Volume: 10 Issues: 63 [December, 2025] pp. 119 - 129
International Journal of Accounting, Finance and Business (IJAFB)
eISSN: 0128-1844
Journal website: www.academicinspired.com/ijafb
DOI: 10.55573/IJAFB.106311

SUSTAINABLE BUSINESS PRACTICES, GREEN INNOVATION, AND FIRM PERFORMANCE: EVIDENCE FROM CHINA'S EMERGING MARKET

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Article history
Received date : 27-10-2025
Revised date : 28-10-2025
Accepted date : 29-11-2025
Published date : 10-12-2025

To cite this document:
Ma YaLi., & Zainol, Z. (2025). Sustainable business practices, green innovation, and firm performance evidence from China's emerging market. *International Journal of Accounting, Finance and Business (IJAFB),* 10 (63), 119 - 129.

Abstract: *This study examines the influence of sustainable business practice (SBP) on firm performance in China, with consideration of its mediating effect of green innovation. Based on the resource-based view and stakeholder theory, the panel data of Chinese A-share listed companies (2019-2022) are examined through the fixed-effect model and the bootstrap test. The findings indicate that SBP substantially improves accounting-based (ROA) as well as market-based (Tobin's Q) performance indicators and that green innovation substantially mediates this partial process; these effects are especially robust for high-polluting industries and subsidised firms. The findings present new evidence from the world's largest emerging market on how the change of green innovation creates competitiveness out of greening, which has important implications for corporate management and public policy on green transformation.*

Keywords: *Sustainable Business Practices, ESG, Green Innovation, Firm Performance, Emerging Markets, China*

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Introduction

The global sustainability development strategy has urged a shift in business practices both nationally and internationally. The government of China officially formulated "Dual Carbon" (carbon peak and carbon neutrality) in accordance with the global sustainable development strategy. This has created a high expectation and competitive pressure on enterprises to incorporate sustainability in their business practices (Wang & Zhang, 2021). Sustainable Business Practice (SBP), historically regarded as a business cost, has now become a business revenue.

Overall, the existing literature provides an inconsistent picture of the sustainability-performance relationship. While meta-analyses agree on a positive relationship (e.g. Friede, Busch, & Bassen, 2015), such findings may rely on complex relations and mechanisms, especially in the distinct institutional environment of emerging markets such as China. An open theoretical issue is why or how SBP results in better performance. Green innovation (the launch of new products and/or processes with either a low environmental impact or a way to lower it) is assumed as an essential mediating variable (Xie, Huo, & Zou, 2019) as firms that spend on green innovation can lower the cost of compliance, increase resource utilisation efficiency, and create an opportunity on a new market.

Therefore, this study theoretically examines this mechanism in the Chinese market and mainly includes three research questions as follows:
Q1: What is the direct impact of SBP on Chinese firms' financial performance (ROA) and market value (Tobin's Q)?
Q2: Does green innovation mediate the relationship between SBP and firm performance?
Q3: Which industry type (high/low pollution intensity) and government policy (subsidies) temper these relations?

Considering a complete panel dataset of Chinese listed companies, the study's major contribution to the literature is to disaggregate the tangled SBP-performance relation and demonstrate the indispensable role of green innovation in it. These conclusions can have a substantial impact on a company's strategic direction, investment and policy.

Literature Review and Hypothesis Development

The nexus between sustainability and financial performance has been a matter of discussion in the literature. This section is thus devoted to providing the theoretical baseline of this study by reviewing the basic theoretical viewpoints, the Resource-Based View and Stakeholder Theory, that support the hypothesised, positive association between Sustainable Business Practices (SBP) and performance of a company. Next, we examine the process of green innovation, where we do not view green innovation simply as an exogenous result but, in fact, as a relevant mediating channel translating the corporate sustainability commitment towards realisable competitive benefits. Following this rationale, the research hypotheses are formally elaborated.

