“Impact of environmental, social, and governance factors on the price discovery process in the Indian stock market”

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IMPACT OF ENVIRONMENTAL, SOCIAL, AND GOVERNANCE FACTORS ON THE PRICE DISCOVERY PROCESS IN THE INDIAN STOCK MARKET

Abstract

Environmental, Social, and Governance (ESG) factors are important in evaluating a company's performance while aligning investment with governance, ethical, environmental, social commitment, and sustainability goals. Recent years have seen an increasing focus on ESG factors, leading to a corresponding evolution in financial markets. ESG is emerging as a key factor among other non-financial performance indicators that impact market dynamics, price, and investment strategies. This study investigates the price discovery process at the firm level in reference to ESG in the Indian stock market. The data were analyzed for 11 key sectors using the daily closing prices in the spot market and futures market prices of selected firms, along with their respective ESG scores. The study used the stationarity test and order of integration test, followed by applying the Johansen cointegration test to analyze long-run co-integrating relationships among futures and spot market prices. Finally, the vector error correction mechanism (VECM) test was applied to detect long-term causality. Findings reveal that the price discovery process takes place in the Indian stock market and is significantly affected by the ESG factor. In the case of a high ESG score, the spot market leads the futures market, while for stocks with low ESG scores, the futures market price leads the spot price. Cement, oil, gas, and pharmaceutical sectors have shown a negative association between the price discovery process and ESG scores, while in the case of the service sector, the positive association is witnessed between ESG scores and the price discovery process between futures and spot prices.

Keywords ESG factors, causality, price discovery, sustainability, lead-lag relationship

JEL Classification G13, G14, C01

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INTRODUCTION

The environmental, social, and governance (ESG) framework helps stakeholders examine risk management and opportunities that arise when firms prioritize sustainability, social impact, and ethical governance. The recent trends show that the adoption of ESG policies can boost a company's reputation, performance, and customer base. Aligning corporate objectives and operations with ESG and global sustainability rules creates significant prospects for innovation and long-term social impact. Investments and lenders can evaluate risks, estimate, and monitor financial performance by considering a company's environmental, social, and governance performance. Transparency in information sharing promotes accountability and confidence among company stakeholders. Demand for ESG data and products is rising (Thomson Reuters Institute, 2023). This drives corporations to develop ESG plans and invest (S&P Global, 2020).

Based on future market predictions, investors use ESG criteria to determine spot prices. New information shows how information asym-

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metry, liquidity, and trade operations affect pricing. Lead-lag correlations between spot and futures markets explain this phenomenon. Futures markets are more responsive to new information and change faster than spot markets. This causes futures market prices to affect spot market prices (Kawaller et al., 1987). The futures market signals informed trading at a cheaper transaction cost, while spot market prices vary based on stock or industry knowledge. ESG alters financial market price discovery since investors know more about a company's profile, performance, and future prospects (Nagouda, 2023). In exchange, firms are encouraged to foster sustainability, ethical governance, efficiency, long-term wealth growth, and stakeholder disclosure. Indian stocks are increasing fast, therefore, price discovery can be examined (Kaicker & Aggarwal, 2023). Growing ESG variables' involvement in price discovery influences stock markets' future. India and other emerging economies need resilient markets that balance economic interests with sustainability.

This study analyzes how ESG influences Indian stock price discovery and explores low- and high-ESG-score firms' pricing discovery methods and consequences. It also illuminates high- and low-ESG firms in Indian stock markets, which is crucial for informed investing, sustainable financial practices, and effective regulatory decision-making in emerging economies.

