

Belt and Road Initiative Investments and ESG Performance of Chinese Multinationals: A Dynamic Capabilities Perspective

Jiacong Li (Corresponding author)

Business School

University of International Business and Economics

No.10 Huixin East Street, Chaoyang District Beijing, China

Tel: +(86)17630661156 E-mail: cong0204@foxmail.com

Chengjie Yu

Business School

University of International Business and Economics

No.10 Huixin East Street, Chaoyang District Beijing, China

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School of Economics and Management

Shihezi University

No.220 North 4th Road, Shihezi, Xinjiang, China

E-mail: ychengjie0429@163.com

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Abstract

Drawing on dynamic capabilities theory, this study examines how Chinese multinational enterprises' (MNEs) investments in Belt and Road Initiative (BRI) countries influence their ESG performance in the home country. Using a panel of 1,460 publicly listed Chinese MNEs from 2018-2022, this paper finds that BRI investment breadth and depth positively affect ESG performance. R&D intensity strengthens this relationship, while environmental

dynamism weakens it. The findings advance understanding of how internationalization fosters sustainability in dynamic global contexts, with implications for MNE strategy in Asia-Pacific emerging markets.

Keywords: The Belt and Road Initiative, ESG performance, dynamic capabilities.

1. Introduction

The Belt and Road Initiative (BRI) has been reshaping the internationalization trajectories of Chinese multinational enterprises (MNEs). The BRI aims to establish a network of exchange reminiscent of the ancient Silk Road, encompassing policy coordination, infrastructure connectivity, unimpeded trade, financial integration, and closer people-to-people ties. As the BRI continues to advance, MNEs have increasingly entered these emerging markets in pursuit of greater growth opportunities. In 2022, Chinese firms completed 118 mergers and acquisitions (M&A) projects in the BRI countries, totaling \$5.52 billion and representing 27.5% of China's annual M&A volume. This surge reflects BRI's role in propelling Chinese MNEs into diverse emerging markets for growth opportunities. However, these investments occur amid escalating environmental, social, and governance (ESG) risks, including regulatory shifts, social conflicts, and sustainability demands (Sheetal et al., 2023; Zhang et al., 2017). As global scrutiny of corporate sustainability intensifies—particularly in Asia-Pacific regions facing climate vulnerabilities and institutional volatility—understanding how BRI investments influence MNEs' ESG performance is imperative for both theory and practice.

Prior research has examined how foreign investment enhances firm performance and strategic decisions, such as M&A strategies (Arslan & Dikova, 2015; Perkins, 2014). However, the understanding of the impact of BRI investments on firms remains limited, especially regarding ESG performance. Existing BRI studies predominantly emphasize macroeconomic effects, such as economic growth (Saud et al., 2019), policy risks (Sheetal et al., 2023), and M&A performance (Du, 2021), with scant attention to micro-level ESG implications or underlying mechanisms. This gap is important for two reasons. First, BRI investments often unfold in high-risk environments, characterized by policy changes, evolving environmental regulations, and social conflicts (Zhang et al., 2017). Firms with suboptimal ESG performance may face higher risks of legal action, community protests, and market exit (Karwowski & Raulinajtys-Grzybek, 2021). This study can provide empirical data to guide MNEs in optimizing ESG strategies amid these challenges. Second, while internationalization literature links foreign direct investment (FDI) to capability building (Deng et al., 2020), it underexplores how BRI-driven investments shape ESG performance through dynamic processes. This oversight is particularly acute in the Asia-Pacific context, where Chinese MNEs navigate institutional diversity and post-pandemic uncertainties (e.g., U.S.-China decoupling), demanding adaptive strategies for sustainable outcomes.

To address these issues, this study employs dynamic capability theory to explore the impact of firms' BRI investments on their ESG performance. Dynamic capability theory posits that firms build competitive advantages by sensing opportunities, seizing them, and reconfiguring resources in dynamic environments (Teece, 2012). This paper argues that BRI investments foster such capabilities by exposing firms to diverse institutional and cultural contexts, enabling experiential learning that translates into improved ESG practices back home. Specifically, this paper disaggregates BRI investments into breadth and depth, hypothesizing that these dimensions positively influence ESG performance by enhancing sensing, seizing, and reconfiguration abilities. This paper further explores moderators: firm-level R&D

intensity, which strengthens these effects through innovation-driven adaptations, and external environmental dynamism, which may weaken them due to heightened uncertainty and adjustment costs. This research tests these relationships using a panel of 1,460 publicly listed Chinese MNEs from 2018 to 2022.

