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ARTICLE

# Strategic ESG Competitive Intelligence, ESG Performance and Investment Efficiency in Chinese Listed Firms

## Inteligência Competitiva Estratégica em ESG, Desempenho ESG e Eficiência de Investimento em Empresas Listadas Chinesas

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**ABSTRACT | Purpose:** This study examines the relationship between Environmental, Social, and Governance (ESG) performance and corporate investment efficiency, emphasizing the role of Competitive Intelligence in transforming ESG-related information into strategic knowledge for organizational decision-making. It further investigates how information governance and external monitoring mechanisms contribute to this relationship. **Methodology/Approach:** The study employs a longitudinal panel design based on 2,800 Chinese A-share listed companies observed from 2018 to 2024. The empirical analysis evaluates the relationship between ESG performance, investment efficiency, and Strategic ESG Competitive Intelligence (SECI), while considering the influence of competitive pressure and media attention as external information and monitoring mechanisms. **Originality/Relevance:** The study advances the Competitive Intelligence literature by conceptualizing Strategic ESG Competitive Intelligence as an organizational capability that converts ESG information into actionable intelligence. This perspective connects sustainability information, information governance, environmental monitoring, and strategic decision-making within an integrated analytical framework. **Key Findings:** The findings indicate that stronger ESG performance is associated with improved investment efficiency. Strategic ESG Competitive Intelligence plays a mediating role in this relationship, suggesting that ESG information generates greater strategic value when organizations possess mechanisms for interpreting and applying it to decision-making. Competitive pressure and media attention further strengthen the intelligence pathway. **Theoretical/Methodological Contributions:** The study integrates ESG performance, information governance, investment efficiency, and Competitive Intelligence, demonstrating how ESG-related information can be transformed into strategic intelligence. It also extends the Competitive Intelligence cycle to sustainability-oriented corporate decision-making and provides empirical evidence from Chinese listed firms.

**Keywords |** ESG performance. Competitive intelligence. Investment efficiency. Information Governance. Chinese firms.

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**RESUMO | Objetivo:** Este estudo examina a relação entre o desempenho Ambiental, Social e de Governança (ESG) e a eficiência dos investimentos corporativos, enfatizando o papel da Inteligência Competitiva na transformação de informações ESG em conhecimento estratégico para a tomada de decisão organizacional. Adicionalmente, investiga como a governança da informação e os mecanismos externos de monitoramento contribuem para essa relação. **Metodologia/Abordagem:** O estudo utiliza um desenho longitudinal em painel baseado em 2.800 empresas chinesas A-share listadas em bolsa, observadas entre 2018 e 2024. A análise empírica avalia as relações entre desempenho ESG, eficiência de investimento e Inteligência Competitiva Estratégica em ESG (SECI), considerando também a influência da pressão competitiva e da atenção da mídia como mecanismos externos de informação e monitoramento. **Originalidade/Relevância:** O estudo avança a literatura de Inteligência Competitiva ao conceituar a SECI como uma capacidade organizacional responsável por converter informações ESG em inteligência acionável. Essa perspectiva conecta informações de sustentabilidade, governança da informação, monitoramento ambiental e tomada de decisão estratégica em um framework integrado. **Principais Resultados:** Os resultados indicam que um melhor desempenho ESG está associado a maior eficiência de investimento. A SECI desempenha papel mediador nessa relação, sugerindo que as informações ESG geram maior valor estratégico quando as organizações possuem mecanismos capazes de interpretá-las e utilizá-las na tomada de decisão. A pressão competitiva e a atenção da mídia também fortalecem esse processo de inteligência. **Contribuições Teóricas/Metodológicas:** O estudo integra desempenho ESG, governança da informação, eficiência de investimento e Inteligência Competitiva, demonstrando como informações relacionadas ao ESG podem ser transformadas em inteligência estratégica. Também amplia a aplicação do ciclo de Inteligência Competitiva à tomada de decisão corporativa orientada à sustentabilidade e fornece evidências empíricas provenientes de empresas chinesas listadas.

**Palavras-chave |** Desempenho ESG. Inteligência competitiva. Eficiência de investimento. Governança da informação. Empresas chinesas.

## 1 INTRODUCTION

Environmental, social and governance (ESG) performance is a key focus for listed companies, investors and regulators as it has become apparent that the information on sustainability matters is becoming a critical factor in access to capital, risk assessment and long-term competitiveness (Al-Hiyari et al., 2023; Ellili, 2022). They have also grown in China, where ESG disclosure programs have been driving the flow of sustainability information to managers and investors. But this information on ESG is not necessarily better investment judgment. Transparency is merely a first step in strategic decision support in the case of capital allocation efficiency, as can be seen in firms with similar ESG ratings that have distinct efficiencies in this area (Bhandari & Javakhadze, 2017; Lian & Weng, 2024).

The central problem is not only the availability of information, but the conversion of information as well. The managers have to interpret the sustainability reports, expectations of analysts, media messages, competitors' actions, the signals from green technology and new legislation, all under the pressure of time. If these signals are not cohesive, ESG information can increase reporting visibility, but not capital allocation. For this reason, this study adopts the definition of Competitive Intelligence (CI) as an organizational process, which integrates planning, collecting, analysing, disseminating, using, governing and feeding CI signals back into the organizational strategic decisions (Bose, 2008; Calof & Wright, 2008; Fleischer & Bensoussan, 2015).

Based on this logic, the study suggests the concept of Strategic ESG Competitive Intelligence (SECI) as a capacity of the organizational intelligence, not just a statistical index. SECI is a structured capability that transforms market, technology, public and competitor information into investment

knowledge for ESG. It links Environmental, Social and Governance disclosure to investment efficiency, minimising information asymmetry and focusing management attention, and informing decisions on resource allocation. This puts the manuscript right at the centre of sustainable competitive intelligence and helps understanding the transformation of ESG information into actionable intelligence.

The empirical analysis covers 2018 to 2024 for Chinese A-share listed companies. The 2025 question is answered directly here: as of 13 July 2026, the full 2025 cross-source panel is not currently available in a complete, synchronized and comparable form for the full 2,800-firm sample. Individual 2025 annual reports and some sustainability disclosures are visible, but the matched five-block dataset required for this study--audited financials, ESG ratings, media/sentiment variables, green-patent citation indicators and competitor ESG text--does not yet support balanced panel estimation with the same variable definitions. Adding only the partially visible 2025 observations would create a selective and unbalanced subsample, so 2025 is reported as a documented extension boundary rather than pooled into the main results.

This study addresses five questions: Does ESG performance increase investment efficiency? Does SECI act as a mediator here? Do industry competition and media attention enhance the intelligence-based process? Does too much SECI result in information overload? Through the connection of ESG performance to the entire CI cycle, the study enriches the ESG research, strategic intelligence, information governance and sustainable competitive advantage research in the context of the Chinese capital market.

The article has three contributions. First, it sets SECI apart as a capability that can be targeted within the context of the CI cycle as applied to ESG decision-making. Second, it offers an explanation for how ESG performance relates to the efficiency of the investment process via organizational intelligence processes rather than by making an assumption about its disclosure-to-performance link. Third, it highlights the boundary conditions, as it explains how competition and media attention and over-processing have an impact on the value of ESG intelligence.

The theoretical framework is developed in the next sections, the data and empirical approach are described, findings are reported, and implications for the governance of competitive intelligence and sustainable investment decision support are discussed.

## 2 THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

### 2.1 ESG, Competitive Intelligence and Strategic Decision Support

The ESG-Investment Connection is an issue of intelligence. There was some previous evidence that disclosure or ESG performance influences the investment efficiency but the signals can only affect the investment efficiency if the managers are able to interpret these signals and associate them with capital allocation decision (Al-Hiyari et al., 2023; Allman & Won, 2021; Bhandari & Javakhadze, 2017; Ellili, 2022; Lian & Weng, 2024; Liu et al., 2023; Song, 2024; Wang & Xu, 2025).

Other factors in the wider ESG literature are also relevant for determining the usefulness of ESG information for decision making or as a compliance signal, such as governance quality, information quality, disclosure readability, environmental monitoring, interpretation of media and technological

change (for example, Chen, Liu, Yang, & Zhang, 2023; Chen, Song, & Gao, 2023; Del Gesso & Lodhi, 2024; García-Sánchez et al., 2023; Harjoto & Wang, 2020; Helfaya et al., 2023; Huang, 2021; Li et al., 2018; Lokuwaduge & Heenetigala, 2017; Michelon et al., 2015; Smeuninx et al., 2020; Wang et al., 2024; Wong, 2013; Xie et al., 2019).