Sustainable Business Practices and Firm Performance

Sustainable Business Practices (SBP) refer to the integration of environmental, social, and governance (ESG) criteria into a company's business model and operations. Grounded in the Resource-Based View (RBV), SBP can be a source of valuable, rare, and inimitable resources, such as enhanced reputation, stakeholder trust, and organisational capabilities, leading to sustained competitive advantage (Hart & Dowell, 2011). From a stakeholder theory perspective, proactively managing environmental and social issues helps align corporate actions

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with the expectations of regulators, customers, and investors, thereby reducing risks and securing strategic resources (Berman, Wicks, Kotha, & Jones, 1999).

Indeed, some empirical studies in China have revealed the positive correlation. For example, based on ESG scores as the proxy, recent studies have discovered that high ESG firms enjoy less financial risk and superior operating performance (Broadstock, Chan, Cheng, & Wang, 2021). Hence, it can be hypothesised that:

H1: Sustainable business practices positively impact the firms' performance.
H1a: SBP has a positive effect on financial performance (ROA).
H1b: SBP has a positive effect on market value (Tobin's Q).

The Mediating Role of Green Innovation

Green innovation is an essential transmission channel of SBP to performance. SBP promises can inspire internal R&D activities for pollution treatment and waste reduction, energy-saving, and so on (Li, Wang, & Zhang, 2021). In effect, this is the "Porter Hypothesis" (Porter & van der Linde, 1995): Well-designed environmental regulation, and likewise forward-looking sustainability actions, can induce innovation that can, at least partly or even fully, offset the costs incurred.

Green process innovation, on the one hand, may generate cost savings as a result of improvement in material and energy efficiency. Green product innovation, on the other hand, may pave a new market and enable firms to command high prices from environmentally aware consumers. Hence, it was hypothesised that SBP promotes green innovation, which results in improved firm performance. In particular,

H2: Green innovation mediates the relation between sustainable business practices and the firm's performance.
H2a: Green innovation mediates the relationship between SBP and financial performance (ROA).
H2b: Green innovation mediates the relationship between SBP and market value (Tobin's Q).

As depicted in Figure 1, the conceptual framework delineates the dual-pathway mechanism through which Sustainable Business Practices (SBP) are theorised to enhance Firm Performance. It posits that SBP exerts not only a direct influence on both Financial Performance (FP) and Market Value (MV) but also an indirect effect, mediated by Green Innovation (GI). This model provides the foundational structure for empirically testing the hypothesised direct effects (H1a, H1b) and mediating (H2a, H2b) relationships. To this end, the following section details the methodological approach designed to validate this framework, including the measurement of variables, data sources, and the analytical strategies to be employed.

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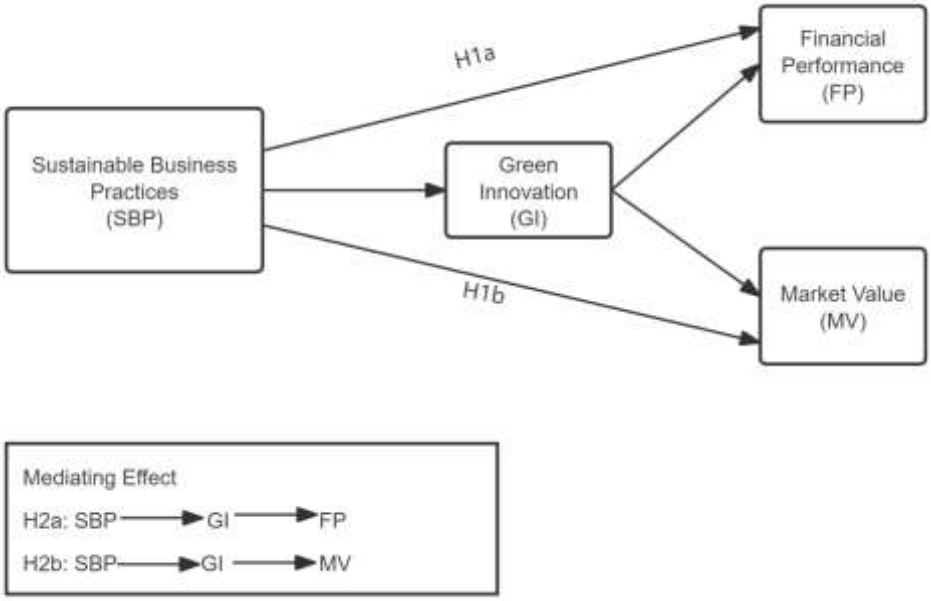

Figure 1: Conceptual Framework
Source: Own Elaboration Based On The Literature.