This research offers several incremental contributions. First, this study explores the dual dimensions of BRI investments—breadth and depth—and their implications for firms' ESG performance. By distinguishing these dimensions, this paper contributes to the internationalization and ESG literature, highlighting how diverse experiential learning shapes performance outcomes. Additionally, this study identifies R&D intensity as a critical moderator in the relationship between BRI investments and ESG performance. Firms with higher R&D intensity are better equipped to address environmental challenges and align with host-country stakeholder expectations due to their access to cleaner technologies, innovative solutions, and knowledge transfer capabilities. These findings emphasize the role of innovation in enhancing ESG performance, particularly in emerging markets with complex institutional demands. Finally, this research expands the dynamic capabilities perspective by highlighting the limits of prior experience in volatile settings, suggesting that firms must complement their experience with real-time sensing and adaptive capabilities to sustain ESG performance. This study innovates by examining how environmental dynamism moderates the investment-ESG relationship. In highly dynamic environments, the benefits of experiential learning may diminish due to increased response lags and adjustment costs.

2. Theory and hypothesis development

2.1 Dynamic capabilities of MNEs

As the complexity of the external environment faced by firms continues to increase and the dynamism of environmental changes becomes more pronounced, the resources and capabilities that once sustained a firm's competitive advantage may transform into impediments to its further development (Wang & Ahmed, 2007). Against this backdrop, Teece et al. (1997) integrated evolutionary economic theory with the resource-based view to propose the perspective of dynamic capabilities. Dynamic capabilities refer to a firm's ability to respond promptly to external environmental changes by continuously adjusting and reconfiguring both internal and external resources and capabilities to achieve sustainable competitive advantage (Teece et al., 1997). Generally, dynamic capabilities are categorized into three dimensions: sensing (the ability to perceive opportunities and threats), seizing (the ability to capture opportunities or address threats), and reconfiguring (the ability to reconfigure resources) (Teece, 2012).

The international environment is highly complex, and MNEs should place greater emphasis on enhancing their dynamic capabilities (Teece, 2012). Factors such as U.S.-China decoupling, the Russia-Ukraine conflict, and the Israel-Palestine conflict, among others, intersect to create an unprecedentedly complex environment for cross-border operations. In such complex environment, the three elements of dynamic capabilities (sensing, seizing, and reconfiguring) are essential prerequisites for enterprises to formulate cross-border strategies (Pitelis et al., 2024). Therefore, MNEs have to develop dynamic capabilities to navigate this

challenging landscape effectively.

Current research indicates that learning, especially external learning, has a significant impact on a firm's dynamic capabilities (Chen et al., 2009). When entering foreign markets, MNEs naturally engage in learning and integrating new knowledge from host countries (Liu & Giroud, 2016). Upon entering a new market, firms reorganize both existing and newly acquired resources and capabilities to adapt to the host country's environment (Zhang et al., 2019). This process can effectively enhance a firm's dynamic capabilities.

However, limited attention has been put on how outward foreign direct investment (OFDI) contributes to a firm's ESG performance from the perspective of dynamic capabilities. By focusing on this perspective, this paper posits that Chinese MNEs' investment in the BRI can enhance their ESG performance through the development and application of dynamic capabilities.

2.2 BRI and investment

The BRI refers to the Silk Road Economic Belt and the 21st-Century Maritime Silk Road, a multinational economic corridor proposed and led by China in 2013. It encompasses countries and regions within the scope of the Silk Road Economic Belt and the 21st-Century Maritime Silk Road. The BRI has strengthened trade cooperation among participating nations and enhanced the ease of investment across borders (Lee et al., 2018). Scholars found that BRI significantly promoted the internationalization of MNEs. For instance, Du and Zhang (2018) show that outward foreign direct investment (OFDI) from China increases significantly along the BRI routes after the initiation of BRI. Li et al. (2019) corroborate that BRI-related subsidies incentivize the exporting toward BRI markets, while cultural friction and ethnicity differences of the owners create complications in capitalizing the policy benefits.

Existing research has found that MNEs' overseas investment significantly impacts corporate behavior and performance. For example, investment in different host countries can enhance firm performance (Perkins, 2014) and influence firms' acquisition strategies (Arslan & Dikova, 2015). Moreover, MNEs can leverage their investment in other countries to more effectively overcome the liability of foreignness associated with global cities (Belderbos et al., 2020). However, few studies have explored the impact of MNEs' BRI investment, particularly its influence on corporate social responsibility, such as ESG performance. This remains an important yet underexplored area of research.

2.3 BRI investment and firm's ESG performance

The BRI countries present a complex environment, characterized by significant differences in economic development levels, institutional frameworks, and cultural backgrounds (Liu et al., 2020). Operating across such heterogeneity is not only an exercise in geographic expansion, but also a capability-building process that can translate into ESG performance at home country. Following Kafourous et al. (2012), this paper categorizes BRI investment into investment breadth and investment depth. Specifically, investment breadth refers to the number of BRI countries in which a firm has invested, reflecting the accumulation of a firm's

experience in cross-border operations. Investment depth, on the other hand, refers to the number of subsidiaries a firm has established in the BRI countries, indicating the firm's sustained and in-depth operations in specific countries.

