ESG firms experience different liquidity outcomes when geopolitical risk is higher.

The annual frequency of the data is another important limitation. ESG and liquidity data are observed at annual frequency, while the GPR index is originally available at higher frequency and is aggregated to annual averages. This aggregation makes the variables consistent within the firm-year panel, but it reduces the ability to capture short-term liquidity responses to geopolitical events. Since bid-ask spreads may react quickly to geopolitical shocks, annual observations may smooth over important within-year variation.

Finally, the available time-series variation in GPR is limited. The annual GPR index provides only one value per year, yielding 20 unique annual observations across the 2005-2024 sample. With year fixed effects absorbing the main variation in GPR, the interaction between ESG and GPR is identified from cross-sectional differences across firms within each year, interacted with annual GPR levels. This limited variation reduces the statistical power of the test and makes it more difficult to detect robust relationships. Therefore, insignificant results in the alternative specifications should be interpreted with caution, as they may reflect limited power rather than the absence of an underlying effect.

4. Empirical Analysis

This section presents the empirical results on the relationship between ESG performance, geopolitical risk (GPR), and stock market liquidity. The dependent variable throughout the analysis is the relative bid-ask spread, expressed in basis points. Since wider bid-ask spreads reflect higher transaction costs and lower liquidity, positive coefficients indicate a deterioration in liquidity.

Because the regressions include year fixed effects, the direct effect of GPR is absorbed and cannot be separately estimated. The analysis therefore does not test whether geopolitical risk increases bid-ask spreads in general. Instead, the coefficient of interest is the interaction between ESG and GPR, which captures whether firms with higher ESG scores experience different liquidity outcomes than firms with lower ESG scores in years with higher geopolitical risk.

4.1 Baseline Results

Table 2 presents the baseline regression results. The first column estimates the interaction between the aggregate ESG score and the annual GPR index. The coefficient on the interaction term is positive and statistically significant at the 1% level (coefficient 0.003). This result does not support the hypothesis that higher ESG performance mitigates liquidity deterioration during periods of elevated geopolitical risk. Instead, the result suggests that firms with higher ESG scores experience wider bid-ask spreads when geopolitical risk is higher.

Table 2. Baseline Regressions of Relative Bid-Ask Spreads on ESG Scores (Aggregate and Environmental, Social, and Governance Pillars), the Geopolitical Risk Index, and Their Interaction for European Firms, 2005–2024

	(1) Overall ESG	(2) Environmental	(3) Social	(4) Governance
ESG Score (centered)	−0.143**			
	(0.057)			
Environmental Score (centered)		−0.113***		
		(0.039)		
Social Score (centered)			−0.008	
			(0.044)	
Governance Score (centered)				−0.083**
				(0.037)
Log Turnover	−9.817***	−9.840***	−9.815***	−9.900***
	(1.043)	(1.046)	(1.049)	(1.044)
Log Market Cap	−7.018***	−7.026***	−7.019***	−6.840***
	(1.782)	(1.789)	(1.790)	(1.785)
Log Assets	2.602	2.538	1.986	2.107
	(1.775)	(1.781)	(1.752)	(1.751)
ROA	−12.033	−11.719	−11.934	−11.761
	(8.607)	(8.615)	(8.589)	(8.605)
Leverage	10.864	11.424*	10.840	10.990
	(6.711)	(6.703)	(6.716)	(6.709)
ESG (centered) × GPR (centered)	0.003***			
	(0.001)			
Environmental (centered) × GPR (centered)		0.002***		
		(0.001)		
Social (centered) × GPR (centered)			0.004***	
			(0.001)	
Governance (centered) × GPR (centered)				0.001
				(0.001)
Observations	19932	19929	19929	19932
R-squared	0.581	0.581	0.581	0.580

* p < 0.1, ** p < 0.05, *** p < 0.01

The dependent variable is the relative bid-ask spread expressed in basis points (1 basis point = 0.01%); raw spread values were multiplied by 10,000 prior to estimation so that coefficients are reported on an interpretable scale.

All independent variables are on their native scales: ESG and pillar scores on a 0–100 scale, the Geopolitical Risk Index on the Caldara-Iacoviello scale, log turnover, log market capitalization, and log assets in natural-log units, return on assets as a ratio, and leverage as a percentage.

All models include firm and year fixed effects.

Standard errors clustered at the firm level are reported in parentheses.