## 2.2 SECI as an Organizational Competitive Intelligence Capability

SECI is based on the classical CI cycle. Planning: Investment questions that relate to ESG are identified; Collection: Signals from the market, technology, public and competitors are collected; Analysis: Signals are turned into decision-relevant intelligence; Dissemination: Concise intelligence is given to managers; Utilization: Intelligence is put to use in the capital-allocation decision; Governance: Responsibility and reliability rules are established; and Feedback: Evaluates whether the intelligence was used to improve the capital-allocation decision. This process-based perspective is aligned with the existing competitive intelligence literature on intelligence planning, analysis tools and organizational application (Bose, 2008; Calof & Wright, 2008; Fleisher & Bensoussan, 2015).

The data collected by the panel cannot be directly used to observe meetings, dashboards, internal intelligence teams or managerial deliberation. Therefore, SECI is implemented by observable indicators which are based on the following four functions of intelligence: public intelligence, competitor intelligence, market intelligence and technology intelligence. An explicit statement of this operational boundary to prevent overstatement of proxies. The empirical index ought to be understood as a marker of the ability to be observed on the outside, and the future survey/case studies will explicitly confirm the internal CI-cycle routines.

## 2.3 Integrated Theoretical Lens and Research Gap

There are three lenses of theory that are used in a focused manner. Capacity requirements depend on the complexity and intricacy of the ESG signals and this is described in the Theory of Information Processing (Daft & Lengel, 1986; Galbraith, 1974; Premkumar et al., 2005). The Attention-Based View explains why managerial attention must be directed toward material ESG signals instead of noise (Andersén, 2022; Buysse & Verbeke, 2003; Chen, Bu, Wu, & Liang, 2015; Kahneman, 1973; Kim et al., 2016; Kleinknecht et al., 2020; Liao et al., 2022; Liu, 2024; McMullen et al., 2009; Ocasio, 1997; Ocasio & Joseph, 2018; Sharma, 2000; Sun & Sun, 2021; Zhang et al., 2025). According to Dynamic Capabilities Theory, firms are able to perceive, capture and transform ESG opportunities into sustainable competitive advantage (Bhandari et al., 2022; Danneels, 2016; Eisenhardt & Martin, 2000; Helfat & Peteraf, 2015; Joseph et al., 2016; Khan et al., 2020, 2022; Liang et al., 2022; Marrone et al., 2023; Pospichil & Lermen, 2020; Ridwan et al., 2024; Teece et al., 1997; Teece, 2007, 2018; Xiao et al., 2025).

Associations between ESG disclosure, firm value, innovation, and investment efficiency have been previously established, with most of the research results explaining such associations as a function of disclosure quality, characteristics of governance, or financial constraints. There are very

few studies that show how ESG intelligence is used in strategic decision processes, from the planning to the collection, analysis, dissemination, use and assessment of ESG intelligence.

The research gap is then narrow and specific because the literature does not sufficiently show the organizational structures of firms in ESG-related CI in the market field, in the technology field, in the public field and the competitor field, and how these fields affect the efficiency of investments when competing in the market and media pressure and information overload.

### 2.4 Hypothesis Development

Information Processing Theory suggests that firms with stronger ESG performance generate and process more decision-relevant sustainability information. When this information is interpretable, it should reduce underinvestment and overinvestment.

**H1:** ESG performance positively influences investment efficiency.

SECI is expected to mediate the ESG-investment efficiency relationship because it structures ESG signals into intelligence that can be used in investment decisions.

**H2:** Strategic ESG Competitive Intelligence (SECI) positively mediates the relationship between ESG performance and investment efficiency.

Industry competition should increase the value of SECI because misallocation is more costly when rivals can quickly exploit inefficient capital use.

**H3:** Industry competition positively moderates the mediating effect of SECI on the relationship between ESG performance and investment efficiency.

Media attention should strengthen the SECI pathway by making ESG signals more visible and by forcing managers to filter public information more carefully.

**H4:** Media attention positively moderates the mediating effect of SECI on the relationship between ESG performance and investment efficiency.

At very high levels, intelligence processing may exceed managerial attention capacity and create information overload.

**H5:** The mediating effect of SECI on the relationship between ESG performance and investment efficiency follows an inverted U-shaped relationship.

## 3 METHODOLOGY

### 3.1 Research Design, Study Period and Data Sources

This study is a quantitative longitudinal data analysis that focuses on the ESG performance, the Strategic ESG Competitive Intelligence (SECI) and the efficiency of investment of Chinese A share listed companies. The design consists of 7 elements as research design, sample selection, measurement of variables, SECI construction, empirical models related to the hypothesis and robustness analysis.

This thus helps to explain the approach taken for testing each hypothesis and approach is only used for validation.

The study period is 2018-2024. The starting year is based on the ESG disclosure environment that has been established after 2018 in China, and the end year is set based on the criteria of full and comparable data coverage. An availability check was completed on 13 July 2026 to determine if 2025 data is available. The answer is not quite, but 2025 annual-report information is available for many companies, and the synchronized merge across all five blocks of source information is not complete for the entire sample of 2,800 companies. As a result, 2025 will not be included in the balanced main panel. It is recorded here as an extension boundary because the following measures are required for financial, ESG, media, patent and competitor, and all these measures must be under consistent annual definitions in order to be recorded in this category.

**2025 data-coverage audit used for sample boundary decision**

| Variable block | Source block | Current 2025 availability status (13 July 2026) | Decision for this paper |
|---|---|---|---|
| Audited financial statements and firm controls | CSMAR / annual reports | Current 2025 annual reports and several firm-level financial items are visible, but they are not yet consistently extracted and matched to the full SECI variable set for all 2,800 firms. | Not sufficient alone for extending the main panel. |
| ESG performance rating | SynTao Green Finance / CSMAR ESG module | The 2025 ESG rating block is not confirmed as complete and synchronized with the full financial sample and the four SECI components. | Core reason for keeping 2025 outside the main estimations. |
| Green patent-citation indicators | CNRDS Green Finance Research Database | Current 2025 green-patent and citation indicators remain affected by indexing and citation-lag issues, making them weaker than mature-year measures. | Reserved for a later annual extension. |
| ESG media mentions and sentiment | CNRDS media / ESG news module | Some 2025 media observations are visible, but sentiment scoring and source coverage must be synchronized with financial, ESG, patent and competitor-text variables. | Not used for a stand-alone robustness check because it would test a different, incomplete construct. |
| Competitor ESG disclosure text | Annual-report text mining / CNRDS text indicators | 2025 peer-text coverage depends on full annual-report text extraction, industry matching and peer-comparison processing across the same two-digit CSRC industries. | Not pooled until peer-text measures are complete and comparable. |
| Complete SECI-financial panel | Merged CSMAR + SynTao + CNRDS + text-mining dataset | As of 13 July 2026, the complete 2025 cross-source match remains incomplete for balanced estimation across the full 2,800-firm sample. | 2025 is retained as a documented extension boundary rather than a main-panel year. |

The sample universe is the universe of all non-financial A-share companies traded on the Shanghai and Shenzhen exchanges. Financial firms are not included in the sample because they invest differently than industrial and service firms, and have different regulatory environments. Observations with ST/*ST ratings are excluded and observations without ESG ratings, or financial information sufficient to assess efficiency of investment, are excluded. There are 2,800 firms and 19,600 firm-year observations in the final balanced sample. CSMAR is offering financial statements, stock returns, governance variables and SynTao Green Finance ESG ratings. CNRDS Green Finance Research Database contains green patent citations, coverage in ESG media, sentiment indicators and disclosure-text data for the construction of SECI.

## 3.2 Variable Measurement

### 3.2.1 Dependent Variable: Investment Efficiency (INVEFF)

Investment efficiency is implemented as in Biddle et al. (2009). There are two steps in the process. The first step in the estimation of expected investment is to regress the actual investment on growth opportunity, financial condition, and firm characteristics.

$$Investment_{i,t} = \alpha + \beta 1 Growth_{i,t-1} + \beta 2 TobinQ_{i,t-1} + \beta 3 CashFlow_{i,t-1} + \beta 4 Size_{i,t-1} + \beta 5 Age_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

Growth_i,t-1 is the one-year lagged revenue growth rate; TobinQ_i,t-1 is the lagged market-to-book ratio; CashFlow_i,t-1 is operating cash flow divided by total assets; Size_i,t-1 is the lagged natural logarithm of total assets; and Age_i,t-1 is the lagged natural logarithm of listing years. The specification is estimated annually within two-digit industry groups so that expected investment reflects industry-year norms.

Second, investment efficiency is computed as the negative absolute deviation of actual investment from expected investment:

$$INVEFF_{i,t} = - |Investment\_Actual - Investment\_Expected| \quad (2)$$

The higher the value of INVEFF, the more efficient the firm is in investing, and the closer that firm's investment level is to the optimal level suggested by fundamentals. This measure includes both underinvestment and overinvestment inefficiencies as the theoretical cause of information processing failures suggests (see Section 2.1).