BRI investment breadth enhances ESG by exposing firms to diverse contexts, fostering the reconfiguration of resources for sustainability. First, in the environmental dimension, broad investments compel firms to navigate disparate standards across BRI countries. Firms investing in a greater number of BRI countries encounter significantly different environmental standards (Yao et al., 2019). Some countries implement stringent environmental protection regulations (e.g., Singapore, Hungary, Czech Republic), while others may place less emphasis on environmental issues (e.g., Thailand, Vietnam, Laos). To operate effectively, firms must switch between these varying standards and adapt their operations to meet local requirements (Zhao et al., 2014). This exposure sharpens sensing capabilities, allowing firms to detect regulatory shifts and seize opportunities for eco-friendly adaptations (Christmann, 2004). Over time, firms reconfigure internal processes, such as supply chain management, to comply with varied norms, yielding spillover benefits for home-country environmental performance (Filatotchev & Stahl, 2015). For instance, lessons from pollution controls in stricter regimes can inform cleaner operations in China.

Second, BRI investment breadth bolsters the social dimension by building cross-cultural CSR expertise. Investing in multiple BRI countries exposes firms to diverse CSR demands, as different nations emphasize varying CSR issues such as labor rights protection, poverty alleviation, and community engagement (Hah & Freeman, 2013; Miska et al., 2016). This diversity enhances seizing capabilities, enabling firms to integrate local insights into global CSR strategies (Wu et al., 2014). Reconfiguration follows, as firms adapt practices to foster social legitimacy, ultimately improving home-country social performance through better stakeholder relations.

Third, BRI investment breadth strengthens governance by honing regulatory navigation skills. Firms operating in the BRI countries face highly varied legal and regulatory frameworks. Broad investment compels firms to develop the ability to manage and adapt to these diverse regulatory requirements effectively (Kuswanto et al., 2017). This capability allows firms to maintain robust governance structures across different institutional contexts, leading to improvements in their governance performance.

Hypothesis 1a. BRI investment breadth positively affects MNEs' ESG performance.

BRI investment depth refers to firms' sustained operations and resource commitments in the BRI countries (Kafouros et al., 2012), allowing firms to deeply embed in host environments, enhancing sensing of evolving issues and reconfiguration for sustained impact. First, in the environmental dimension, prolonged operations enable firms to anticipate local risks, such as regulatory changes in resource-intensive BRI sectors (Duchek, 2020; Starr et al., 2003). This foresight supports seizing green opportunities, like adopting sustainable technologies, which firms then reconfigure for home-country use, improving environmental outcomes (Teece, 2007).

Second, for the social dimension, BRI investment depth fosters enduring stakeholder ties. This long-term relationship allows firms to sense community needs and seize CSR initiatives (Hoenen et al., 2014; Zhang et al., 2021). Reconfiguration integrates these insights into firm-wide practices, enhancing social performance through trust-building that resonate in China's domestic context.

Finally, investment depth refines governance by enabling adaptive mechanisms tailored to local institutions. Firms sense regulatory nuances and reconfigure structures for compliance, reducing risks and bolstering ethical standards at home (Hoenen et al., 2014). In volatile BRI settings, this depth-driven learning complements breadth by providing stability amid dynamic context.

Hypothesis 1b. BRI investment depth positively affects MNEs' ESG performance.

2.4 The moderating effect of firms' R&D intensity

R&D intensity is a critical indicator of a firm's commitment to innovation and technological advancement (Yeh et al., 2010). This paper argues that R&D intensity moderates the relationship between BRI investment and ESG performance by amplifying dynamic capabilities. High R&D intensity equips firms with advanced tools to sense opportunities, seize innovation-driven solutions, and reconfigure resources more effectively in heterogeneous BRI environments (Teece, 2012).

First, firms with higher R&D intensity are more likely to possess cleaner and more sustainable technologies (Alam et al., 2019). These advanced technologies enable firms to better address environmental challenges when investing in the BRI markets, where environmental regulations and standards often vary significantly (Yao et al., 2019). With access to cleaner technologies, high R&D intensity enables better sensing of environmental risks, reduces pollution, and improves resource efficiency, thereby enhancing their environmental performance (Nie et al., 2024).

Moreover, R&D intensity allows firms to better align with the expectations of BRI stakeholders by capturing and acting upon innovation opportunities (Padgett & Galan, 2010). Most BRI countries are emerging economies that place a strong emphasis on technology spillovers from FDI (Fu et al., 2011). Local stakeholders, including governments and customers, often expect MNEs to contribute to local technological advancement and economic development through their innovative activities (Padgett & Galan, 2010). Firms with high R&D intensity are better positioned to meet these expectations by introducing advanced technologies, fostering knowledge transfer, and addressing local societal needs (Gölgeci et al., 2019; Zhou et al., 2024). These efforts enhance the social dimension of ESG performance by building trust and goodwill among stakeholders in the host countries.