ESG, pillar (E, S, G), and GPR scores marked '(centered)' are demeaned by the regression-sample mean. With centering, the main effect of each variable can be read as the effect at the sample-average value of the other interacted variable.

The continuous Geopolitical Risk Index varies only at the year level and is therefore absorbed by the year fixed effects; only its interaction with ESG is identified.

This finding is contrary to the expectation derived from prior literature. Previous studies suggest that stronger ESG or CSR characteristics may improve firm resilience by reducing information asymmetry, strengthening stakeholder relationships, and improving trust during periods of uncertainty (Albuquerque et al., 2019; Lins et al., 2017; Ding et

al., 2021; Fiorillo et al., 2024). In contrast, the baseline result indicates that ESG performance is not associated with lower liquidity frictions in high-GPR years.

The main effect of ESG is negative and statistically significant at the 5% level (coefficient −0.143). At the sample-mean level of geopolitical risk, firms with higher ESG scores therefore tend to have narrower bid-ask spreads, after controlling for firm and year fixed effects and the firm-level controls. Among the controls, log turnover is negative and statistically significant at the 1% level across specifications, indicating that higher trading activity is associated with narrower bid-ask spreads. Log market capitalization is likewise negative and significant at the 1% level, consistent with larger firms being more liquid. The remaining controls (log assets, ROA, and leverage) are not statistically significant.

Overall, the baseline result suggests that ESG does not improve liquidity during periods of geopolitical stress. The robustness of this finding across alternative specifications is examined in the sections that follow.

4.2 ESG Pillar Analysis

Columns 2-4 of Table 2 replace the aggregate ESG score with the environmental, social, and governance pillar scores. This allows us to examine whether the baseline result is driven by a specific ESG dimension.

The interaction between GPR and the environmental score is positive and statistically significant at the 1% level (coefficient 0.002). The interaction between GPR and the social score is also positive and statistically significant at the 1% level (coefficient 0.004). In contrast, the interaction between GPR and the governance score is small (coefficient 0.001) and statistically insignificant. These results suggest that the positive baseline interaction is mainly driven by the environmental and social pillars, while governance does not appear to have a systematic relationship with bid-ask spreads during periods of elevated geopolitical risk.

This result is noteworthy because Fiorillo et al. (2024) find that the mitigating role of ESG in the relationship between GPR and stock price crash risk is mainly driven by the environmental and social dimensions. Our results differ from theirs: rather than indicating that environmental and social performance reduce financial market vulnerability during geopolitical stress, the positive coefficients suggest that firms with stronger environmental and social scores experience wider bid-ask spreads when GPR is higher.

The pillar main effects are mixed: the environmental score is negative and statistically significant at the 1% level (coefficient −0.113), the governance score is negative and statistically significant at the 5% level (coefficient −0.083), and the social score is small and statistically insignificant. At the sample-mean level of geopolitical risk, higher environmental and governance scores are therefore associated with narrower bid-ask spreads, while the social score has no detectable relationship with liquidity outside its interaction with GPR.

4.3 High-GPR and Conflict Spike Specifications

Table 3 presents alternative specifications in which the continuous GPR index is replaced by indicator variables for elevated geopolitical-risk periods. Column 1 defines high-GPR years as years in the top 20% of the annual GPR distribution over the sample. Column 2

uses an event-based indicator that takes the value one in the conflict spike years 2022 and 2024, and zero otherwise. Both indicators are interacted with ESG.

Table 3. Regressions of Relative Bid-Ask Spreads on ESG Scores and Their Interaction with Indicators for High Geopolitical Risk Periods (Top 20% of the GPR Distribution) and Years of Acute Geopolitical Conflict for European Firms, 2005-2024

	(1) High GPR (Top 20%)	(2) Conflict Spike Years
ESG Score (centered)	−0.201***	−0.179***
	(0.055)	(0.055)
Log Turnover	−9.776***	−9.866***
	(1.044)	(1.045)
Log Market Cap	−7.117***	−6.880***
	(1.785)	(1.780)
Log Assets	2.697	2.494
	(1.770)	(1.778)
ROA	−12.018	−11.754
	(8.595)	(8.616)
Leverage	10.620	11.034*
	(6.723)	(6.693)
ESG (centered) x High GPR (Top 20%)	0.245***	
	(0.056)	
ESG (centered) x Conflict Spike		0.059
		(0.061)
Observations	19932	19932
R-squared	0.581	0.580

* p < 0.1, ** p < 0.05, *** p < 0.01

The dependent variable is the relative bid-ask spread expressed in basis points (1 basis point = 0.01%); raw spread values were multiplied by 10,000 prior to estimation so that coefficients are reported on an interpretable scale.