1. LITERATURE REVIEW

Stock prices, investor behavior, macroeconomic factors, market structure, technology, and more affect price discovery. It is affected by investor dynamics, intraday volatility, quick event responses, options trading, and macroeconomic news (Gavious & Kedar-Levy, 2013). These traits hinder price discovery. Indriawan et al. (2019) examined Thomson Reuters' government bond futures tick history transaction-level data and found that the U.S. stock market drives global price discovery in these markets, showing how international market dynamics affect domestic price discovery mechanisms. Price discovery in corporate bonds, futures, and stocks has been extensively studied. Hasbrouck (2021) modelled high-resolution U.S. equities market data and found that technology, market structure, and high-frequency trading drive firm-level price discovery. Chinese stock index futures markets often contribute to price discovery, especially after regulatory changes, according to Hao et al. (2019). Mohamad (2024) revealed that the Russo-Ukrainian war affected price dynamics across numerous financial instruments, with the yen and US dollar acting as safe havens. Gao et al. (2024) used a wavelet approach to investigate soybean markets and revealed COVID-19- and trade-related dynamic price interdependencies between the US and China. Sharma et al. (2022) analyzed Bitcoin futures and spot prices, revealing that Bitcoin futures lead the price discovery process by acting as the leading indicator, while Bitcoin spot lags in the process. Many previous studies have analyzed price discovery across a range of asset markets using methods such as regression analysis, Information Share (IS), and Vector Error Correction Model (VECM) to find important insights. According to Hendershott et al. (2020), who analyze the function of short selling in corporate bonds, bond short sellers have a significant impact on price discovery, particularly in high-yield bonds. Ahn et al. (2019) examined the SSE 50 Index and concluded that, despite rising transaction costs, derivative markets such as options and futures are rapidly impacted by price discovery. Fassas and Siriopoulos (2019) examine data from the Athens Exchange and find that futures markets drive price discovery. Bitcoin markets exhibit a significant relationship between trade informativeness and order aggressiveness, highlighting the importance of liquidity in price movements (Ghysels & Nguyen, 2019). Ibikunle et al. (2020) also examine Bitcoin price discovery, showing that investor attention leads to noisier trading than knowledgeable arbitrage does. Chen et al. (2021) compare regular and micro futures in Taiwan's stock index and conclude that regular futures have a greater impact on price discovery. Fassas (2021) compares LIBOR with SOFR and finds that while SOFR's influence is increasing, LIBOR continues to dominate price discovery in U.S. markets. Amairi et al. (2021) draw attention to the influence of geographic location on stock market efficiency, showing that information dissemination is slower for businesses located in remote places. With

varying results across BRICS economies, Sharma et al. (2022) reveal short-term causality in futures and spot markets of Russia and Brazil and long-term causality in the futures and spot markets of Russia and China. The remaining two BRICS countries, India and South Africa, do not show either long-term or short-term causality between futures and spot market indices. In India, single-stock futures (SSFs) contribute 55% to information sharing, increasing to 61% during negative news arrivals with spot market restrictions. This shows that SSFs are significant in price discovery, especially during high information flow and negative news (Aggarwal & Thomas, 2019). Curran et al. (2020) analyze SSF markets, revealing that implicit trading costs hinder the futures market's ability to lead price discovery despite its advantages over other trading protocols in the Indian context. Investor behavior, market procedures, and other factors affect pricing, according to extensive research on price discovery methods. Khandelwal et al. (2023) have shown that ESG factors significantly affect the return expectations of investors. ESG variables have changed stock price discovery by incorporating non-financial information and adding sustainability (Zairis et al., 2024). Potharla et al. (2023) found that better ESG scores lower stock price synchronization and enhance information efficiency, which may affect price discovery. Fiorillo et al. (2024) find that ESG performance reduces geopolitical crash risks and strengthens markets. In unpredictable times, ESG engagement in price discovery stabilizes stock performance. Investors may focus on ESG factors that worsen market swings and indirectly affect price discovery (Yu et al., 2024). Singh and Jaiwani (2024) claim that investor sensitivity to ESG affects stock volatility differently in developed and developing economies, impacting market responses and price discovery. Liang et al. (2024) show how increasing corporate governance can reduce price volatility in Chinese stock markets, whereas Jonwall et al. (2024) argue that ESG indexes may boost price discovery by factoring sustainable practices into stock performance. Dwibedi et al. (2024) suggest that ESG transparency may promote investor decision-making based on business disclosures, which may boost management sentiment's price discovery benefits. Sharma et al. (2024) have shown that ESG factors carry significant implications for Indian stock price movement during the COVID-19 pandemic. Few studies have used firm-level data to study price discovery in Indian stock markets. ESG investment is gaining popularity (Sharma et al., 2024), but less is known about its role in price discovery in emerging economies like India. This study fills this gap by revealing how ESG characteristics affect market dynamics at the business level and comparing price discovery methods of high- and low-ESG companies.