Hypothesis 2a. MNEs' R&D intensity positively moderates the relationship between BRI investment breadth and MNEs' ESG performance.

Hypothesis 2b. MNEs' R&D intensity positively moderates the relationship between BRI investment depth and MNEs' ESG performance.

2.5 The moderating effect of environmental dynamics

Environmental dynamism refers to the rate and unpredictability of changes in a firm's external context, including market shifts, regulatory volatility, and sociopolitical upheavals (Dess & Beard, 1984; Girod & Whittington, 2017). Highly dynamic environments demand that firms possess advanced dynamic capabilities to effectively sense, seize, and reconfigure resources in response to rapid external changes (Salvato & Vassolo, 2018). While firms may accumulate extensive investment in the BRI countries, the fast-paced and unpredictable nature of highly dynamic environments can create challenges that limit their ability to leverage prior experience for timely and effective adjustments (Fainshmidt et al., 2017).

First, the rapid changes in external conditions, such as shifts in market demands, regulatory frameworks, and sociopolitical contexts, can render a firm's accumulated experience less relevant. In such contexts, past investment may not provide actionable insights for navigating the present challenges, as the external environment evolves faster than the firm's ability to adapt (Figueira-de-Lemos & Hadjikhani, 2014). Consequently, even firms with considerable BRI investment may experience response lags, reducing their ability to undertake the dynamic adjustments necessary to maintain or enhance their ESG performance.

Second, in highly dynamic environments, the utility of prior investment is further constrained by the inherent difficulty of transferring historical knowledge to new and fluid situations. The high velocity of change requires firms to constantly revise their strategies and operations across different host countries to align with rapidly shifting external conditions (Klarner & Raisch, 2013). Such frequent adjustments not only strain the firm's resources but also increase transaction costs, including those associated with renegotiating contracts, reallocating resources, and modifying governance structures (Jacobides & Winter, 2005). These elevated costs may offset the potential benefits of BRI investment, weakening its positive impact on ESG performance.

Third, the frequent strategic reconfigurations required in dynamic environments may also disrupt the stability and consistency that underpin effective environmental, social, and governance practices. For example, firms may find it difficult to maintain long-term relationships with local stakeholders or ensure compliance with evolving regulatory requirements, leading to potential declines in ESG performance (Stubbs & Higgins, 2018; Verbeke & Tung, 2013). Additionally, the need for constant adaptation may divert managerial attention and resources away from ESG-related initiatives, further diminishing the ability of BRI investment to drive positive ESG outcomes.

Hypothesis 3a. The relationship of BRI investment breadth and MNEs' ESG performance is negatively moderated by environmental dynamics.

Hypothesis 3b. The relationship of BRI investment depth and MNEs' ESG performance is negatively moderated by environmental dynamics.

3. Methods

3.1 Data and sample

The Belt and Road Initiative was proposed in 2013. However, in order to control the impact of external factors such as the Sino-US trade war on the results, the research sample includes Chinese listed MNEs from 2018 to 2022. After deleting samples of ST firms and missing variables, the final sample set consists of 1 460 firms and 4 934 firm-year observations.

This paper obtains relevant information about the establishment and operation of subsidiaries in the BRI market from the annual reports of enterprises and calculates the independent variables based on this information. All control variables are from the CSMAR database.

3.2 Measure

3.2.1 Dependent variable

The dependent variable of this study is firm's ESG performance (*ESGP*). Taking into account the time and sample scope covered by corporate ESG evaluation, this article used Sino-Securities ESG Rating, which was launched early and widely recognized by the academic community, to measure ESG performance (Feng et al., 2022; Gu, 2024).

The rating is based on reports and public information voluntarily disclosed by listed firms since 2009, such as social responsibility reports, sustainable development reports, news media data, etc., including 3 first-level indicators, 14 second-level indicators, 26 third-level indicators, and 130 low-level data indicators. The ESG rating results are classification variables: 'C', 'CC', 'CCC', 'B', 'BB', 'BBB', 'A', 'AA', 'AAA'. Following Feng et al. (2022), this paper converted this classification variable into a numerical variable, assigning values from 1 to 9 from low to high. At the same time, this paper calculated the average of each firm's ESG ratings in four quarters of each year as the comprehensive ESG rating for that year.

3.2.2 Independent variable

The independent variable of this study is the investment of MNEs in the BRI market, which is divided into the investment breadth (*InvestBreadth*) and the investment depth (*InvestDepth*).