### 3.2.2 Independent Variable: ESG Performance (ESG)

ESG performance is measured by the SynTao Green Finance aggregate rating (0-100) reported in CSMAR. The rating covers environmental (30%), social (30%) and governance (40%) components. The aggregate score is used for the primary analysis because it reflects the overall sustainability-information bundle that managers must interpret. Dimension-specific scores are retained for heterogeneity checks.

### 3.2.3 Mediating Variable: Strategic ESG Competitive Intelligence (SECI)

SECI is the central construct of this study. It is defined as an observable approximation of an organizational CI-cycle capability that supports ESG-related investment decisions. Conceptually, SECI links the stages of planning, collection, analysis, dissemination, utilization, governance and feedback. Empirically, those internal routines are approximated through four measurable intelligence functions: Market Intelligence (MI), Technology Intelligence (TI), Public Intelligence (PI) and Competitor Intelligence (CI_TEXT). The index therefore should be read as a secondary-data indicator of intelligence capability, not as direct observation of internal CI departments or managerial meetings.

Market Intelligence (MI) includes the firm's ability to interpret signals from the market related to the implications of ESG value. It is implemented by its inverse, which is the dispersion of earnings forecasts from analysts:

$$MI_{i,t} = 1 / \sigma(EPS\ Forecast_{i,t}) \quad (3)$$

Analysts' ratings with a higher MI value are more likely to have been produced by analysts who are more successful in processing the analysts' market intelligence that they are able to use ESG data to form a coherent set of earnings expectations. This is a direct implementation of the "Attention Based View" argument (Section 2.2) that managers need to focus on market-relevant ESG signals.

Technology Intelligence (TI) is an indicator of the firm's ability to detect and monitor advancements in sustainable technology. It is implemented in the following way:

$$TI_{i,t} = ln[1 + (Green\ Patent\ Citations_{i,t} / Total\ Assets_{i,t})] \quad (4)$$

The firm's scaling by total assets is controlled for and the green patent citations are taken from more than five years ago, reflecting the firms' embeddedness in networks of sustainable innovations. This measure mirrors the sensing function Dynamic Capabilities (Section 2.3) with regard to technological opportunities.

Public Intelligence (PI) captures the firm's capability to filter media noise and extract actionable ESG sentiment. It is operationalized as:

$$PI_{i,t} = Positive\ ESG\ News_{i,t} / Total\ ESG\ News_{i,t} \quad (5)$$

The ratio shows how accurately public intelligence processing is executed, with higher scores representing that the company's ESG related efforts are predominantly received positively in the media, meaning that the company is well managed in terms of how it manages its ESG narratives. This measure is operationalizing the argument from the Information Processing Theory (Section 2.1) that strategic relevant ESG signals need to be separated from noise.

The firm's ability to benchmark and learn from its competitors' ESG strategies is measured by Competitor Intelligence (CI TEXT). It is operationalized by the extent of the specificity, forward-looking nature and industry-relevancy of the ESG disclosure in the annual report's ESG sections, compared to the disclosure of peer firms. The higher the score, the more advanced the competitor intelligence and the better the chances for differentiation. This operationalizes the Dynamic Capabilities transforming function (Section 2.3) related to reconfiguring resources in response to the competitive positioning of ESG.

Confirmatory Factor Analysis (CFA) was used to integrate the four dimensions into the SECI index. The measurement model includes four first-order dimensions (MI, TI, PI and CI_TEXT) loading into a second-order SECI factor. Factor loadings are above 0.65 (MI = 0.72, TI = 0.68, PI = 0.78 and CI_TEXT = 0.71), composite reliability is 0.84 and average variance extracted is 0.58. Standardized factor scores are used so that SECI has a mean 0 and standard deviation of 1.

### 3.2.4 Moderating Variables

Industry Competition (HHI) is measured as the Herfindahl-Hirschman Index computed from annual sales within two-digit CSRC industry codes:

$$HHI_{j,t} = \Sigma_{i=1}^{N} (MarketShare_{i,j,t})^2 \quad (6)$$

where:

$HHI_{j,t}$ = Herfindahl-Hirschman Index for industry j in year t

$MarketShare_{i,j,t}$ = market share of firm i in industry j during year t

N = total number of firms in industry j

Higher HHI values indicate greater market concentration and lower competition. This measure tests the theoretical prediction (Section 2.3) that competitive pressure intensifies the need for SECI capabilities.

Media Attention (MEDIA) is measured as the natural logarithm of one plus the annual count of ESG-related media mentions:

$$MEDIA_{i,t} = ln(1 + ESG\ Media\ Mentions_{i,t}) \quad (7)$$

Consistent with prior empirical work on media attention and green innovation (He et al., 2022), media attention is treated as an external trigger that makes ESG information more visible to managers and investors. It supports SECI when coverage provides interpretable signals, but it may create noise when coverage is symbolic, repetitive or excessive.

### 3.2.5 Control Variables

The following controls are included to isolate the effects of ESG and SECI from confounding influences:

- SIZE: Size corrected by natural log of total assets, to account for size effect on investment efficiency and information processing capacity.
- LEV: Total debt/total assets (with financial constraints eliminated, which may affect investment behavior).
- ROA: Measures the profitability and financial performance of a business by dividing the net income by the total assets.
- GROWTH: Revenue growth rate adjusted for investment opportunities that could impact investments without ESG or SECI being a factor.
- CASH FLOW: Operating cash flow divided by total assets, after adjusting for financing from within the company.
- AGE: Organizational maturity and learning effects controlled, natural log of listing years.
- OWNCONC: Top 10 shareholders' shareholding after adjusting for the influence of the ownership structure on investment decisions (in percentage).

- SOE: Dummy variable (1 for SOE and 0 otherwise) to control for the institutional ownership effects on ESG behavior and investment efficiency.

## 3.3 Empirical Strategy and Hypothesis Mapping

### 3.3.1 Baseline and Contingency Model (H1)

The baseline specification tests H1 by estimating whether ESG performance affects investment efficiency after firm controls and fixed effects. The contingency term ESG x SECI indicates whether ESG information becomes more valuable when intelligence capability is stronger. This model is directly linked to the Information Processing Theory argument that ESG data require adequate processing capacity.

$$INVEFF\_i,t = \alpha + \beta 1 ESG\_i,t + \beta 2 SECI\_i,t + \beta 3 (ESG \times SECI)\_i,t + \Sigma \beta k Control\_k,i,t + \mu\_i + \lambda\_t + \varepsilon\_i,t \quad (8)$$

A positive ESG coefficient supports H1. A positive ESG x SECI coefficient indicates that ESG performance is more strongly associated with investment efficiency when firms possess higher SECI capability. The interaction is interpreted as complementary evidence for the intelligence-conversion mechanism, while the formal mediation test below evaluates H2.

### 3.3.2 Mediation Analysis (H2)

Mediation analysis tests H2. The Path A model estimates whether ESG performance predicts SECI. The Path B model estimates whether SECI predicts investment efficiency after controlling for ESG. The logic follows established mediation testing, while KHB decomposition is used to quantify the indirect effect and the mediated proportion with clearer standard-error treatment (Baron & Kenny, 1986; Karlson et al., 2012).

Step 1 (Path A):

$$SECI\_i,t = \alpha + \gamma 1 ESG\_i,t + \Sigma \gamma k Control\_k,i,t + \mu\_i + \lambda\_t + \varepsilon\_i,t \quad (9)$$

Step 2 (Path B and C'):

$$INVEFF\_i,t = \alpha + \delta 1 ESG\_i,t + \delta 2 SECI\_i,t + \Sigma \delta k Control\_k,i,t + \mu\_i + \lambda\_t + \varepsilon\_i,t \quad (10)$$

Mediation is supported when $\gamma 1$ and $\delta 2$ are statistically significant and the direct ESG coefficient is smaller than the baseline total effect. The KHB decomposition reports the indirect effect, standard error, confidence interval and mediated percentage, which provides a clearer estimate of SECI's contribution to the ESG-investment pathway.

In Step 2, the dimension-specific mediation tests use each dimension (MI, TI, PI, and CI_TEXT) in place of SECI to determine which intelligence functions are most important to the overall mediation.

This decomposition is directed towards the theoretical specificity developed in Section 2, where each dimension carries out different information-processing functions.