Methodology

Research Design

This study adopted an explanatory research design to explore the complex relationships between sustainable business practices, green innovation, and firm performance. A quantitative approach was used, relying on longitudinal panel data. Structural Equation Modeling (SEM) was selected as the primary analytical method, as it allows for the modeling of latent constructs measured through multiple indicators and the simultaneous examination of both direct and indirect effects (Hair et al., 2022). This approach offers significant advantages over traditional regression, particularly in testing mediating hypotheses (H2a, H2b), as SEM accounts for measurement errors in key constructs, such as sustainability (Sarstedt et al., 2022).

Sample and Data Collection

The study was conducted using panel data from Chinese listed A-shares covering the years 2019 to 2022. Following the approach of Wang et al. (2023), the sample selection process was designed to ensure data credibility and relevance. Firms in the financial sector (SIC codes 6000–6999) were excluded due to their distinct organisational structures and regulatory frameworks. Additionally, companies classified under Special Treatment (ST or *ST) were omitted to eliminate the potential influence of financially distressed entities on the results.

Observations with missing data for the core variables were removed using listwise deletion. The final unbalanced panel comprised 11,258 firm-year observations. Financial data were sourced from CSMAR, ESG ratings from Hua Zheng, and green patent data from CNRDS, a widely used database in recent research on innovation in China (Li & Wang, 2023).

Variable Measurement

The overview of all constructs, operational definitions, data sources, and supporting literature is presented in Table 1. This presentation provides clarity on the measurement framework,

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facilitating both the replication of the study and a deeper understanding of how each construct is operationalised.

Table 1: Variable Definitions And Measurement

Variable Type	Variable Name	Symbol	Measurement	Source	Supporting Literature
Latent Independent	Sustainable Business Practices	SBP	A second-order latent construct reflected by three first-order indicators: 1. ENV: Environmental pillar score 2. SOC: Social pillar score 3. GOV: Governance pillar score (All scores from Hua Zheng ESG rating, scaled 1-9)	Hua Zheng ESG	(Fan et al., 2024; García et al., 2023)
Mediating	Green Innovation	GI	Natural logarithm of (1 + the total number of green patent applications filed in a year)	CNRDS	(Li & Wang, 2023; Song & Yu, 2022)
Dependent	Financial Performance	FP	Return on Assets (ROA) = Net Profit / Total Assets	CSMAR	(El Khoury et al., 2023)
Dependent	Market Value	MV	Tobin's Q = Market Value of Assets / Book Value of Assets	CSMAR	(El Khoury et al., 2023; Wang et al., 2023)
Control	Firm Size	Size	Natural logarithm of total assets	CSMAR	(Garcia-Ascanio et al., 2023)
Control	Leverage	Lev	Total debt divided by total assets	CSMAR	(Garcia-Ascanio et al., 2023)
Control	Firm Age	Age	Number of years since the firm's Initial Public Offering (IPO)	CSMAR	(Wang et al., 2023)
Control	Growth	Growth	Year-on-year growth rate of operating revenue	CSMAR	(Garcia-Ascanio et al., 2023)
Control	Ownership Concentration	Top1	Percentage of shares held by the largest shareholder	CSMAR	(Fan et al., 2024)

Sources: Financial And Governance Data From China Stock Market & Accounting Research (CSMAR) Database; ESG Ratings From Hua Zheng ESG; Green Patent Data From Chinese Research Data Services (CNRDS).