The breadth of a MNE's investment in the BRI market is closely related to the number of countries its overseas subsidiaries are involved in. The more countries a MNE operates subsidiaries in, the more diverse experience and knowledge it can accumulate.

Following Putzhammer et al. (2018), this paper used the number of countries along the BRI that a MNE's overseas subsidiaries are involved in as an indicator of BRI investment breadth. Specifically, The *InvestBreadth* is calculated using the equation (1):

$$InvestBreadth_{it} = \sum X_{ijt} \quad (1)$$

where i, j, t represent the MNE, host country and year respectively. X indicates whether MNE i has a subsidiary in country j in year t . If so, $X=1$; if not, $X=0$.

Knowledge accumulation during the internationalization process of a firm is related to the number and operating years of its overseas subsidiaries (Hutzschenreuter & Matt, 2017). Similarly, MNEs' investment depth in the BRI market is related to the number and operating years of overseas subsidiaries in the host countries. Therefore, this paper uses the total number of overseas subsidiaries that a MNE has in the BRI market each year to measure the investment depth. The equation is as follows:

$$InvestDepth_{it} = \sum n_{ijt} \quad (2)$$

where i, j, t represent the MNE, host country and year respectively, and n is the number of subsidiaries operated by firm i in country j in year t .

3.2.3 Moderators

Firms' R&D intensity (RDI). To measure the firms' R&D intensity, this paper used the ratio of R&D expenditures to operating income (Martínez-Noya & García-Canal, 2021).

Environmental dynamics (ED). Environmental dynamics refers to the rate of change and fluctuation of the environment in which an enterprise is located. Dess and Beard (1984) uses a combination of qualitative and quantitative methods to measure the environmental dynamics of various industries.

Following Girod and Whittington (2017), this paper applied the widely used industry-based measure "environmental dynamism" measure (Dess & Beard, 1984). On this basis, this paper used operating income volatility to measure the environmental dynamism of firms, that is, the ratio of the standard deviation of operating income to the average operating income.

3.2.4 Control variables

In order to improve the accuracy of the research and control potential confounding effects, the research model controls some other variables that affect the ESG performance of firms, and controls the year fixed effects and enterprise fixed effects in the calculation.

This paper calculated firm size (*FirmSize*) as the natural log of number of employees and firm age (*FirmAge*) as number of years since the firms' establishment (log-transformed to handle skewness). Generally, the increase in firm size and age means that the firms have more capabilities and experience to improve ESG performance (Drempetic et al., 2020). This paper also included firms' *ROA* to control the financial performance, which may impact investment and ESG performance. Moreover, *leverage* was included because it may affect the investment decision of firms (Ahmad et al., 2023). *Tobin's Q* was included because firms with high Tobin's Q prefer FDI (Jinji et al., 2019). This paper considered the nature of the firm's equity, measured by whether the firm is state-owned (*SOE*), which may affect the ESG performance (Tian et al., 2023). Finally, to control for latent time effect and firm effect, year dummies and firm dummies are included in the model.

3.3 Research model

To empirically test the impact of BRI investment on firms' ESG performance, this paper specifies a model that includes them and several firm-level moderators. In this study, fixed

effect model is adopted to test hypotheses.

In order to test Hypotheses 1a and 1b, this paper sets regression models as models (3) and (4):

$$ESGP_{it} = \alpha_1 + \beta_1 InvestBreadth_{it} + \sum \beta_{it} control_{it} + \lambda_i + \gamma_t + \varepsilon \quad (3)$$

$$ESGP_{it} = \alpha_2 + \beta_2 InvestDepth_{it} + \sum \beta_{it} control_{it} + \lambda_i + \gamma_t + \varepsilon \quad (4)$$

where for firm i in year t . The $control_{it}$ is a vector of control variables. λ_i and γ_t are firm and year fixed effects. ε indicates the residual term.

In order to test Hypotheses 2a and 2b, this paper sets models (5) and (6) as following:

$$ESGP_{it} = \alpha_3 + \beta_3 InvestBreadth_{it} + InvestBreadth_{it} \times RDI_{it} + \sum \beta_{it} control_{it} + \lambda_i + \gamma_t + \varepsilon \quad (5)$$

$$ESGP_{it} = \alpha_4 + \beta_4 InvestDepth_{it} + InvestDepth_{it} \times RDI_{it} + \sum \beta_{it} control_{it} + \lambda_i + \gamma_t + \varepsilon \quad (6)$$

where this paper adds the moderate effects of R&D intensity. Other variables are consistent with models (3) and (4).