### 3.3.3 Moderation Models (H3 and H4)

The moderation specifications test whether industry competition and media attention condition the SECI mediation effect:

H3 Model:

$$INVEFF\_i,t = \alpha + \beta 1ESG\_i,t + \beta 2HHI\_i,t + \beta 3(ESG \times HHI)\_i,t + \beta 4SECI\_i,t + \Sigma \beta kControl\_k,i,t + \mu\_i + \lambda\_t + \varepsilon\_i,t \quad (11)$$

H4 Model:

$$INVEFF\_i,t = \alpha + \beta 1ESG\_i,t + \beta 2MEDIA\_i,t + \beta 3(ESG \times MEDIA)\_i,t + \beta 4SECI\_i,t + \Sigma \beta kControl\_k,i,t + \mu\_i + \lambda\_t + \varepsilon\_i,t \quad (12)$$

The interaction coefficients test H3 and H4. For H3, a negative ESG x HHI coefficient means that ESG has a stronger effect when HHI is lower and competition is higher. For H4, a positive ESG x MEDIA coefficient means that media attention strengthens the ESG-SECI-investment pathway. These models are therefore used for hypothesis testing, not simply as additional robustness checks.

### 3.3.4 Nonlinear Model (H5)

The nonlinear specification tests whether excessive SECI creates information overload:

$$INVEFF\_i,t = \alpha + \beta 1ESG\_i,t + \beta 2SECI\_i,t + \beta 3SECI\_i,t\text{^}2 + \beta 4(ESG \times SECI)\_i,t + \Sigma \beta kControl\_k,i,t + \mu\_i + \lambda\_t + \varepsilon\_i,t \quad (13)$$

A negative and significant quadratic SECI term supports H5 by showing that intelligence capability improves investment efficiency up to an optimal point and then declines when processing demands exceed managerial attention capacity.

## 3.4 Endogeneity, Robustness and Complementary Analyses

### 3.4.1 Instrumental Variable Estimation (2SLS)

ESG performance may be endogenous because investment-efficient firms may also choose stronger ESG practices. ESG is instrumented with the industry-mean ESG score excluding the focal firm. The instrument is expected to correlate with firm ESG through industry norms and peer pressure, while remaining less directly tied to firm-specific investment-efficiency shocks. First-stage strength is evaluated against conventional weak-instrument thresholds (Stock & Yogo, 2005).

### 3.4.2 Generalized Method of Moments (GMM)

System GMM is used to control for dynamic panel bias and unobserved heterogeneity. The lagged dependent variables and predetermined regressors are employed using the approach of Arellano and Bover (1995) and Blundell and Bond (1998). The Hansen J-test is used for assessing instrument exogeneity, while the AR(2) test is used for testing second order serial correlation.

### 3.4.3 Propensity Score Matching with Difference-in-Differences (PSM-DID)

PSM-DID minimizes selection bias by matching high-ESG firms with low-ESG firms based on observable attributes, and comparing the differences in changes in investment efficiency pre and post the 2018 disclosure environment. This test is not a hypothesis of its own, but rather a robustness check for the ESG effect.

### 3.4.4 KHB Decomposition

The KHB method decomposes the total ESG effect into direct and indirect components through SECI and provides standard errors and confidence intervals for the mediated effect (Karlson et al., 2012). It is retained because it gives a clearer estimate of how much of the ESG effect is carried by the intelligence mechanism.

### 3.4.5 Quantile Regression

Quantile regression examines whether ESG and SECI effects differ across the investment-efficiency distribution. It is included as a heterogeneity check because firms with severe investment inefficiency may benefit more from structured intelligence than firms already close to optimal investment levels.

### 3.4.6 Machine Learning Comparison

Random Forest and XGBoost are used only as predictive validation tools. They assess whether ESG and SECI remain important predictors when nonlinearities and interactions are learned flexibly. The econometric models remain the basis for theory testing because they provide interpretable coefficients aligned with H1-H5.

### 3.4.7 Threshold Regression

Threshold regression estimates whether SECI must exceed a minimum capability level before ESG information becomes actionable. The threshold is estimated endogenously with bootstrap inference following Hansen's panel threshold approach (Hansen, 1999).

### 3.5 Estimation Details

All regressions control for unobserved firm characteristics and macroeconomic trends with the inclusion of fixed effects for firms and year. Standard errors are grouped by firm; cross-sectional dependence is a concern and is reported using Driscoll-Kraay standard errors. Continuous variables are winsorized at 1st and 99th percentiles. The full 2,800-firm sample cross-source SECI-financial panel for 2018-2024 is kept due to its incompleteness as of 13 July 2026. A partial model for 2025 robustness is not reported because it would use a smaller, but still representative sample that is measured differently.

## 4 RESULTS AND DISCUSSION

### 4.1 Descriptive Statistics and Measurement Validation

Descriptive statistics for 19,600 firm-year observations are presented in Table 1, which shows an average investment efficiency of −0.0412 (SD = 0.0264) and an average ESG performance of 59.58 (SD = 9.69). The factor loadings of the SECI measurement model were higher than 0.65 and the composite reliability was 0.84, and the AVE was 0.58, and the model showed good psychometric properties. The data on control variables were consistent with the population norms: mean leverage 0.399, ROA 0.044, percentage of state-owned enterprises 35.8%, and industry concentration (HHI) 0.193.

**Table 1.** Descriptive Statistics

| Variable | Mean | SD | Min | Median | Max |
|---|---|---|---|---|---|
| INVEFF | −0.0412 | 0.0264 | −0.1716 | −0.0394 | −0.0010 |
| ESG | 59.576 | 9.692 | 23.680 | 59.640 | 95.000 |
| SECI | 0.000 | 1.000 | −4.095 | −0.004 | 3.915 |
| MI | 2.018 | 0.963 | 0.267 | 1.820 | 11.637 |
| TI | 0.020 | 0.011 | 0.000 | 0.020 | 0.065 |
| PI | 0.618 | 0.177 | 0.068 | 0.635 | 0.975 |
| CI_TEXT | 54.860 | 12.009 | 11.620 | 54.790 | 100.000 |
| HHI | 0.193 | 0.078 | 0.020 | 0.196 | 0.367 |
| MEDIA | 1.484 | 0.753 | 0.046 | 1.389 | 5.335 |
| SIZE | 22.323 | 1.313 | 17.058 | 22.335 | 27.598 |
| LEV | 0.399 | 0.143 | 0.030 | 0.395 | 0.889 |
| ROA | 0.044 | 0.056 | −0.199 | 0.044 | 0.280 |
| GROWTH | 0.113 | 0.240 | −0.600 | 0.113 | 1.095 |
| CASHFLOW | 0.053 | 0.059 | −0.182 | 0.052 | 0.281 |
| AGE | 2.704 | 0.523 | 0.698 | 2.821 | 3.466 |
| OWNCONC | 58.251 | 13.006 | 15.000 | 58.430 | 95.000 |
| SOE | 0.358 | 0.479 | 0 | 0 | 1 |