By analyzing firm-level ESG and price discovery data, this study provides insights into sustainable investments and market efficiency, filling a critical knowledge gap (Beloskar & Rao, 2023). In view of the review of the studies presented above, there is little empirical evidence available in the literature on how ESG factors affect the price discovery process. Whether the price discovery behavior of firms with high ESG scores differs from that of firms with low ESG scores is yet to be established. To address this research gap, the present study focuses on the following hypotheses:

H1: ESG scores have a significant impact on the price discovery process in the Indian stock market.

H2: The impact is significant in the case of firms with high ESG scores as compared to low ESG scores.

This study addresses the research objectives by conducting an in-depth analysis of different sectors of the Indian stock market, as described in the following sections.

2. METHODS

The present study considers 11 sectors of the Indian market: agriculture, automotive, banking, adhesives and paints, cement, fast-moving consumer goods (FMCG), information technology (IT), oil & gas, pharmaceuticals, construction/real estate, and power. Time-series data (daily closing prices) from spot and futures markets were collected for 22 selected ESG-compliant companies, one from each with high and low ESG levels, listed on the Bombay Stock Exchange (BSE) in India. The selected companies were classified into high- and low-ESG levels based on their ESG scores for 2020,

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with scores above 50 considered high and scores below 50 considered low. The data were obtained from Investing.com, a web-based financial database. The time series variables often exhibit unit root problems due to trends, cyclicality, structural breakdowns, and seasonality. Time series data analysis without unit root correction yields spurious results (Sharma et al., 2020). Augmented Dickey-Fuller (ADF) was used to find unit root issues (Dickey & Fuller, 1981). If the test results are significant, the null hypothesis is rejected because the time-series variables have a unit root issue and a particular stationarity. According to Equation (1), the stationarity test of closing spot prices and futures price data followed the Johansen co-integration test to assess the variables' long-run cointegration connection.

$$\Delta Y_t = \mu + Y_{t-1} + \sum_{j=1}^{p} \alpha_j \Delta Y_{t-1} - \beta t + \omega_t, \qquad (1)$$

where ehe closing price of the time series variable (the spot and futures market prices of the selected companies) is represented by Y_t in equation (1), where Y_{t-1} indicates the first lag of Y, μ is the drift term, t is the time trend, p is the longest lag length used, and ω_t represents the error term or residual at time. The primary reason for conducting this test was to determine the order of integration that both the spot and futures market series followed in the data. The test uses the maximum likelihood method, and the results are shown in two sections: the first presents the eigenvalues, and the second shows the trace statistics (Johansen & Juselius, 1990). The null hypothesis (there is no co-integrating relationship between the spot and futures prices of the selected companies) is tested using the Johansen co-integration method. The test assumes a VAR framework in reduced form and is also known as the multivariate version of the Dickey-Fuller test. The functional form of the test of order is given by Equation (2):

$$\Delta y_t = B_1 y_{t-1} + \ldots + B_n y_{t-n} + C x_t + \mu_t, \qquad (2)$$

where y_t indicates the k-vector of I (1) variables, deterministic trends of n-vector are represented by x_t, and vector of shocks is depicted by μ_t. Therefore, this VAR model can be rewritten as:

$$\Delta y_t = \prod y_{t-1} + \sum_{i=1}^{n-1} r_i \Delta y_{t-1} + C x_t + \mu_t. \qquad (3)$$

A vector error correction mechanism (VECM) test was performed (Hasbrouck, 1995). This method uses the error correction term (ECT) to establish long-term causality, which is mathematically represented by Equations (4) and (5).

$$\Delta\left(Company\_S\right)_t = \alpha_1 + \sum_{i=1}^{i=n} \beta_{S,i} \Delta\left(Company\_S\right)_{t-1} + \sum_{i=1}^{i=m} \gamma_{S,i} \mathrm{H}\left(Company\_F\right)_{t-1} + \lambda_1 e_{t-1} + \nu_{1t}. \qquad (4)$$

$$\Delta\left(Company\_F\right)_t = \alpha_1 + \sum_{i=1}^{i=n} \beta_{F,i} \Delta\left(Company\_F\right)_{t-1} + \sum_{i=1}^{i=m} \gamma_{F,i} \Delta\left(Company\_S\right)_{t-1} + \lambda_1 e_{t-1} + \nu_{1t}. \qquad (5)$$

The first difference between the spot and futures market prices is represented by Δ in Equations (4) and (5), and the lag in ECT's error values is shown by e_{t-1}.