All independent variables are on their native scales: ESG and pillar scores on a 0-100 scale, the Geopolitical Risk Index on the Caldara-Iacoviello scale, log turnover, log market capitalization, and log assets in natural-log units, return on assets as a ratio, and leverage as a percentage.

All models include firm and year fixed effects.

Standard errors clustered at the firm level are reported in parentheses.

ESG, pillar (E, S, G), and GPR scores marked '(centered)' are demeaned by the regression-sample mean. With centering, the main effect of each variable can be read as the effect at the sample-average value of the other interacted variable.

The continuous Geopolitical Risk Index varies only at the year level and is therefore absorbed by the year fixed effects; only its interaction with ESG is identified.

The two specifications yield different conclusions. In Column 1, the interaction between ESG and the top-20% high-GPR indicator is positive and statistically significant at the 1% level (coefficient 0.245), mirroring the sign and significance of the baseline continuous-GPR result. In Column 2, by contrast, the interaction between ESG and the conflict-spike indicator is small and statistically insignificant. The positive ESG-GPR interaction is therefore robust to redefining geopolitical risk as a broad top-20% indicator of elevated-risk years, but it does not survive when geopolitical risk is restricted to the two acute conflict-spike years (2022 and 2024).

Overall, Table 3 provides partial support for the baseline result. The positive ESG-GPR interaction is reproduced when elevated-risk years are defined using the top-20% high-

GPR indicator, but it is not detected when geopolitical risk is restricted to the narrow set of acute conflict-spike years.

4.4 Differential GPR Sensitivity of High-ESG Firms

Table 4 examines whether firms with persistently high ESG scores experience different liquidity responses to geopolitical risk. High-ESG firms are defined as firms in the top 30% of the distribution of firm-level average ESG scores. Specifically, each firm's average ESG score is calculated over the sample period, and firms above the 70th percentile are classified as high-ESG firms. The classification is therefore time-invariant within firms.

Table 4. Differential Sensitivity of Relative Bid-Ask Spreads to Geopolitical Risk Across Firms with High versus Low ESG Scores for European Firms, 2005–2024

	(1) High vs Low ESG
Log Turnover	−9.877***
	(1.046)
Log Market Cap	−6.976***
	(1.793)
Log Assets	1.944
	(1.744)
ROA	−11.688
	(8.597)
Leverage	10.643
	(6.699)
High ESG × GPR (centered)	0.130***
	(0.031)
Observations	19932
R-squared	0.580

* p < 0.1, ** p < 0.05, *** p < 0.01

The dependent variable is the relative bid-ask spread expressed in basis points (1 basis point = 0.01%); raw spread values were multiplied by 10,000 prior to estimation so that coefficients are reported on an interpretable scale.

All independent variables are on their native scales: ESG and pillar scores on a 0–100 scale, the Geopolitical Risk Index on the Caldara-Iacoviello scale, log turnover, log market capitalization, and log assets in natural-log units, return on assets as a ratio, and leverage as a percentage.

All models include firm and year fixed effects.

Standard errors clustered at the firm level are reported in parentheses.

ESG, pillar (E, S, G), and GPR scores marked '(centered)' are demeaned by the regression-sample mean. With centering, the main effect of each variable can be read as the effect at the sample-average value of the other interacted variable.

The continuous Geopolitical Risk Index varies only at the year level and is therefore absorbed by the year fixed effects; only its interaction with ESG is identified.

The coefficient on the interaction between GPR and the high-ESG indicator is positive and statistically significant at the 1% level (coefficient 0.130). This indicates that high-ESG firms experience wider bid-ask spreads than lower-ESG firms when geopolitical risk is higher. This result is consistent with the baseline specification, in which the continuous ESG-GPR interaction is also positive.

However, this result again contradicts the hypothesis. If ESG improved firm resilience during periods of geopolitical stress, the interaction term would be expected to be

negative. Instead, the positive coefficient suggests that high-ESG firms are more exposed to liquidity deterioration when geopolitical risk increases.