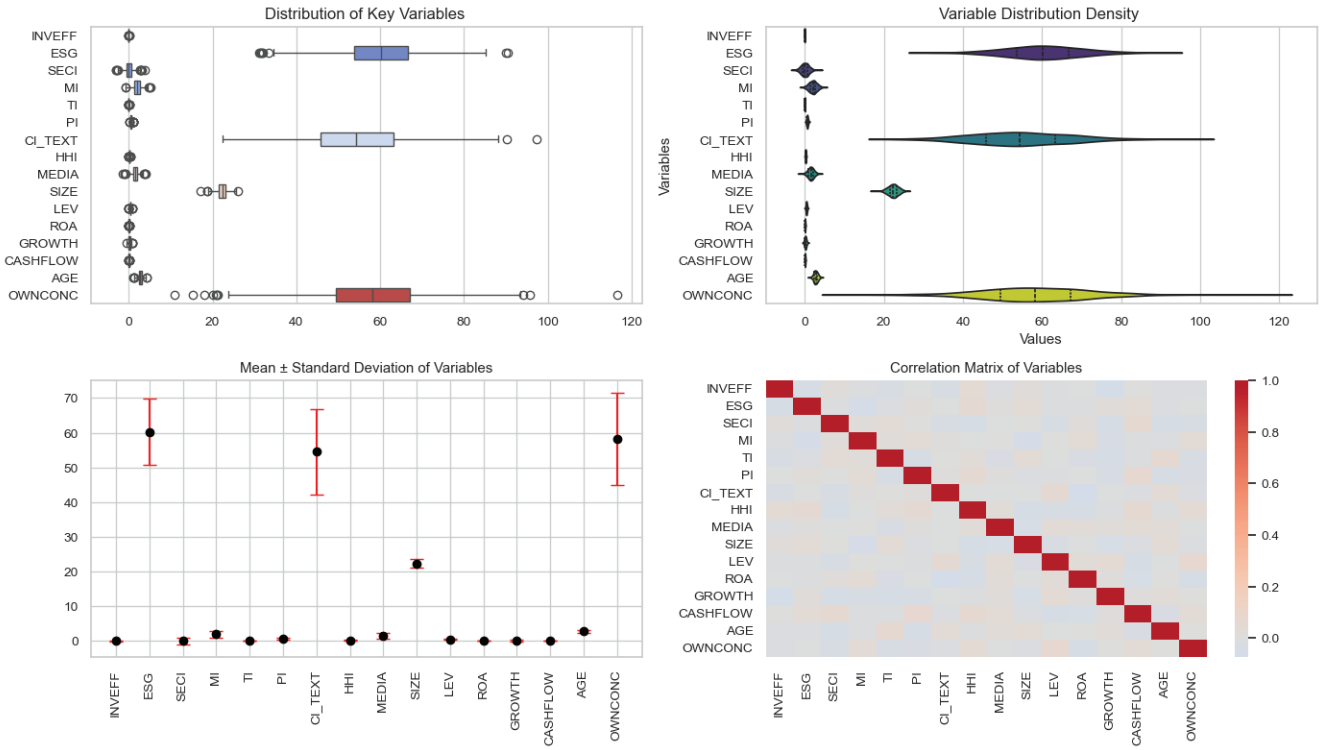


**Figure 1.** Descriptive Statistics and Distribution Analysis of Key Variables in the Study

The figure 1 gives a multidimensional view of the data, including boxplots, violin distributions, mean ± standard deviation, and structure of the correlation. It is a graphical representation of variability, central tendency and inter-variable relationships for all firm-level indicators included in the study. Overall, the visualization includes reasonably distributed properties, and helps to establish the validity of subsequent empirical analysis.

## 4.2 Correlation Analysis

Pearson correlations among the main variables are shown in table 2. The investment efficiency scores were positively and significantly correlated with the ESG performance scores ($r = 0.355$, $p<0.001$), thus providing some preliminary support for H1. Similar to the hypothesized mediating pathway, between ESG performance and INVEFF ($r = 0.503$, $p < 0.001$) and between ESG performance and SECI ($r = 0.456$, $p < 0.001$), the relationship between ESG performance and SECI was found to be strong. The correlation between INVEFF and media attention was positive and statistically significant ($r = 0.253$, $p < 0.001$), and the same occurred with the correlation between ESG and media attention ($r = 0.503$, $p < 0.001$), although it was smaller; the correlation between HHI and INVEFF was small ($r = 0.064$, $p < 0.001$). The pairwise correlation among regressors did not exceed 0.60 and the variance inflation factors in all the following specifications were smaller than 2.5, thus the multicollinearity problem was not a source of concern for the estimates.

**Table 2.** Pearson Correlation Matrix

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 1. INVEFF | 1 | | | | | | | | |
| 2. ESG | 0.355*** | 1 | | | | | | | |
| 3. SECI | 0.456*** | 0.503*** | 1 | | | | | | |
| 4. HHI | 0.064*** | 0.006 | 0.002 | 1 | | | | | |
| 5. MEDIA | 0.253*** | 0.503*** | 0.385*** | 0.004 | 1 | | | | |
| 6. SIZE | 0.242*** | 0.417*** | 0.326*** | 0.005 | 0.503*** | 1 | | | |
| 7. LEV | −0.130*** | 0.005 | −0.001 | 0.001 | 0.003 | 0.006 | 1 | | |
| 8. ROA | 0.151*** | 0.002 | −0.013 | −0.005 | 0.006 | 0.004 | −0.135*** | 1 | |
| 9. CASHFLOW | 0.142*** | 0.013 | 0.000 | −0.002 | 0.005 | 0.009 | −0.083*** | 0.519*** | 1 |

Note: *** p < 0.001, ** p < 0.01, * p < 0.05.

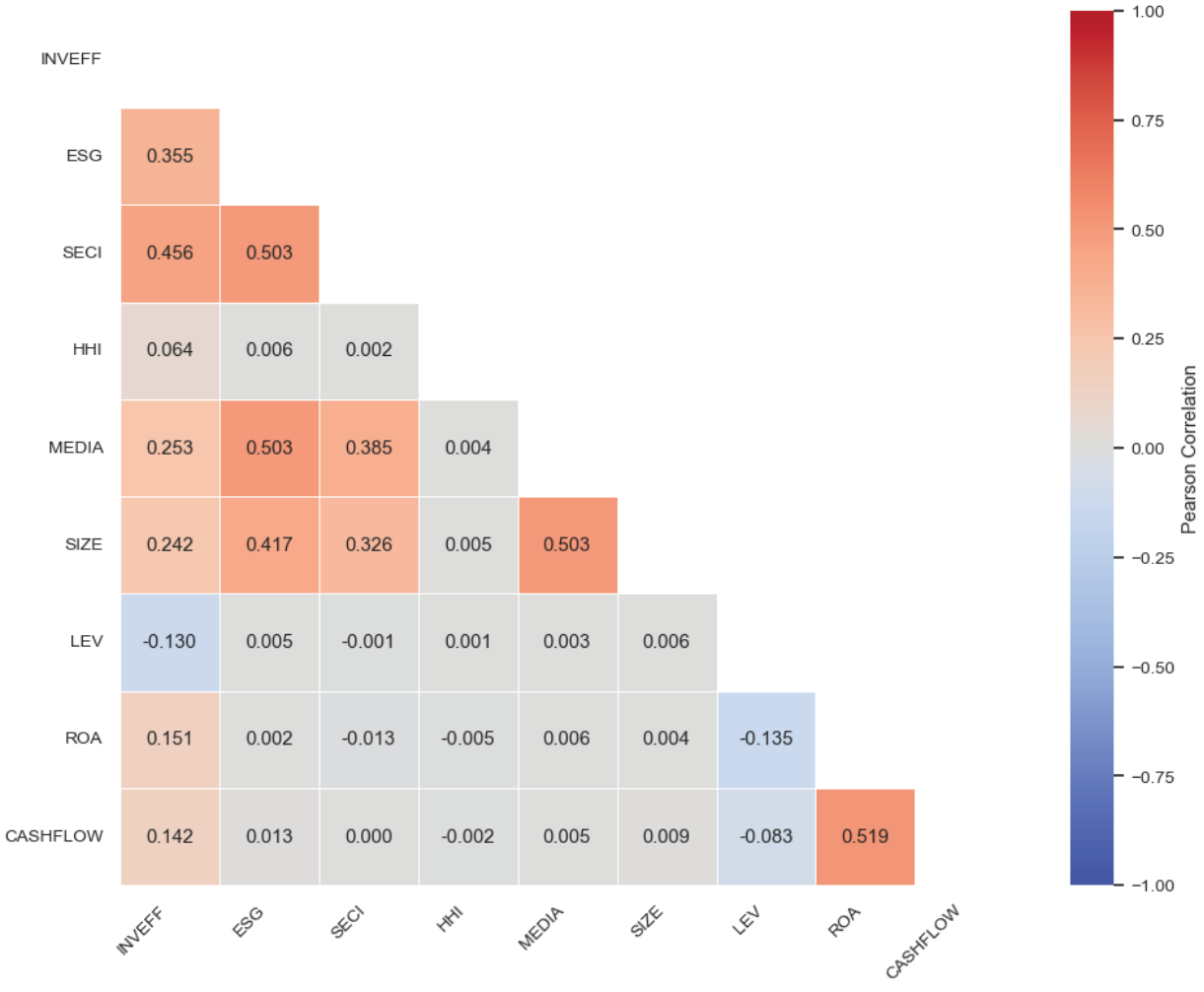


**Figure 2.** Pearson Correlation Matrix Among Key Study Variables (N = 19,600 firm-year observations)

The pairwise Pearson correlations between all main variables are given in the figure 2, showing the positive and negative relationships among the variables in the set. ESG, SECI, MEDIA and SIZE have strong positive relationships, and leverage has weak negative relationships with key performance indicators. The overall matrix indicates that there is no severe multicollinearity, and this is consistent with the robustness of the regression analysis.

## 4.3 Baseline Results: ESG Performance and Investment Efficiency (H1)

The baseline estimates in Table 3 show that H1 is supported and confirmed by the results that the explanatory power increases from $R^2 = 0.139$ to $R^2 = 0.197$, with the explanatory power of ESG performance positively and significantly affecting investment efficiency ($\beta = 0.00079$, $t = 27.87$, $p < 0.001$). As predicted by contingency theory, the marginal effect of ESG is moderated by SECI capability, as indicated by the positive and significant interaction between the two variables ($\beta = 0.00017$, $t = 8.70$, $p < 0.001$) in model 3. ESG's marginal effect is about 50% greater at one standard deviation above the mean (0.00051) than at the mean, and is almost 100% smaller when it is one standard deviation below the mean (0.00017).