The negative and significant coefficients in Equation 4 indicate long-term causality from the futures market to the spot market and imply price discovery. On the contrary, if the coefficients in Equation (5) are negative and significant, this shows long-term causality from the spot market to the futures market, where β is the speed adjustment coefficient. This study used the VAR framework to determine the optimal lag length and select the optimal number of lags according to the minimum AIC and SIC values as criteria. If the ECT is negative and significant in Equation (4), it is appropriate to conclude that price discovery and long-term causality between futures and spot market prices occur for the stocks of companies considered in this study.

3. RESULTS

The results reported in Table 1 show the stationarity of time series variables at level and first difference using the ADF test. The results indicate that the t-statistics of each firm for both spot prices and prices are less than the critical value. This

confirms that all series have the problem of unit root and are non-stationary at level. Further, the ADF test was applied to the first difference of each series and found that the t-test statistics are greater than the critical value, and confirm that all series are stationary at the first level. According to the standard mechanism for time series analysis, the Johansen cointegration test is applied to assess the long-run cointegrating relationship between the spot and futures prices of 22 firms in 11 sectors.

The results of the Johansen cointegration test show that all null hypotheses of $r = 0$ are rejected, as the trace statistics are greater than the critical values. This confirms the rejection of the null hypothesis, which suggests a no-cointegrating relationship be-

Table 1. Unit root test

Stock	Variables	Variables	t-Statistics at Level	t-Statistics at first difference	Lag Length
Pidilite	Adhesives and Paint	Spot	1.0736	–20.8464	2
	Adhesives and Paint	Futures	1.0929	–21.0958	2
Asian Paints	Adhesives and Paint	Spot	0.8241	–20.3131	3
	Adhesives and Paint	Futures	0.8586	–20.1787	3
UPL Ltd.	Agriculture	Spot	0.2242	–20.4268	2
	Agriculture	Futures	0.2348	–21.1909	2
Chambal Fertilizers	Agriculture	Spot	0.4488	–23.9267	2
	Agriculture	Futures	0.1621	–21.7734	2
Tata Motors	Automobile	Spot	1.3376	–20.718	4
	Automobile	Futures	1.3658	–20.7334	4
Hero MotoCorp Ltd	Automobile	Spot	1.1309	–22.5485	6
	Automobile	Futures	1.1344	–22.6655	2
ICICI Bank	Banking	Spot	1.509	–22.3647	4
	Banking	Futures	1.5656	–22.0896	5
AXIS Bank	Banking	Spot	1.4343	–21.4171	2
	Banking	Futures	1.4953	–21.2772	2
Ambuja Cement	Cement	Spot	0.8246	–22.6994	7
	Cement	Futures	0.8394	–22.889	7
Ultratech Cement	Cement	Spot	1.9272	–22.2035	3
	Cement	Futures	1.9119	–21.8425	2
DLF	Construction / Real Estate	Spot	1.4399	–21.211	2
	Construction / Real Estate	Futures	1.4953	–21.0896	2
L&T	Construction / Real Estate	Spot	1.4301	–20.8558	2
	Construction / Real Estate	Futures	1.5239	–20.725	2
Colgate-Palmolive	FMCG	Spot	1.5767	–21.6941	2
	FMCG	Futures	1.1871	–22.6697	2
Marico Ltd.	FMCG	Spot	0.8036	–24.2592	2
	FMCG	Futures	0.7996	–24.1968	2
Infosys	IT	Spot	0.8087	–21.8718	2
	IT	Futures	0.752	–21.4392	2
TCS	IT	Spot	1.1207	–23.2039	2
	IT	Futures	1.2018	–22.7265	2
BPCL	Oil & Gas	Spot	0.3845	–21.083	2
	Oil & Gas	Futures	0.4022	–21.2358	2
GAIL India	Oil & Gas	Spot	1.5383	–21.3406	2
	Oil & Gas	Futures	1.5328	–21.7254	2
Cipla	Pharmaceutical	Spot	1.5065	–21.943	2
	Pharmaceutical	Futures	1.4904	–22.3586	4
Dr Readdy's	Pharmaceutical	Spot	0.8315	–21.4935	2
	Pharmaceutical	Futures	0.8728	–21.4218	2
Coal India	Power	Spot	2.2927	–20.6691	2
	Power	Futures	2.3862	–20.7052	2
NTPC	Power	Spot	3.5224	–21.1497	8
	Power	Futures	3.5215	–21.3362	2