One possible interpretation is that high-ESG firms attract greater investor attention, which may lead to increased trading activity and heterogeneous investor reactions during periods of uncertainty (Barber and Odean, 2008). Another possibility is that ESG scores reflect more complex information environments, especially when investors disagree about the meaning or quality of ESG performance. This interpretation is consistent with the ESG rating disagreement literature, which shows that ESG ratings may introduce uncertainty rather than reduce it when investors interpret ESG information differently (Berg et al., 2022; Christensen et al., 2022).

4.5 Size Heterogeneity

Table 5 investigates whether the relationship between ESG, GPR, and liquidity differs across firm size. The sample is divided into three groups based on firm-level average log market capitalization: small, medium-sized, and large firms. The high-ESG specification is then estimated separately for each size group, with log market capitalization dropped from the controls (because firms within a tercile have very limited variation in size).

Table 5. Regressions of Relative Bid-Ask Spreads on ESG Scores, Geopolitical Risk, and Their Interaction Across Firm Size Terciles (Small, Medium, and Large Firms) for European Firms, 2005–2024

	(1) Small Firms	(2) Medium Firms	(3) Large Firms
Log Turnover	−15.786***	−10.660***	−5.937***
	(1.969)	(1.610)	(1.546)
Log Assets	−9.562	−5.434**	1.643
	(6.454)	(2.378)	(1.754)
ROA	−67.254***	−30.790***	6.248
	(24.695)	(10.218)	(9.341)
Leverage	32.583*	1.046	13.962**
	(19.762)	(7.855)	(5.829)
High ESG × GPR (centered)	0.128	0.075	0.075**
	(0.133)	(0.046)	(0.034)
Observations	4082	6480	9370
R-squared	0.585	0.410	0.331

* p < 0.1, ** p < 0.05, *** p < 0.01

The dependent variable is the relative bid-ask spread expressed in basis points (1 basis point = 0.01%); raw spread values were multiplied by 10,000 prior to estimation so that coefficients are reported on an interpretable scale.

All independent variables are on their native scales: ESG and pillar scores on a 0–100 scale, the Geopolitical Risk Index on the Caldara-Iacoviello scale, log turnover, log market capitalization, and log assets in natural-log units, return on assets as a ratio, and leverage as a percentage.

All models include firm and year fixed effects.

Standard errors clustered at the firm level are reported in parentheses.

ESG, pillar (E, S, G), and GPR scores marked '(centered)' are demeaned by the regression-sample mean. With centering, the main effect of each variable can be read as the effect at the sample-average value of the other interacted variable.

The continuous Geopolitical Risk Index varies only at the year level and is therefore absorbed by the year fixed effects; only its interaction with ESG is identified.

The interaction between GPR and the high-ESG indicator is positive in all three size groups, but the statistical significance varies across terciles. The coefficient is largest for

small firms (0.128) but is statistically insignificant because the standard error is large (0.133). For medium-sized firms the coefficient is smaller (0.075) and also statistically insignificant. For large firms the coefficient is likewise 0.075 but is estimated more precisely (standard error 0.034) and is statistically significant at the 5% level.

Taken together, the size-tercile results provide only limited evidence of size-related heterogeneity. The interaction is statistically significant only in the large-firm tercile, where it is also the most precisely estimated, while the small- and medium-firm coefficients are statistically indistinguishable from zero. Although smaller firms may be expected to have more fragile liquidity and wider spreads, the estimates do not support the view that ESG matters more for small firms during periods of geopolitical risk; if anything, the only detectable differential GPR sensitivity in this specification is concentrated among large firms.

Log turnover remains negative and statistically significant across the size-group specifications, confirming that trading activity is consistently associated with narrower bid-ask spreads.

4.6 Summary of Empirical Findings

The empirical results reject the resilience hypothesis in a direction that is itself informative. The baseline specification shows a positive and statistically significant interaction between ESG and GPR, indicating that higher-ESG firms experience wider bid-ask spreads when geopolitical risk is higher, and the same pattern appears in the high-ESG specification using a top-30% indicator. The pillar analysis shows that this pattern is driven by the environmental and social pillars, while the governance pillar interaction is small and insignificant.