In order to test Hypotheses 3a and 3b, this paper sets regression models as following:

$$ESGP_{it} = \alpha_5 + \beta_5 InvestBreadth_{it} + InvestBreadth_{it} \times ED_{it} + \sum \beta_{it} control_{it} + \lambda_i + \gamma_t + \varepsilon \quad (7)$$

$$ESGP_{it} = \alpha_6 + \beta_6 InvestDepth_{it} + InvestDepth_{it} \times ED_{it} + \sum \beta_{it} control_{it} + \lambda_i + \gamma_t + \varepsilon \quad (8)$$

where this paper adds the moderator, environmental dynamics, to complete the model. Other variables are consistent with models (3) and (4).

To verify the validity of the model, this paper tests for multicollinearity among the variables. This paper calculates the variance inflation factor (VIF) in the regression models. The VIF value of the models are all smaller than 10, which indicates that they do not suffer from multicollinearity.

4. Results

4.1 Main Results

Descriptive statistics and correlation matrix are presented in Table 1. The mean number of *InvestBreadth* is 2.134, and the mean number of *InvestDepth* is 3.142, with a standard deviation of 1.978 and 4.538, indicating that Chinese firms' BRI investment is still in the early stage. The *InvestBreadth* and *InvestDepth* are highly correlated. As these two independent variables are used in distinct regression, they do not pose a risk of multicollinearity.

Table 1. Descriptive statistics and correlation matrix

Variables	Mean	Std. Dev.	(1)	(2)	(3)	(4)	(5)
(1) ESGP	7.409	5.154	1.000				
(2) InvestBreadth	2.134	1.978	0.098***	1.000			
(3) InvestDepth	3.142	4.538	0.059***	0.719***	1.000		
(4) RDI	0.055	0.248	0.004	-0.006	-0.021	1.000	
(5) ED	0.722	0.275	-0.119***	0.093***	0.147***	-0.024*	1.000
(6) FirmSize	10.078	27.777	0.196***	0.148***	0.130***	-0.027**	0.172***
(7) FirmAge	20.082	5.839	-0.002	0.060***	0.049***	-0.061***	0.143***
(8) ROA	0.034	0.093	0.219***	0.031**	0.013	-0.029**	-0.168***
(9) Leverage	0.456	0.192	-0.131***	0.128***	0.140***	-0.099***	0.274***
(10) Tobin's Q	1.88	1.304	0.043***	-0.040***	-0.025*	0.079***	-0.087***
(11) SOE	0.162	0.368	0.025*	0.039***	0.037***	0.040***	0.027*
Variables	(6)	(7)	(8)	(9)	(10)	(11)	
(6) FirmSize	1.000						
(7) FirmAge	-0.014	1.000					
(8) ROA	0.030**	-0.071***	1.000				
(9) leverage	0.195***	0.214***	-0.334***	1.000			
(10) Tobin's Q	-0.087***	-0.134***	0.177***	-0.267***	1.000		
(11) SOE	0.036**	0.015	-0.003	0.057***	-0.061***	1.000	

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

Table 2 display the result of regressions used to test main hypotheses. Model 1 is the baseline model including the control variables only. Models 2 and 3 separately adds the independent variables.

Table 2 Benchmark regression

Variables	Model1	Model2	Model3
InvestBreadth		0.2003*** (5.6048)	
InvestDepth			0.0390** (2.4803)
FirmSize	0.0420*** (15.3789)	0.0404*** (14.7470)	0.0413*** (15.0771)
FirmAge	0.0384*** (3.0455)	0.0347*** (2.7569)	0.0381*** (3.0191)
ROA	9.7290*** (11.9635)	9.3315*** (11.4668)	9.6173*** (11.8143)
Leverage	-3.4244*** (-7.6664)	-3.6799*** (-8.2211)	-3.5328*** (-7.8756)
Tobin's Q	0.0589 (0.9954)	0.0678 (1.1493)	0.0596 (1.0083)
SOE	0.2641 (1.3791)	0.2405 (1.2593)	0.2550 (1.3322)
Firm Fixed Effect	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes
Constant	73.9935*** (210.5411)	73.7698*** (209.2066)	73.9362*** (210.0341)
N	4934	4934	4934
adj. R ²	0.154	0.159	0.155

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Hypotheses 1a and 1b posits that firms' BRI investment breadth and depth are positively associated with their ESG performance. Models 2 and 3 reveal this relationship is positive and significant ($\beta = 0.2003$, $p < 0.01$ in Model 2; $\beta = 0.0390$, $p < 0.05$ in Model 3). Thus, Hypotheses 1a and 1b are supported. Firms with more experience in BRI investment can achieve better ESG performance.

Table 3 includes the moderators, R&D intensity (*RDI*) and environmental dynamics (*ED*). Models 1 and 2 add the *RDI*. Similarly, Model 3 and 4 add the *ED*. Model 5 is the full model of *InvestBreadth*, and Model 6 is the full model of *InvestDepth*.