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tween the spot and futures prices of firms from 11 sectors. Thus, the study confirms that both the spot and futures price series of the twenty-two firms' sample sectors have long-term integrated relationships with each other. After confirming the co-integrating relationship between the spot and futures prices, the long-run causality was tested using the VECM.

The results in Table 3 indicate that in the adhesive and paint industry, the Asian Paint firm, which has a low ESG score, demonstrates price discovery because the error correction term (–2.71) is negative and significant at the 1% level. This finding confirms that the future prices of Asian Paints act as leading indicators, while spot prices act as lagging indicators. Conversely, Pidilite, another firm

Table 2. Trace statistics

Stocks	Sector	Number of Lags (SPOT)	Hypothesized No. of CE(s)	Trace Statistics	0.05 Critical Value
Pidilite	Adhesives and Paint	2	r <= 1	358.94	9.24
			r = 0	724.18	15.67
Asian Paints	Adhesives and Paint	3	r <= 1	270.8	9.24
			r = 0	484.44	15.67
UPL Ltd.	Agri	2	r <= 1	343.97	9.24
			r = 0	729.59	15.67
Chambal Fertilizers	Agri	2	r <= 1	380.33	9.24
			r = 0	450.33	15.67
Hero MotoCorp Ltd	Auto	6	r <= 1	142.3	9.24
			r = 0	316.27	15.67
Tata Motors	Auto	4	r <= 1	200.45	9.24
			r = 0	336.94	15.67
ICICI Bank	Banking	4	r <= 1	182.12	9.24
			r = 0	590.41	15.67
AXIS Bank	Banking	2	r <= 1	372.34	9.24
			r = 0	632.17	15.67
Ambuja Cement	Cement	7	r <= 1	127.34	9.24
			r = 0	249.47	15.67
Ultratech Cement	Cement	3	r <= 1	248.72	9.24
			r = 0	416.29	15.67
DLF	Construction / Real Estate	2	r <= 1	370.43	9.24
			r = 0	719.03	15.67
L&T	Construction / Real Estate	2	r <= 1	323.17	9.24
			r = 0	846.67	15.67
Colgate–Palmolive	FMCG	2	r <= 1	325.79	9.24
			r = 0	873.69	15.67
Marico Ltd.	FMCG	2	r <= 1	454.53	9.24
			r = 0	720.3	15.67
Infosys	IT	2	r <= 1	355.24	9.24
			r = 0	798.72	15.67
TCS	IT	2	r <= 1	409.92	9.24
			r = 0	625.61	15.67
BPCL	Oil & Gas	2	r <= 1	363.56	9.24
			r = 0	740.59	15.67
GAIL India	Oil & Gas	2	r <= 1	375.37	9.24
			r = 0	686.27	15.67
Cipla	Pharmaceutical	2	r <= 1	393.58	9.24
			r = 0	705.04	15.67
Dr Readdy's	Pharmaceutical	2	r <= 1	375.04	9.24
			r = 0	755.79	15.67
Coal India	Power	2	r <= 1	356.42	9.24
			r = 0	670.48	15.67
NTPC	Power	8	r <= 1	93.18	9.24
			r = 0	196.41	15.67

in the same sector, does not exhibit the same behavior. With a high ESG score for Pidilite, there is no significant causality from futures to spot prices. Future prices do not lead spot prices; rather, spot prices lead to future prices and confirm reverse causality. In addition to the adhesive and paint sectors, similar trends were observed in the case of three more sectors: agriculture, automobiles, and fast-moving consumer goods (FMCG). In these sectors, firms with low ESG scores, such as Chambal Fertilizers (agriculture sector), Tata Motors (automobile sector), and Colgate-Palmolive (FMCG sector), have causality from future prices to spot prices, while the first with high ESG scores, including UPL (agriculture sector), Motocorp (automobile sector), and Marico Ltd. (FMCG sector), have no significant causality from futures to spot prices. In the case of firms with high ESG scores, reverse causality was observed. This study shows that price discovery has a negative association with ESG scores in four sectors: the adhesive and paint industry, agriculture, automobiles, and FMCG.