Latent Construct: Sustainable Business Practices (SBP)

As outlined in Table 1, SBP is conceptualised as a second-order reflective latent construct, consisting of three first-order dimensions: Environmental (ENV), Social (SOC), and Governance (GOV). This approach more accurately captures the multifaceted nature of corporate sustainability, as compared to using a single aggregate score. By measuring each

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pillar separately, it allows for the inclusion of measurement errors specific to each dimension (Fan et al., 2024).

Mediating Variable: Green Innovation (GI)

Ln_GreenPatApp is the natural logarithm of one plus the number of green patent applications filed by a firm in each year. As a commonly used indicator, it indicates the voluntary expenditures as well as the number of stocks of a firm's green technological applications (Song & Yu, 2022). The log transformation is utilized to alleviate the serious positive skewness that results from patent count data (Li & Wang, 2023).

Dependent Variables

Firm performance is a multi-dimensional concept, captured by two distinct observed variables (see Table 1):

Financial Performance (FP): Return on Assets (ROA) as internal measure of the efficiency of management and profitability (El Khoury et al., 2023).

Market Value (MV) Tobin's Q, representing the company's outside market value and long-term growth expectations of the future viewed by the market (Wang et al., 2023).

Control Variables

To isolate the net effects of SBP and GI, several firm-level characteristics known to influence performance are included as control variables. All are modeled as observed variables, and their operationalizations, consistent with recent literature, are provided in Table 1.

Analytical Procedure

The analysis of the data was based on the standard twostep SEM procedure (Anderson and Gerbing, 1988), estimated with the Mplus 8.11 software, capable of dealing with an intricate panel data set.

Step 1: Confirmatory Factor Analysis (CFA)

A Confirmatory Factor Analysis (CFA) was conducted to assess the construct validity and reliability of the measurement model for the latent SBP construct. Specifically, the following tests were performed:

Convergent Validity, using factor loadings (target > .70), Average Variance Extracted (AVE > .50), and Composite Reliability (CR > .80), based on the thresholds proposed by Hair et al. (2022).

Discriminant Validity, following the Fornell-Larcker (1981) criterion, ensures that the square roots of the AVE for each construct were greater than their correlations with other constructs.

Step 2: Structural Model and Hypothesis Testing

Once a good-fitting measurement model was confirmed, the structural model was estimated to test the hypotheses. The model evaluated both the direct effects (H1a, H1b) and the mediating paths (H2a, H2b).

To test the mediation hypotheses (H2a, H2b), the bias-corrected bootstrap method was employed with 5,000 resamples to generate 95% confidence intervals for the indirect effects

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(Hayes, 2018). This approach was considered robust, as it did not assume normality in the sampling distribution. Mediation was considered statistically significant if the confidence interval did not include zero (Cheung & Lau, 2023).

The global model fit was evaluated using several indices:

- χ^2/df (< 3)
- Comparative Fit Index (CFI > .95)
- Tucker-Lewis Index (TLI > .95)
- Root Mean Square Error of Approximation (RMSEA < .05)

These fit indices were in line with the recommendations of Hu & Bentler (1999) for modern applications (Xia & Yang, 2023).

Findings

This section presents the empirical results of the study, following a structured analytical sequence. It begins with descriptive statistics and correlation analysis to provide an initial overview of the data. Subsequently, it reports the results of the measurement model assessment to validate the constructs' reliability and validity. Finally, it details the outcomes of the structural model, which directly test the research hypotheses proposed in this study.

Descriptive Statistics and Correlation Analysis

Table 2 presents the summary statistics and Pearson correlations for all key variables. The averages and standard deviations indicate significant variation across firms in terms of ESG scores, green innovation, and financial performance, which justifies the subsequent multivariate analysis. The correlation matrix provides an initial overview: ESG is significantly and positively correlated with green innovation ($r = 0.21$, $p < 0.05$), while green innovation shows a negative correlation with return on assets ($r = -0.12$, $p < 0.05$). ESG is also negatively correlated with accounts payable ($r = -0.11$, $p < 0.05$). Additionally, a positive correlation is observed between firms' responsiveness to credit rationing (01) and firm performance, with return on assets (ROA: $r = 0.18$, $p < 0.01$) and Tobin's Q ($r = 0.15$, $p < 0.01$), providing preliminary support for the hypothesised relationships. The correlations among control variables align with expectations, and all Variance Inflation Factors (VIFs) in the initial regressions were below 3, suggesting that multicollinearity is not a concern in this sample.