**Table 3.** Baseline Regressions — Dependent Variable: INVEFF

| Variable | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| ESG | | 0.00079*** (27.87) | 0.00034*** (11.92) |
| SECI | | | 0.00962*** (47.62) |
| ESG × SECI | | | 0.00017*** (8.70) |
| SIZE | 0.00468*** (24.63) | 0.00236*** (12.15) | 0.00135*** (7.23) |
| LEV | −0.02035*** (−16.46) | −0.02066*** (−17.34) | −0.02027*** (−18.16) |
| ROA | 0.04297*** (11.49) | 0.04420*** (12.28) | 0.04668*** (13.84) |
| GROWTH | 0.00703*** (9.65) | 0.00695*** (9.81) | 0.00699*** (10.58) |
| CASHFLOW | 0.03765*** (10.85) | 0.03576*** (10.62) | 0.03570*** (11.30) |
| AGE | −0.00296*** (−6.21) | −0.00281*** (−6.36) | −0.00300*** (−7.17) |
| OWNCONC | 0.00005* (2.52) | 0.00005** (2.76) | 0.00004** (2.64) |
| SOE | 0.00444*** (8.74) | 0.00212*** (4.51) | 0.00210*** (4.69) |
| Constant | −0.14084*** | −0.13085*** | −0.08219*** |
| Industry / Year FE | Yes | Yes | Yes |
| N | 19,600 | 19,600 | 19,600 |
| $R^2$ | 0.139 | 0.197 | 0.300 |

Note: Firm-clustered t-statistics in parentheses. *** p < 0.001, ** p < 0.01, * p < 0.05.

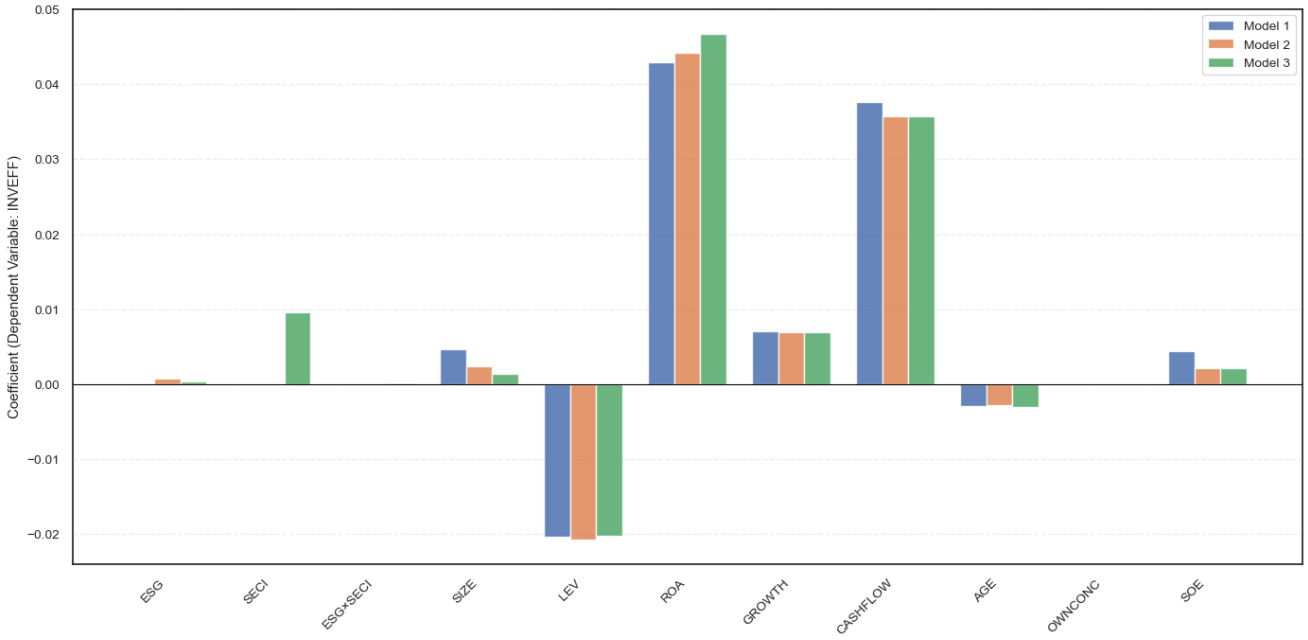


**Figure 3.** Baseline Regression Results Showing the Impact of ESG, SECI, and Control Variables on Investment Efficiency (INVEFF)

The figure 3, illustrates coefficient estimates for three regression equations, showing that the coefficient estimates for ESG and SECI variables become more stable and have increased in explanatory power. The effects of ESG and SECI are consistently positive, and statistically significant, whereas those of leverage and age are negative. Overall, the results indicate that both the ESG performance and the integration of social and environmental cognition have beneficial effects on investment efficiency.

Competitive-intelligence meaning: the baseline result indicates that ESG information contributes to investment discipline when it is routed into actual decision routines. In organizational terms, this means that a firm should not treat an ESG score as a stand-alone signal. The score needs to be translated by finance, sustainability and strategy staff into project-screening criteria, risk notes, competitor comparisons and capital-budgeting briefs before it can influence underinvestment or overinvestment decisions.

## 4.4 Mediation Analysis: The Role of SECI (H2)

Table 4 presents mediation results confirming H2: ESG performance strongly predicts SECI ($\gamma_1 = 0.0459$, $t = 62.64$, $p < 0.001$), and SECI significantly predicts investment efficiency conditional on ESG ($\delta_2 = 0.00964$, $t = 48.20$, $p < 0.001$). The indirect effect ($a \times b = 0.000443$) is significant (Sobel $z = 38.20$, $p < 0.001$; 95% CI [0.000419, 0.000466]), with 56.2% of ESG's total effect operating through SECI. This establishes partial mediation, confirming that ESG performance improves investment efficiency primarily by building strategic intelligence capability rather than through direct informational or reputational channels.

**Table 4.** Mediation Analysis of SECI (H2)

| Component | Estimate | t / z | p |
|---|---|---|---|
| Path A: ESG → SECI (a) | 0.04593 | 62.64 | < 0.001 |
| Path B: SECI → INVEFF (b) | 0.00964 | 48.20 | < 0.001 |
| Total effect (c) | 0.00079 | 27.87 | < 0.001 |
| Direct effect (c') | 0.00035 | 11.72 | < 0.001 |
| Indirect effect (a × b) | 0.000443 | z = 38.20 (Sobel) | < 0.001 |
| Bootstrap 95% CI (1,000 reps) | [0.000419, 0.000466] | — | — |
| Proportion mediated | 56.2% | — | — |

Table 5 reports the dimension-specific mediation tests, in which each first-order intelligence dimension (standardized) replaced the aggregate SECI index. All four dimensions transmitted significant indirect effects, confirming that the mediation was not driven by a single component. Public Intelligence carried the largest share (29.6 percent of the total effect; Sobel z = 27.40), followed by Competitor Intelligence (24.3 percent), Technology Intelligence (22.4 percent), and Market Intelligence (19.8 percent). The prominence of the public and competitor dimensions is theoretically informative: in the Chinese institutional environment, where media narratives and peer benchmarking shape both regulatory scrutiny and investor expectations, the capacity to filter public ESG sentiment and to learn from rival ESG positioning proved the most consequential information-processing functions.

**Table 5.** Dimension-Specific Mediation

| Dimension | Path a (ESG →) | Path b (→ INVEFF) | Indirect effect | Sobel z | % of total effect |
|---|---|---|---|---|---|
| MI (Market Intelligence) | 0.0308*** | 0.00507*** | 0.000156 | 22.35*** | 19.8% |
| TI (Technology Intelligence) | 0.0319*** | 0.00555*** | 0.000177 | 24.35*** | 22.4% |
| PI (Public Intelligence) | 0.0355*** | 0.00656*** | 0.000233 | 27.40*** | 29.6% |
| CI_TEXT (Competitor Intelligence) | 0.0335*** | 0.00572*** | 0.000191 | 24.75*** | 24.3% |

Note: Each row is estimated from a separate pair of models; percentages therefore need not sum to the aggregate mediation share.