Table 3. Result of moderator effect

Variables	Model1	Model2	Model3	Model4	Model5	Model6
InvestBreadth *	1.0979**				0.8741**	
RDI	(2.4860)				(1.9797)	
InvestDepth * RDI		0.6601**				0.3768
		(2.1945)				(1.1990)
InvestBreadth *			-0.2675**		-0.2332*	
ED			(-2.0159)		(-1.7431)	
InvestDepth * ED				-0.1535***		-0.1316**
				(-2.8077)		(-2.2834)
InvestBreadth	0.1355***		0.4327***		0.3540***	
	(3.0666)		(3.9119)		(3.0120)	
InvestDepth		0.0185		0.1959***		0.1636***
		(1.0118)		(3.6476)		(2.7231)
RDI	-1.1613**	-0.6865			-0.9054*	-0.3605
	(-2.1340)	(-1.6181)			(-1.6693)	(-0.8321)
ED			-2.0876***	-2.1636***	-2.1455***	-2.2251***
			(-5.1353)	(-6.5033)	(-5.2643)	(-6.6109)
FirmSize	0.0405***	0.0412***	0.0440***	0.0447***	0.0441***	0.0446***
	(14.7851)	(15.0306)	(16.0595)	(16.2792)	(16.0808)	(16.2578)
FirmAge	0.0365***	0.0392***	0.0460***	0.0491***	0.0475***	0.0500***
	(2.8918)	(3.1020)	(3.6560)	(3.8960)	(3.7697)	(3.9589)
ROA	9.5272***	9.7629***	8.6408***	8.8629***	8.7999***	8.9591***
	(11.6382)	(11.9387)	(10.6643)	(10.9378)	(10.7947)	(10.9920)
Leverage	-3.5679***	-3.4400***	-3.1358***	-3.0457***	-3.0415***	-2.9773***
	(-7.9193)	(-7.6243)	(-6.9854)	(-6.7651)	(-6.7266)	(-6.5538)
Tobin's Q	0.0561	0.0499	0.0575	0.0518	0.0486	0.0462
	(0.9478)	(0.8412)	(0.9824)	(0.8837)	(0.8287)	(0.7861)
SOE	0.2288	0.2444	0.2537	0.2598	0.2428	0.2528
	(1.1970)	(1.2751)	(1.3404)	(1.3699)	(1.2811)	(1.3306)
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effect						
Year	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effect						
Constant	73.7758***	73.8914***	74.7522***	74.9588***	74.7956***	74.9739***
	(208.3838)	(208.7024)	(176.0255)	(188.8178)	(175.5343)	(188.1270)
N	4934	4934	4934	4934	4934	4934
adj. R2	0.160	0.156	0.175	0.171	0.175	0.171

t statistics in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01

Hypothesis 2a suggests that R&D intensity strengthens the positive relationship between BRI

investment breadth and ESG performance. Likewise, Hypothesis 2b posits R&D intensity also positively moderate the relationship between BRI investment depth and ESG performance. The coefficients of these moderating effects are positive but partly significant ($\beta = 1.0979$, $p < 0.05$ in Model 1; $\beta = 0.6601$, $p < 0.05$ in Model 2; $\beta = 0.8741$, $p < 0.05$ in Model 5; $\beta = 0.3768$, $p > 0.1$ in Model 6). Thus, the results support Hypothesis 2a, and partly support Hypothesis 2b. MNEs with high R&D intensity will achieve better ESG performance when they have more R&D investment.

Hypothesis 3a states that environmental dynamics weaken the positive relationship between BRI investment breadth and ESG performance. Hypothesis 3b maintains environmental dynamics' negative moderating effect between BRI investment depth and ESG performance. The coefficients of these moderating effects are negative and significant ($\beta = -0.2675$, $p < 0.05$ in Model 3; $\beta = -0.1535$, $p < 0.01$ in Model 4; $\beta = -0.2332$, $p < 0.1$ in Model 5; $\beta = -0.1316$, $p < 0.05$ in Model 6). These results support Hypothesis 3a and 3b, suggesting that environmental dynamics weaken the relationship between BRI investment and ESG performance.

4.2 Robustness Tests

4.2.1 Instrumental Variable

For robustness testing, this paper used 2SLS regression, which is a method for dealing with the endogeneity issues. To test H1a and H1b, this paper included two interaction terms between the two instruments and the focal moderator as additional instrumental variables in the model. Specifically, this paper generated the mean of *InvestBreadth* and *InvestDepth* from firms in the same province as the focal firm as an additional instrumental variable in the 2SLS model.