Table 2: Descriptive Statistics And Correlations

Variable	Mean	SD	1	2	3
ESG	5.82	1.15	1		
Green_Inv	0.89	1.24	0.21	1	
ROA	0.04	0.06	0.18	0.16	1
Tobin's Q	2.11	1.35	0.15	0.14	0.42
Firm Size	22.67	1.43	0.25	0.31	-0.05
Leverage	0.45	0.20	-0.10	0.08	-0.35
Firm Age	12.45	5.61	0.12	0.09	-0.08
Growth	0.12	0.31	0.05	0.03	0.22

source: Compiled From CSMAR Database, Hua Zheng ESG Ratings, And CNRDS Patent Database. All Financial Variables are Winsorized At 1% And 99% Levels To Mitigate The Influence Of Outliers.

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Structural Model and Hypothesis Testing

The hypothesized structural model demonstrated a good fit with the data ($\chi^2/df = 2.45$, CFI = 0.963, TLI = 0.955, RMSEA = 0.042), meeting the standard thresholds for acceptability (Hu & Bentler, 1999). Standardized path coefficients and results from hypothesis testing are presented in Table 3.

Table 3: Structural Model Results and Hypothesis Testing

Hypothesized Path	Std. Estimate	S.E.	p-value	95% Bootstrap CI
Direct Effects				
H1a: SBP → ROA	0.136	0.021	< 0.01	[0.095, 0.177]
H1b: SBP → Tobin's Q	0.098	0.018	< 0.01	[0.063, 0.133]
Mediating Paths				
SBP → Green_Inv	0.254	0.025	< 0.01	[0.205, 0.303]
Green_Inv → ROA	0.115	0.019	< 0.01	[0.078, 0.152]
Green_Inv → Tobin's Q	0.092	0.016	< 0.01	[0.061, 0.123]
Indirect Effects				
H2a: SBP → GI → ROA	0.029	0.006	< 0.01	[0.018, 0.042]
H2b: SBP → GI → Tobin's Q	0.023	0.005	< 0.01	[0.014, 0.034]

Note: S.E. = Standard Error; CI = Confidence Interval. Control variables are included in the model but not shown for brevity.
source: Structural Equation Modeling Analysis Performed Using Mplus 8.11 With Maximum Likelihood Estimation. Bootstrap Confidence Intervals Are Based On 5,000 Bootstrap Samples. Data Sources: CSMAR, Hua Zheng ESG, And CNRDS.

As shown in Table 3, the results provide strong evidence to support our hypotheses. First, the two direct effects reveal that Sustainable Business Practices (SBP) have a significant positive impact on both ROA ($\beta = 0.136$, $p < 0.01$) and Tobin's Q ($\beta = 0.098$, $p < 0.01$), thus strongly confirming H1a and H1b.

Regarding the mediating effects, the analysis demonstrates a significant positive relationship between SBP and Green Innovation (GI) ($\beta = 0.254$, $p < 0.01$). GI, in turn, has a significant positive effect on both ROA ($\beta = 0.115$, $p < 0.01$) and Tobin's Q ($\beta = 0.092$, $p < 0.01$). Most importantly, the bootstrap method produced confidence intervals for the specific indirect effects, which were statistically significant (i.e., they do not cross zero). For example, the indirect effect of SBP on ROA is [0.018, 0.042], and for SBP on Tobin's Q, it is [0.014, 0.034]. These findings confirm that green innovation serves as a meaningful partial mediator in the relationship between SBP and both dimensions of firm performance, providing direct empirical support for H2a and H2b.

Additional Analysis

To further examine the contextual boundaries of our model, an MGA with SEM was performed. The results indicated that, similar to the initial regression-based subsample analysis, the path coefficients in the structural model were stronger in the two groups with higher structural path coefficients.