The result holds across most alternative specifications. When geopolitical risk is measured using a discrete top-20% high-GPR indicator, the ESG interaction remains positive and statistically significant, consistent with the baseline. By contrast, when geopolitical risk is restricted to the event-based conflict-spike years 2022 and 2024, the ESG interaction is statistically insignificant. The size-tercile tests provide only limited evidence of size-related heterogeneity: the high-ESG-GPR interaction is statistically significant only in the large-firm tercile, while the small- and medium-firm coefficients are statistically indistinguishable from zero. The positive interaction therefore appears to reflect cross-sectional variation in the continuous ESG-GPR relationship and a pattern that is concentrated among large firms in the discrete tercile split, rather than a stable pattern that survives every alternative measurement of geopolitical stress.

Taken together, the findings point to a two-part pattern. At the sample-mean level of geopolitical risk, higher ESG scores are associated with narrower bid-ask spreads, as shown by the negative and statistically significant ESG main effects in the baseline and high-GPR/conflict-spike specifications. As geopolitical risk rises, however, the positive ESG-GPR interaction implies that this liquidity advantage shrinks and, at sufficiently high levels of GPR, reverses - so that high-ESG firms experience relatively wider spreads in stressed periods. The interaction is robust to the continuous GPR index, the top-20% high-GPR indicator, and the high-ESG dummy, but it does not survive when geopolitical risk is restricted to the conflict-spike years 2022 and 2024 and is detected only in the large-firm tercile in the size split. The picture that emerges is therefore one in which ESG

is associated with better average liquidity but a steeper deterioration when geopolitical risk is elevated, in contrast to the unconditional resilience predicted by the hypothesis.

5. Discussion

5.1 Interpretation of Main Findings

The empirical analysis points to a layered relationship between ESG performance, geopolitical risk, and stock market liquidity. At the sample-mean level of GPR, the negative and statistically significant ESG main effect in the baseline specification indicates that firms with higher ESG scores have narrower bid-ask spreads on average, consistent with the view that ESG performance is associated with greater liquidity in normal conditions. The positive ESG-GPR interaction, however, indicates that this liquidity advantage is state-dependent: as geopolitical risk rises, the spread between high- and low-ESG firms narrows, and, at sufficiently elevated levels of GPR, reverses, so that high-ESG firms experience wider spreads than lower-ESG firms. This conditional reversal contrasts with the prevailing expectation that ESG performance should unambiguously mitigate adverse market outcomes in times of uncertainty.

Given the inclusion of year fixed effects, the analysis does not identify the direct effect of geopolitical risk on liquidity, but rather whether ESG alters firms' relative exposure to such risk. The positive interaction between ESG and GPR therefore suggests that, in the baseline specification, higher-ESG firms experience a greater widening in bid-ask spreads than lower-ESG firms when geopolitical risk is elevated. The high-ESG indicator specification reinforces this pattern: firms in the top 30% of long-run ESG performance show a positive and significant differential GPR sensitivity relative to lower-ESG firms.

The pattern holds across most, though not all, alternative specifications. When geopolitical risk is captured using a top-20% high-GPR dummy, the ESG interaction remains positive and statistically significant, in line with the baseline. However, when geopolitical risk is restricted to the conflict-spike years 2022 and 2024, the interaction between ESG and the elevated-risk indicator is no longer statistically significant. The size-tercile split shows that the high-ESG-GPR interaction is statistically significant only in the large-firm tercile, while the coefficients for small- and medium-sized firms are statistically indistinguishable from zero. The positive interaction therefore appears most clearly in the continuous-GPR specifications, in the broad top-20% high-GPR indicator, and, within the size split, among large firms; it does not survive when geopolitical risk is restricted to the narrow conflict-spike years or when the sample is restricted to smaller firms.

Taken together, the results suggest that the relationship between ESG and liquidity is state-contingent rather than uniformly favorable or unfavorable. The negative ESG main effects indicate that higher-ESG firms tend to have narrower spreads at average levels of geopolitical risk, while the positive ESG-GPR interaction indicates that this advantage narrows as GPR rises and is reversed at high GPR levels. This conditional pattern emerges most clearly in the continuous-GPR baseline, in the top-20% high-GPR specification, and in the size-tercile split among large firms; it is not detected when geopolitical risk is restricted to the two conflict-spike years or in the smaller size terciles, where limited time-series variation in GPR and smaller sub-samples also reduce statistical power. The

findings therefore document a state-dependent ESG-liquidity relationship, in contrast to the unconditional ESG resilience predicted by prior literature.