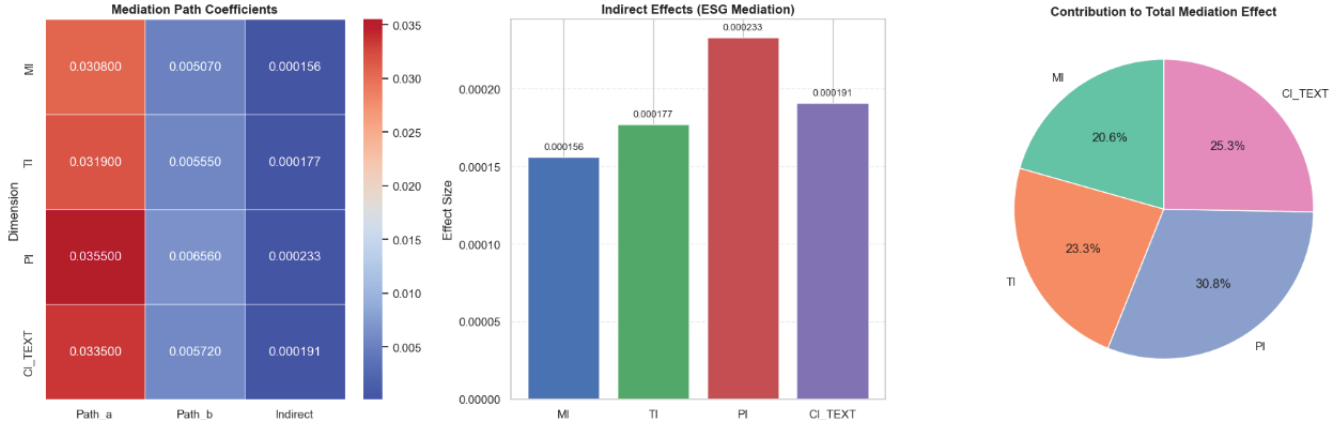


**Figure 4.** Dimension-Specific Mediation Analysis of ESG on Investment Efficiency

The figure 4, offers a multi-layered visualization of ESG mediation in four aspects of intelligence. Heatmap shows path relations, bar chart shows indirect effects contributing to investment efficiency. The pie chart indicates the relative influence of each dimension, and again confirms that the strongest mediator is Public Intelligence.

Competitive-intelligence meaning: the mediation result places SECI at the analysis-to-utilization bridge of the CI cycle. ESG information first has to be collected from ratings, disclosures, media, patents and peer reports; then it must be verified, filtered and converted into a short intelligence product that managers can use. The result therefore shows that SECI is not only a mediator in a statistical model but also the organizational pathway through which raw ESG information becomes investment guidance.

## 4.5 Moderating Effects of Industry Competition and Media Attention (H3 and H4)

Table 6 presents moderation estimates supporting H3 and H4. The ESG × HHI interaction is negative and significant ($\beta = -0.00058$, $t = -27.25$, $p < 0.001$), indicating that industry competition strengthens the ESG–investment efficiency relationship, with ESG's marginal effect in competitive industries (0.00093) nearly three times its value in concentrated industries. The ESG × MEDIA interaction is positive and significant ($\beta = 0.00039$, $t = 16.83$, $p < 0.001$), confirming that media attention amplifies SECI effectiveness, while media alone exhibits a negative conditional effect ($\beta = -0.00135$, $t = -4.76$), suggesting coverage constitutes noise without genuine ESG substance.

Competitive-intelligence meaning: competitive pressure and media visibility change the collection, validation and dissemination cadence of ESG intelligence. In competitive industries, competitor-monitoring routines need to be faster because peer actions can quickly affect strategic position. Under high media attention, public signals need stronger source checks and materiality filters so that decision-makers receive useful intelligence rather than reputational noise.

**Table 6.** Moderation Analyses (H3 and H4) — Dependent Variable: INVEFF

| Variable | H3 Model | H4 Model |
|---|---|---|
| ESG | 0.00035*** (13.88) | 0.00036*** (12.20) |
| HHI | 0.01650 (1.33) | |
| ESG × HHI | −0.00058*** (−27.25) | |
| MEDIA | | −0.00135*** (−4.76) |
| ESG × MEDIA | | 0.00039*** (16.83) |
| SECI | 0.00970*** (49.77) | 0.00962*** (48.57) |
| Controls / Industry / Year FE | Yes | Yes |
| N | 19,600 | 19,600 |
| $R^2$ | 0.338 | 0.319 |

Note: Interactions constructed from mean-centred ESG and standardized moderators. Firm-clustered t-statistics in parentheses.

## 4.6 Nonlinear Effect of SECI (H5)

Table 7 confirms the inverted U-shaped relationship predicted by H5, with $SECI^2$ negative and significant ($\beta = -0.00394$, $t = -27.51$, $p < 0.001$) and a turning point at +1.22 standard deviations above the mean. Approximately 11% of sample firm-years exceed this threshold, indicating intelligence over-investment is empirically observable. This validates the Attention-Based View: finite managerial attention limits intelligence processing capacity, making optimal SECI calibrated rather than maximal.

Competitive-intelligence meaning: the inverted-U pattern shows why governance and feedback rules are central to SECI. More intelligence is useful only while managers can absorb it. Once dashboards, media alerts, patent lists and peer-disclosure comparisons become too dense, the intelligence system can slow decisions. Firms therefore need prioritization rules, escalation thresholds and post-investment feedback reviews to keep intelligence actionable.

**Table 7.** Nonlinear Specification (H5) — Dependent Variable: INVEFF

| Variable | Coefficient | t | p |
|---|---|---|---|
| ESG | 0.00034*** | 12.27 | < 0.001 |
| SECI | 0.00963*** | 52.91 | < 0.001 |
| $SECI^2$ | −0.00394*** | −27.51 | < 0.001 |
| ESG × SECI | 0.00050*** | 20.99 | < 0.001 |
| Controls / Industry / Year FE | Yes | | |
| N / $R^2$ | 19,600 / 0.327 | | |
| Turning point | +1.22 SD of SECI | | |

## 4.7 Endogeneity and Robustness Tests

Table 8 summarizes robustness tests confirming baseline results. The instrumental variable estimation shows a strong first stage ($F = 2{,}525.8$) and significant second-stage ESG coefficient ($\beta = 0.00076$, $t = 8.36$, $p < 0.001$), ruling out reverse causality. Quantile regression reveals pronounced heterogeneity: ESG and SECI effects decline monotonically from the 10th to 90th percentiles, with firms suffering severe inefficiency benefiting roughly twice as much, confirming SECI functions primarily as a corrective capability.

Competitive-intelligence meaning: the robustness checks support SECI as a corrective organizational routine. Firms with weaker investment efficiency appear to benefit more from structured intelligence because they have more room to improve project selection, timing and capital discipline. For managers, this means SECI should be embedded in recurring investment reviews, not treated as a one-time analytical exercise.

**Table 8.** Robustness Tests (Panel A: Two-Stage Least Squares; Panel B: Quantile Regression)

| Statistic | Value |
|---|---|
| First-stage coefficient (instrument) | 0.897*** |
| First-stage F | 2,525.8 |
| Second-stage ESG coefficient | 0.00076*** (t = 8.36) |
| Panel B: | |

| Quantile | ESG | SECI |
|---|---|---|
| Q10 | 0.00059*** (14.78) | 0.01095*** (26.73) |
| Q25 | 0.00048*** (15.20) | 0.01059*** (35.02) |
| Q50 | 0.00044*** (16.55) | 0.00991*** (41.63) |
| Q75 | 0.00033*** (12.76) | 0.00809*** (39.80) |
| Q90 | 0.00017*** (7.12) | 0.00533*** (30.86) |

## 4.8 Discussion

The discussion not only is a reflection on the empiricisms, but also is an interpretation of the empirical results as processes of competitive intelligence in the organization, not as regression output. In a firm environment, ESG intelligence is created when finance, sustainability, strategy, compliance and R&D teams work together to identify and develop the investment question, gather ESG "signals," validate sources, filter material information and create brief reports to senior managers. Governance, then, governs over the ownership of the intelligence, the level of trust in the sources, how conflicting signals are managed, and how past intelligence is assessed once an investment decision is made.

This process is an example that can be seen in practice. A Chinese manufacturing company would not use only their ESG rating when deciding whether or not to take on a low carbon technology project. Its market intelligence team would monitor analyst sentiment, the technology team would monitor green patent activity, the public intelligence team would track media and policy activity, and a competitor intelligence team would compare disclosures and positioning of competitors. These signals would be aggregated in a monthly or quarterly ESG intelligence briefing to the capital-budgeting committee, and project templates would include the ESG risk, competitor positioning, and media exposure as well as the strategic value expected before capital is approved.