On the other hand, the results show that in the case of the cement, oil and gas, and pharmaceutical sectors, the reverse tends to occur. In these sectors, firms with high ESG scores have evidence of price discovery, while it is not significant in the case of firms with low ESG scores. From Table 3, it is evident that the firms with low ESG scores, including Ultra Tech Cement (cement industry), BPCL (oil and gas industry), and Dr. Reddy's (pharmaceutical industry), have not shown statistically significant evidence of causality from futures to spot prices, while similar observations were found in the case of firms with high ESG scores from these sectors, including Ambuja Cement (cement industry), Gail India (oil and gas industry), and Cipla (pharmaceutical industry). This could be because the ESG scores were divided into high and low based on the median ESG scores (50), while in the case of these sectors, both firms have higher than the median scores. Although firms from these sectors have relatively high and low scores in the complete sample, both have high ESG scores.

In the case of the services sector, firms belonging to the banking and information technology sectors are considered in the study. From the banking sector, ICICI and Axis Bank, and from the IT sector, Infosys and TCS were considered as part of the sample of the study. The results show that in the case of both banking and information technology sectors, bidirectional causality is witnessed irrespective of the high or low ESG scores of selected sample firms. Both spot and futures prices significantly affect each other and act as leading and lagging indicators. In the case of the power sector, there is no evidence of causality observed from future to spot prices for both sample firms, such as Coal India and NTPC. NTPC has higher ESG scores than Coal India, but in the case of both firms, there is no causality from futures to spot prices during the sample period.

4. DISCUSSION

This study reveals that price discovery in the Indian context is industry-specific, showing varying mechanisms based on high or low ESG levels of firms across sectors. These results are different in the case of the findings of sector-specific studies conducted in the case of other countries (Assael, 2023; Brounen et al., 2021; Zhang et al., 2023). This study partially supports Zhang et al.'s (2023) argument that mandatory ESG disclosure increases price discovery in the case of developed countries. This may not be the case at the firm or industry level in emerging economies such as India, where ESG-related norms and regulatory environments have not matured sufficiently. Similarly, the future as a leading and spot as a lagging indicator in high-ESG firms supports Serafeim and Yoon (2023), meaning that the future market assimilates ESG-related information ahead of the spot market. This phenomenon could suggest that investors depend on speculative or sentiment-driven expectations, which spot prices later confirm. Price discovery may not be efficient for high or low ESG scores because of ambiguity in the ESG rating, as argued by Jin et al. (2024). In this study, three high-score ESG firms, namely Pidilite, Hero MotoCorp, and NTPC, do not show future-to-spot causality; on the contrary, low-score ESG firms such as Asian Paints and Tata Motors show clear spot causality. This variation could be due to ambiguity in ESG ratings, or investors might not be sensitive to ESG scores alone. In addition to the findings of Banerjee et al. (2025) that ESG sentiment helps predict prices, this study adds that investors' opin-

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Table 3. Results of the error correction mechanism corresponding to the ESG score