5.2 Relation to Literature

Prior research generally suggests that stronger ESG characteristics are associated with enhanced firm resilience during crisis periods through stronger brand loyalty and product differentiation (Albuquerque et al., 2019), strong governance (Ding et al., 2021), and stakeholder support (Lins et al., 2017). Similarly, better reputation and greater transparency associated with ESG performance mitigate the effect of geopolitical risk on stock price crash risk (Fiorillo et al., 2024).

However, the ESG literature is mixed. Bae et al. (2021) find that CSR activities did not improve stock returns during the COVID-19 pandemic, challenging the idea that ESG consistently enhances firm resilience during periods of increased stress. Our findings partially align with prior work in the unconditional cross-section: the negative ESG main effects in the baseline and Table 3 specifications are consistent with the broader literature linking stronger ESG performance to narrower bid-ask spreads and better market liquidity on average (e.g., Egginton and McBrayer, 2019; He et al., 2023). The novel feature of our results is the conditional pattern - the positive ESG-GPR interaction - which indicates that this average liquidity advantage weakens, and ultimately reverses, in periods of elevated geopolitical risk. Relative to Fiorillo et al. (2024), who document an ESG-related mitigation of crash risk under geopolitical stress, our results provide more limited support for the hypothesis that ESG mitigates trading-friction outcomes during geopolitical uncertainty.

We examine market liquidity through bid-ask spreads rather than firm value or crash risk, which is one possible explanation for the differing results. Bid-ask spreads reflect information asymmetry (Glosten and Milgrom, 1985), trading frictions, and are priced in expected returns (Amihud and Mendelson, 1986). Heightened geopolitical stress may increase uncertainty, causing liquidity providers to demand higher compensation for bearing informational (Glosten and Milgrom, 1985). Furthermore, such market frictions may outweigh the potential reputational and stakeholder-related resilience associated with strong ESG performance.

Findings related to ESG measurement uncertainty may provide another explanation for the results. Our study relies exclusively on LSEG ESG ratings, which represents a limitation of the analysis. Previous literature documents substantial divergence across ESG rating providers (Berg et al., 2022) and shows that disagreement across ESG rating agencies is increased by greater ESG disclosure (Christensen et al., 2022). When geopolitical uncertainty increases, the ambiguity associated with ESG ratings may amplify disagreement among investors rather than reduce uncertainty, potentially contributing to wider bid-ask spreads for high-ESG firms.

5.3 Economic Mechanisms

Although the results do not allow for strong causal conclusions, several potential mechanisms may help explain why the liquidity advantage associated with higher ESG performance at the sample-mean level of geopolitical risk appears to erode, and ultimately reverse, as geopolitical risk rises.

One possible explanation is that ESG scores proxy for firm visibility and investor attention. Firms with higher ESG ratings are often larger, more transparent, and more closely followed by investors (Gillan et al., 2021). During periods of geopolitical uncertainty, such firms may attract increased trading activity driven by information asymmetries and differing investor expectations, which can widen bid-ask spreads.

A related mechanism concerns investor behavior. ESG-focused investors may be more active during periods of heightened geopolitical risk, either rebalancing portfolios or adjusting exposure to perceived risks. If ESG investors respond more strongly to geopolitical developments, this could generate temporary order imbalances, contributing to wider spreads for high-ESG firms.

Another explanation is linked to the measurement of ESG itself. ESG scores capture a broad set of firm characteristics, including disclosure practices, governance structures, and stakeholder engagement. These factors may correlate with other firm attributes, such as firm size, transparency, or international exposure, which independently affect liquidity during periods of geopolitical stress. This raises the possibility that the positive interaction between ESG and GPR reflects underlying firm characteristics rather than ESG performance itself.

Finally, the temporal structure of the data may also play a role. While ESG scores and bid-ask spreads are measured at annual frequency, the GPR index is originally constructed at a higher frequency and is aggregated to annual averages in this study. This aggregation may obscure short-term fluctuations in geopolitical risk and weaken the ability to capture immediate market responses to geopolitical events. As a result, the analysis reflects broader annual patterns rather than short-term dynamics in liquidity.

5.4 Limitations and External Validity

Several limitations of the empirical approach are important when interpreting the results.

A key concern is endogeneity. ESG performance is not randomly assigned, and firms with higher ESG scores tend to differ systematically from other firms. They are often larger, more profitable, and more transparent which are characteristics that are independently associated with tighter bid-ask spreads. The inclusion of firm fixed effects helps control for time-invariant differences across firms, and the firm-level controls absorb part of the remaining cross-sectional heterogeneity, but neither fully addresses time-varying confounding factors. Changes in investor attention, disclosure quality, ownership structure, or international exposure may move with both ESG performance and liquidity over time, which limits the strength of any causal interpretation.