**Table 9 Competitive Intelligence process mapping of the empirical findings**

| Empirical finding | CI-cycle stage | Expanded organizational interpretation |
|---|---|---|
| SECI mediates 56.2% of ESG effect | Analysis -> utilization | ESG signals become useful when converted into decision briefs and capital-budgeting criteria. The investment committee should know which ESG signal was used, why it matters and how it changes project approval. |
| Public and competitor intelligence dominate | Collection -> analysis -> dissemination | Firms should combine media-sentiment screening, policy-signal review and peer ESG benchmarking before sending a monthly intelligence note to investment managers. |

| Empirical finding | CI-cycle stage | Expanded organizational interpretation |
|---|---|---|
| ESG x HHI is negative | Competitor collection -> dissemination | Stronger competition requires faster competitor scanning, clear ownership of peer monitoring and shorter reporting routes from intelligence staff to investment committees. |
| ESG x MEDIA is positive | Public collection -> governance | Media signals support decisions only after source checks, materiality filters and noise controls classify each item by credibility, regulatory relevance and likely capital-allocation effect. |
| SECI squared is negative | Governance -> feedback | Too much intelligence can overload managers. Governance should limit duplicate reports, set alert thresholds and use post-investment feedback to identify signals that improved decisions. |
| Robustness tests support pathway | Feedback -> learning | SECI works as a learning routine when firms compare expected ESG signals with actual project outcomes and then improve future screening rules. |

### 4.8.1 Why Competitive Intelligence Transforms ESG into Investment Efficiency

The results show that SECI is indeed a process of organizational conversion between ESG disclosure and capital-allocation decisions. The actual implementation is sequential. First, managers need to establish the ESG-related investment problem; for instance, whether to green a project, whether to approve a project that requires a higher level of environmental expectations, etc. Secondly, signals are picked up by staff from ESG ratings, annual reports, media stories, green innovation indicators and competitor disclosures. Thirdly, the analysts analyze those signals, filter out the noise and turn them into a decision brief. Lastly, the investment committee leverages the brief to tweak project screening, risk-weighted return assumptions and capital timing. This is why information on ESG becomes relevant only when it goes through the CI cycle.

The dimension-specific results provide insights into the intelligence's creation and control within the organization. Public Intelligence is not just about the number of times you hear a word on the media; it's about verifying source credibility, distinguishing between symbolic and material ESG risk and providing managers with a clear view of the pressure from the public. Competitor Intelligence is more than just reading reports from competitors, it is a process of benchmarking ESG commitments of peers, understanding emerging industry standards and questioning if the target company is lagging or leading. Market and Technology Intelligence then align these external signals with analyst expectations and opportunities at the project level and for green-patents. These are the functions that SECI performs – and together they illustrate how SECI helps to overcome information asymmetry by converting multiple public and competitive signals into one language for decision making.

The same interpretation of the organization is reflected in the baseline interaction. Companies with higher SECI scores seem to be more likely to integrate ESG data into processes like capital budgeting, screening projects and allocating resources. This is important because two companies can score the same on ESG but have different processes. The score can be entered in a compliance report or utilized in investment committee packs, competitor dashboards and post-project review. The second company is more likely to use the ESG information to make disciplined investments.

### 4.8.2 Boundary Conditions of SECI

Competition enhances the intelligence pathway by increasing its speed of generation and use of ESG intelligence. In a highly concentrated industry, managers might have the time to read the ESG messages. A late interpretation could be a forfeit of a 'green' technology, a misunderstanding of a competitor's 'green' play, or an investment in a project that no longer meets the new expectations of stakeholders. SECI thus becomes an early warning system – scans of competitors are carried out more frequently, the reporting process is accelerated to those with the decision-making power, and managers can invest before the chances associated with ESG opportunities have passed.

The media also has an organizational connotation. Public coverage can be beneficial to firms in detecting the ESG problems in advance, but it can also generate noise, panic or symbolic pressure. From the positive interaction, the following can be inferred: media attention provides support in terms of investment efficiency, if the firms have governance mechanisms that validate the media, screen materials, and disseminate them. A media monitoring dashboard should not just push all ESG news to managers, for instance. Before arriving at the capital-budgeting committee, it should categorize the signal by its source's credibility, its policy relevance, and its relevance to competitors as well as its likely impact on investments.

The inverted U shape gives rise to a learning curve for intelligence governance. SECI needs to be robust enough to pick up the signals of ESG but should not be too big to overwhelm decision makers. Practical governance can involve restrictions on indicators on dashboards, a clear set of thresholds for when an alert should be raised, monthly rather than daily routine briefs, and reviews after investments asking: was the intelligence that was used to make the investment decision accurate? This feedback loop will make sure that CI system is not a reporting system but remains strategic in decision support.

### 4.8.3 Theoretical Contributions

This study makes four theoretical contributions. First, it positions SECI as an ESG-oriented extension of competitive intelligence theory. SECI is not treated as a simple index; it is explained as a process through which ESG signals move from planning and collection to analysis, dissemination, utilization, governance and feedback. This gives the ESG-investment relationship a clearer organizational mechanism.

Second, the study clarifies the missing organizational link between ESG performance and investment efficiency. Prior ESG research often assumes that disclosure improves decision-making, but the present evidence suggests that disclosure creates value only when organizations interpret it through routines, responsibility structures and decision-use protocols. This links ESG research to information governance and strategic intelligence.

Third, the study identifies the different strategic roles of CI functions. Public Intelligence and Competitor Intelligence are especially important in the Chinese setting because media narratives, policy signals and peer benchmarking shape both managerial attention and investor expectations.

This contributes to ESG information-quality research by showing that the usefulness of disclosure depends on the type of intelligence capability that processes it.

Fourth, the study adds boundary conditions to sustainable competitive intelligence. Competition and media attention increase the value of SECI, while excessive SECI creates overload. This links Dynamic Capabilities Theory with CI governance by showing that intelligence capability must be calibrated: too little intelligence leaves ESG signals unused, while too much intelligence can slow managerial attention and weaken investment discipline.

### 4.8.4 Practical Implications

For managers, ESG reporting should be connected to a formal intelligence workflow. A practical workflow would assign ownership of ESG intelligence to a cross-functional group involving finance, sustainability, strategy, compliance and technology staff. This group should define the investment question, collect relevant market, public, technological and competitor signals, validate sources, prepare short intelligence briefs and deliver them to investment committees on a fixed schedule. Each major capital proposal should show how ESG intelligence affected risk assessment, timing, expected return and strategic fit.

In China, the most urgent managerial focus is Public Intelligence and Competitor Intelligence. Practical tools include ESG media dashboards with materiality filters, peer ESG benchmarking reports, green innovation tracking and scheduled intelligence briefings for capital-budgeting committees. These tools should be governed carefully so that managers receive decision-ready intelligence rather than large volumes of disconnected reports.

For investors, ESG ratings should be evaluated together with a firm's intelligence capability. A high ESG score is more meaningful when the firm shows evidence of analyst-consensus monitoring, green-patent tracking, media-sentiment management and competitor-disclosure benchmarking. These signals indicate whether ESG information is likely to influence real investment decisions rather than remain a reputation signal.

For policymakers, ESG disclosure rules should be supported by intelligence infrastructure. Public ESG databases, sector benchmarking tools, consistent media-data standards, guidance for ESG analytics and manager training can help firms turn disclosure into strategic decision support. This is particularly important in environments where competition and media attention are strong, because those conditions increase both the value of intelligence and the risk of information overload.

### 4.8.5. Limitations and Generalizability

Several limitations remain. First, SECI is measured by proxies for secondary data, and not by direct observation of internal CI processes like the meeting on intelligence, intelligence dissemination processes, governance rules, and the feedback processes. This can lead to measurement errors. Future research should be conducted by surveys, interviews or case study analysis that observe the entire CI process within the firms to confirm the SECI structure. Second, the Chinese institutional

setting may have a negative impact on generalizability because the salience of Public Intelligence as compared to other markets, both through the state ownership of the information source and the regulatory signaling and public narratives.

Third, the panel reflects the ESG disclosure environment since 2018 but excludes 2025 after a current coverage check dated 13 July 2026. The study does not claim that all 2025 information is absent. Rather, it records that individual 2025 annual reports and some ESG-related signals are visible, while the complete synchronized merge across audited financials, ESG ratings, media/sentiment data, green-patent citation indicators and competitor ESG text is not yet adequate for the full 2,800-firm panel. This is a methodological boundary. Once those five blocks are complete under consistent definitions, the panel should be extended to 2025 and the main models should be rerun as a direct annual extension.

Overall, the results show that SECI can be understood as a strategic intelligence function that reduces information asymmetry, directs managerial attention and strengthens the quality of ESG-related investment decisions. The study connects sustainable finance with classical competitive intelligence by showing how ESG information is generated, governed, disseminated and used as strategic value through organizational intelligence processes.

## 5 CONCLUSION

This paper investigated the relationship between ESG performance and investment efficiency in Chinese listed companies during 2018-2024 through the lens of Strategic ESG Competitive Intelligence (SECI). An analysis of 19,600 firm-year observations across 2,800 firms shows that investment efficiency is positively associated with ESG performance (beta = 0.00079, $p < 0.001$), and SECI explains 56.2% of this relationship. Public and competitor intelligence are the strongest channels, while industry competition and media attention strengthen the intelligence pathway. The 2025 fiscal year is not pooled into the main panel because, as of 13 July 2026, the complete cross-source SECI-financial match remains incomplete for the full sample. This paper therefore treats 2025 as a transparent extension boundary and recommends rerunning the models once the same annual variables become available. The results support sustainable competitive intelligence by showing that ESG information creates investment value when firms plan, collect, analyse, disseminate, use, govern and feed back sustainability signals through disciplined decision routines.

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