Stock's name	Sectors	Spot (CointEq1)	Spot (Causality)	Future (CointEq1)	Future (Causality)	ESG Scores 2020	ESG level
Pidilite	Adhesive and Paints	−0.5760(0.3788)	No	−1.3507(0.3916)***	Reverse	52.027	High
Asian Paints	Adhesive and Paints	−2.6973(0.6919)***	Yes	0.6266(0.6853)	No	41.6256	Low
UPL Ltd.	Agri	−0.4267(0.4232)	No	−1.6901(0.4298)***	Reverse	58.9377	High
Chambal Fertilisers	Agri	−1.2131(0.0630)***	Yes	0.0409(0.0116)***	No	39.1611	Low
Tata Motors	Auto	−1.8270(0.2107)***	Yes	−1.5970(0.2180)***	Reverse	48.3855	Low
Hero MotoCorp Ltd.	Auto	−0.5945(0.5546)	No	−1.7256(0.2641)***	Reverse	58.817	High
ICICI Bank	Banking	−1.6583(0.1797)***	Yes	−1.9256(0.1991)***	Reverse	39.0504	Low
AXIS Bank	Banking	−3.5611(0.6757)***	Yes	1.7414(0.6657)**	No	50.3873	High
Ambuja Cement	Cements	−4.4089(1.2659)***	Yes	1.1150(1.2713)	No	71.4214	High
Ultra Tech Cement	Cements	−1.1646(0.6796).	No	−0.4781(0.5543)	No	63.5952	High
L&T	Construction / Real Estate	−1.3231(0.0964)***	Yes	−1.1328(0.1018)***	Reverse	60.8389	High
DLF	Construction / Real Estate	−1.9072(0.6914)**	Yes	−0.1514(0.6868)	No	51.6548	High
Colgate-Palmolive	FMCG	−1.2005(0.0847)***	Yes	−1.3401(0.0883)***	Reverse	39.2918	Low
Marico Ltd.	FMCG	−0.8362(0.4268).	No	−1.2475(0.4279)**	Reverse	54.6122	High
Infosys	IT	−1.4199(0.1015)***	Yes	−0.8672(0.1067)***	Reverse	56.3726	High
TCS	IT	−4.7399(0.4720)***	Yes	3.0047(0.4532)***	No	54.8436	High
BPCL	Oil & Gas	0.0739(0.3802)	No	−2.2090(0.3924)***	Reverse	64.9432	High
GAIL India	Oil & Gas	−0.7140(0.3342)*	Yes	−1.3657(0.3407)***	Reverse	76.3505	High
Cipla	Pharmaceutical	−0.8070(0.3711)*	Yes	−2.3402(0.5761)***	Reverse	62.4585	High
Dr Readdy's	Pharmaceutical	−0.4322(0.4643)	No	−1.5670(0.4649)***	Reverse	60.7786	High
Coal India	Power	0.2293(0.3417)	No	−2.1293(0.3473)***	Reverse	39.7445	Low
NTPC	Power	−0.2125(0.6604)	No	−1.2095(0.2653)***	Reverse	55.9501	High

Note: *, **, and *** are significant at 10%, 5%, and 1% level of significance, respectively.

ions do not always affect current prices, especially if investors focus on futures.

In contrast to Tan et al. (2025), this study's findings indicate that analyst attention alone is not sufficient to improve stock price efficiency, as some high-score ESG firms do not show spot causality. These findings could mean that investor trust, sector visibility, and other ESG-related issues might mediate the impact of analysts' attention on price discovery. The results obtained in this study partially contradict those of Potharla et al. (2024), which revealed how improvements in ESG reflect company-specific information in stock prices. However, some high ESG stocks (such as Hero MotoCorp, Infosys, and BPCL) show reverse causality in futures but no clear causality in spot prices. The findings of this study lead us to the conclusion that there are mixed results on price discovery in Indian firms, which could be contingent upon sector-specific peculiarities and evolving markets in a developing country. Therefore, this study suggests that investors and stakeholders look at how sustainable different companies and sectors are by grouping them into ESG levels and making investment choices based on those ESG factors.

CONCLUSION

This study aimed to evaluate the impact of ESG on the price discovery process in the Indian stock market. This study considers the daily closing prices of spot and futures markets in 11 sectors of the Indian stock market, including agriculture, automotive, banking, adhesives and paints, cement, fast-moving consumer goods (FMCG), information technology (IT), oil & gas, pharmaceuticals, construction/real estate, and power. The data are considered for the post-COVID period, and the impact of ESG on price

discovery was analyzed using the vector error correction mechanism (VECM) framework. The results of the study show that in the case of firms with low ESG scores, price discovery takes place and the futures market acts as the leading indicator, while spot price is a lagging indicator. However, firms with high ESG scores have shown that spot prices are leading, while futures prices follow price movements. This is mainly due to the market efficiency framework, where investors have already factored in the high ESG scores in the prices of stocks, and, as a result, spot prices are leading future prices. On the other hand, investors are still in the process of adjusting ESG scores in the case of firms with low scores, and the result is reflected first in future prices followed by spot prices. Regardless of ESG scores, the study reports the bidirectional causality in the case of services sector firms.

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