A second limitation is that we rely exclusively on LSEG ESG ratings. Berg et al. (2022) document substantial divergence across major ESG providers, and Christensen et al. (2022) show that greater ESG disclosure tends to widen rather than narrow disagreement across rating agencies. Because our analysis uses a single provider, the estimated coefficients may be specific to LSEG's methodology and could differ in magnitude, or potentially in sign, under an alternative provider such as MSCI, Sustainalytics, or S&P Global. This is both an interpretational caveat for the present results and an external-validity concern: a study repeating the design with a different ESG vendor could plausibly find different patterns. Triangulating ESG measurement across providers, as in the rating-

disagreement literature, would help establish whether the ESG-GPR-liquidity relationship is a robust feature of the data or a feature of the rating instrument.

A third limitation concerns sample selection. The sample is restricted to firms with a market capitalization of at least €100 million, which improves data quality but limits external validity. Smaller firms typically have lower liquidity, weaker ESG coverage, and a different investor base. As a result, the findings should not be generalized to the small-cap segment without caution.

Another limitation relates to the measurement of geopolitical risk. The GPR index reflects global geopolitical conditions based on U.S. newspaper coverage and may not fully capture the specific exposure of European firms to geopolitical risk. This may introduce measurement error in the key explanatory variable and works against finding a precisely estimated effect.

A further limitation concerns the temporal alignment of the variables. While ESG scores and bid-ask spreads are observed at annual frequency, geopolitical risk is incorporated through annual averages of the GPR index. This reduces the time-series variation in geopolitical risk and may attenuate the estimated relationship between GPR and liquidity, since within-year movements in spreads around specific events are smoothed away by the annual average.

An additional limitation concerns the statistical power of the analysis. The GPR index varies only at the annual level, providing 20 unique observations across the 2005-2024 sample. With year fixed effects absorbing the main variation in GPR, the interaction between ESG and GPR is identified from cross-sectional differences across firms within each year, interacted with annual GPR levels. This limited variation reduces the statistical power of the test and makes it more difficult to detect robust relationships. As a result, insignificant findings - particularly in the alternative shock-dummy and size-tercile specifications - should be interpreted with caution, as they may reflect limited power rather than the absence of an underlying effect.

The sample selection also affects external validity beyond the small-cap exclusion discussed above. The dataset includes only European firms with available ESG data from LSEG. It is unclear whether the results would extend beyond the European context, given differences in market structure, regulation, and ESG reporting practices across regions. Extending the analysis to non-European settings would help establish the geographic robustness of the findings.

Finally, a regulatory development that bears on external validity is the EU Corporate Sustainability Reporting Directive (CSRD), which entered application for in-scope companies from financial year 2024 (European Commission, 2025a). By substantially expanding the breadth and depth of mandatory ESG-related disclosures for European firms, the CSRD will gradually change the information environment underlying ESG ratings -and, if the rating-disagreement literature is right, may either narrow or widen ESG-rating divergence as more disclosure flows into rating models. Our 2005-2024 sample only barely overlaps with the first year of CSRD application, so the present results should be read as evidence on the pre-CSRD information regime. Future research using post-CSRD samples could test whether the ESG-GPR-liquidity relationship is stable across reporting regimes, or whether the expanded disclosure changes the interaction between ESG performance and trading frictions during periods of geopolitical stress.

Overall, these limitations suggest that the results should be interpreted with caution. While the analysis documents a state-contingent relationship between ESG and liquidity under geopolitical risk, further research using higher-frequency data, alternative ESG providers, broader geographic coverage, and post-CSRD disclosure data would be needed to establish a clear causal relationship.

6. Conclusion

This paper examines whether ESG performance influences stock market liquidity during periods of heightened geopolitical risk. Using a panel of European firms, we analyze whether firms with higher ESG scores experience different changes in bid-ask spreads when geopolitical risk increases.