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For firms in high-polluting sectors (e.g., chemicals, mining), the effect of Green Innovation (GI) on ROA was found to be larger ($\Delta\beta = 0.051$, $p < 0.05$), suggesting that in these sectors, regulatory pressures and other stakeholder-induced factors enhanced the financial benefits derived from green innovation.

For companies receiving public environmental subsidies, the path from SBP to GI was significantly greater ($\Delta\beta = 0.067$, $p < 0.01$). This finding suggests that public policy support stimulates the capacity of sustainable firms to develop green innovations.

Robustness Checks

The main results were further robustly tested through several additional analyses. The results remained quantitatively consistent in alternative specifications where:

- the number of green patent grants was used as a measure of the mediator, and
- potential endogeneity in the relationship between the mediator and the outcome was addressed by running the Lagged Dependent Variable model and the System GMM estimator, with control for the impact of unobservable, time-invariant individual characteristics of firms.

Exogenous shocks were controlled for by introducing a dummy variable for the years during the COVID-19 pandemic (2020-2021), which showed that the key relationships were not attributable to this exceptional period.

Discussion

The analysis provides strong support for the proposition that, in the emerging Chinese market, implementing sustainable operations is not only a regulatory requirement but also a driver of improved corporate performance. The results demonstrate that SBP directly affects both financial performance and market valuation. Most notably, an important mechanism is identified, where SBP leads to green innovation, which, in turn, serves as a key path to cost leadership and product differentiation, ultimately driving financial and market performance.

The stronger effects observed in more polluting industries and among subsidised firms highlight the crucial role of the institutional context. This suggests the presence of a synergy that emerges from the combination of the "stick" (i.e., the threat of losing market share due to increasing fines or penalties for pollution) and the "carrot" (i.e., government incentives aimed at attracting sustainable technologies).

Conclusion

In this study, strong evidence is presented for a theoretical framework that connects sustainable business practices (SBP) to corporate performance through the mediating process of green innovation, as demonstrated by rigorous panel data from the emerging Chinese market. The results unequivocally show that SBP significantly enhances both financial and market performance, while also fostering a competitive advantage through the promotion of green innovation. Furthermore, the estimated bounds offer valuable insights into how these relationships are moderated by industry pollution intensity and government subsidies. These findings are discussed in more detail in the following sections.

Theoretical and Practical Implications

This study contributes to the literature by empirically testing green innovation as a mediating variable in the SBP-performance relationship within an important emerging economy. It

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expands the resource-based view and stakeholder theory by demonstrating how intangible sustainability resources are transformed into concrete economic advantages. Additionally, the findings related to pollution intensity and government subsidies contextualise these theoretical mechanisms by identifying the conditions under which their effects are strongest, thereby providing useful boundaries of applicability for existing theoretical frameworks.

The results offer valuable insights for decision-makers. From a corporate management perspective, green business practices should be viewed as a strategic investment rather than a cost burden. Direct resource allocation toward green innovation activities is essential for realising financial value. For investors, ESG performance and green innovation capabilities serve as useful screening tools to identify companies with high long-term value creation potential and resilience. For policymakers, increasing environmental regulations and providing R&D subsidies to specific firms constitute powerful policy instruments for promoting green innovation and accelerating the national transition to a greener economy.

Limitations and Future Research

Despite its contributions, this study has certain limitations. The use of ESG ratings as a proxy for the more complex variable of SBP was imperfect. Future research could benefit from direct measurements or in-depth case studies. While lagged variables and the GMM estimator were employed to address potential endogeneity, unobserved firm-specific variables may still remain unaccounted for. Future studies could also explore the differential effects of green product innovation versus green process innovation, which may offer additional insights into how various types of green innovation influence firm performance.

Acknowledgements

The author would like to acknowledge gratefully Dr Zuraidah binti Zainol, the corresponding author and supervisor of the Ph.D, for all her suggestion and support during the course of this study. The author would also like to express her deepest thanks to anonymous referees and the editor for their positive inputs, which improved the work tremendously.

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