The empirical results point to a state-contingent relationship between ESG performance and liquidity. The baseline specification shows that the ESG main effect is negative and statistically significant, indicating that higher-ESG firms have narrower bid-ask spreads at the sample-mean level of geopolitical risk. The positive and statistically significant ESG-GPR interaction, however, indicates that this liquidity advantage erodes as geopolitical risk rises and reverses at sufficiently elevated GPR levels, so that higher-ESG firms experience wider spreads in stressed periods. The high-ESG indicator specification reproduces the same conditional pattern. The pillar-level decomposition shows that the baseline result is mainly driven by the environmental and social pillars, while the governance pillar interaction is small, positive, and insignificant. This finding contrasts with the prevailing expectation that ESG performance enhances resilience during periods of uncertainty. The result holds across most alternative specifications: when geopolitical risk is captured through a top-20% high-GPR dummy, the ESG interaction remains positive and statistically significant, but when geopolitical risk is restricted to a conflict-spike dummy for 2022 and 2024, the interaction is no longer statistically significant. In the size-tercile split, the high-ESG-GPR interaction is statistically significant only in the large-firm tercile and statistically indistinguishable from zero among small and medium-sized firms. Taken together, the findings document a state-contingent ESG-liquidity relationship: higher ESG performance is associated with narrower spreads on average, but with relatively wider spreads when geopolitical risk is elevated - the opposite of the resilience pattern predicted by prior literature.

The paper contributes to the literature by examining the interaction between ESG performance and geopolitical risk in the context of stock market liquidity. While prior research suggests that ESG may provide resilience during periods of uncertainty, our results highlight that this relationship is not straightforward when considering liquidity outcomes. In particular, the findings indicate that the average liquidity advantage associated with higher ESG performance does not extend to periods of elevated geopolitical risk and may reverse when geopolitical stress is sufficiently high.

Several limitations should be considered when interpreting the results. First, ESG performance is not randomly assigned, and firms with higher ESG scores differ systematically from other firms in ways that also affect liquidity, so the analysis cannot be interpreted as fully causal. Second, the analysis relies on a single ESG-rating provider (LSEG); the rating-disagreement literature suggests that estimates can vary substantially across vendors, so the findings should be read as specific to the LSEG methodology. Third, the analysis relies on annual data, and the aggregation of the geopolitical risk index

may obscure short-term market responses. Fourth, the limited time-series variation in geopolitical risk reduces the statistical power of the analysis. Finally, the sample is restricted to European firms with a market capitalization of at least €100 million, which may limit the generalizability of the findings to smaller firms and to non-European settings.

These limitations suggest several directions for future research. First, future studies could employ higher-frequency data to better capture the timing of liquidity responses to geopolitical events. Second, alternative identification strategies, such as exogenous shocks or instrumental variables, could help address endogeneity concerns. Third, triangulating ESG measurement across multiple rating providers - for instance LSEG, MSCI, Sustainalytics, and S&P Global - would help establish whether the ESG-GPR-liquidity relationship is a robust feature of the data or an artefact of the rating instrument. Fourth, examining different measures of geopolitical risk or firm-specific exposure may provide a more precise understanding of how geopolitical uncertainty affects financial markets. Fifth, post-CSRD samples, once mandatory EU sustainability disclosures have flowed through several reporting cycles, would allow researchers to test whether the ESG-GPR-liquidity relationship is stable across reporting regimes, or whether the expanded disclosure changes the interaction between ESG performance and trading frictions during periods of geopolitical stress. Finally, extending the analysis to smaller firms or to non-European settings could shed light on the external validity of the results.

In conclusion, this paper finds that the relationship between ESG performance and stock market liquidity is state-contingent rather than uniform. Higher-ESG firms appear to enjoy narrower bid-ask spreads at average levels of geopolitical risk, but this liquidity advantage erodes, and ultimately reverses, as geopolitical risk rises, with the pattern most clearly visible in the continuous-GPR baseline, the top-20% high-GPR specification, and the large-firm tercile. The pattern is not detected when geopolitical risk is restricted to the conflict-spike years 2022 and 2024 or among smaller firms. The findings therefore point to a more nuanced relationship between ESG and financial market outcomes than the prevailing view of unconditional ESG resilience, emphasizing the need for further research to better understand how the role of ESG in financial markets varies with geopolitical conditions.

AI Appendix Disclosure

ChatGPT and Claude have been used to assist us in the coding process. In addition to ChatGPT, Claude and Gemini have been used to assist us with improving phrasing, clarity, and grammar. We have tested, reviewed, and adapted all generated code. Furthermore, we have developed all intellectual content, including ideas, arguments, and analysis.

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