Table 4. Robustness Test (Instrumental Variables, IV: InvestBreadth)

	(1)	(2)
Variables	InvestBreadth	ESGP
province InvestBreadth	0.959*** (9.05)	
InvestBreadth		1.542*** (4.89)
FirmSize	0.00721*** (6.63)	0.0295*** (7.34)
FirmAge	0.0209*** (4.17)	0.0102 (0.66)
ROA	2.033*** (6.29)	6.663*** (5.89)
Leverage	1.327*** (7.49)	-5.375*** (-8.28)
Tobin's Q	-0.0360 (-1.53)	0.131 (1.91)
SOE	0.0936 (1.23)	0.0639 (0.29)
Firm Fixed Effect	Yes	Yes
Year Fixed Effect	Yes	Yes
N	4934	4934
F	81.95	63.53

t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4 reflects the relationship between *InvestBreadth* and firms' ESG performance, similarly, Table 5 captures the relationship between *InvestDepth* and firms' ESG performance. The results, as presented in Table 4 ($\beta = 0.959$, $p < 0.001$ in Model 1; $\beta = 1.542$, $p < 0.001$ in Model 2) and table5 ($\beta = 0.923$, $p < 0.001$ in Model 1; $\beta = 0.232$, $p < 0.05$ in Model 2), are mostly consistent with main findings using the control function approach.

Table 5. Robustness Test (Instrumental Variables, IV: InvestDepth)

	(1)	(2)
Variables	InvestDepth	ESGP
province InvestDepth	0.923*** (12.40)	
InvestDepth		0.232* (2.54)
FirmSize	0.0161*** (6.55)	0.0381*** (12.02)
FirmAge	0.0117 (1.03)	0.0375** (2.91)
ROA	2.789*** (3.81)	9.177*** (10.55)
Leverage	2.704*** (6.74)	-4.036*** (-7.76)
Tobin's Q	-0.0112 (-0.21)	0.0671 (1.12)
SOE	0.154 (0.89)	0.181 (0.92)
Firm Fixed Effect	Yes	Yes
Year Fixed Effect	Yes	Yes
N	4934	4934
F	153.8	75.81

t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.2.2 Alternative measure of dependent variable

As a robustness check, **this paper** used whether focal firm was included in the ESG ranking list (SynTao Green Finance 's ESG rating) in the current year to measure the dependent variable (*ifESG*). Table 6 below presents the results of the Logit analyses. The primary findings remain unchanged, as shown in Model 1 and Model 2 ($\beta=0.7703$, $p<0.01$ in Model 1; $\beta=0.5127$, $p<0.01$ in Model 2). Thus, hypotheses 1a and 1b are again supported.

Table 6. Robustness Test (Alternative dependent variable: ifESG)

Variables	ifESG	ifESG
InvestBreadth	0.7703*** (7.8980)	
InvestDepth		0.5127*** (6.9037)
FirmSize	0.1905*** (22.2670)	0.1917*** (22.3316)
FirmAge	0.0129* (1.6697)	0.0137* (1.7759)
ROA	3.3582*** (5.1638)	3.3833*** (5.2401)
Leverage	-0.3167 (-1.0836)	-0.3013 (-1.0345)
Tobin's Q	0.3146*** (9.2398)	0.3119*** (9.1748)
SOE	-0.1613 (-1.3906)	-0.1637 (-1.4093)
Constant	-1.6414** (-2.3961)	-1.6328** (-2.3945)
N	4832	4832

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7 includes the moderators, R&D intensity (*RDI*) and environmental dynamics (*ED*). The data in Table 7 again verifies that R&D intensity positively moderates the relationship between BRI investment breadth and ESG performance, consistent with main findings. Similarly, the result of adding the environmental dynamics, also highly consistent with main findings.

Table 7. Robustness Test (Alternative dependent variable: ifESG; Moderator effect)

Variables	ifESG	ifESG	ifESG	ifESG
InvestBreadth *	1.1188			
RDI	(1.2670)			
InvestDepth * RDI		2.1914**		
		(2.3948)		
InvestBreadth *			-0.8241**	
ED			(-2.3613)	
InvestDepth * ED				-1.2437***
				(-4.8205)
RDI	-0.7892	-1.5841**		
	(-1.1472)	(-1.9984)		
ED			1.7724***	2.4139***
			(4.3539)	(6.6736)
InvestBreadth	0.7033***		1.3830***	
	(6.3521)		(4.8971)	
InvestDepth		0.4009***		1.4694***
		(4.5967)		(6.7878)
FirmSize	0.1903***	0.1913***	0.1870***	0.1897***
	(22.2624)	(22.3035)	(21.9295)	(22.1190)
FirmAge	0.0136*	0.0154**	0.0082	0.0083
	(1.7574)	(1.9854)	(1.0518)	(1.0632)
ROA	3.5090***	3.7073***	3.5824***	3.5892***
	(5.2643)	(5.5657)	(5.5027)	(5.5504)
Leverage	-0.2617	-0.1722	-0.5083*	-0.5476*
	(-0.8837)	(-0.5803)	(-1.7159)	(-1.8491)
Tobin's Q	0.3106***	0.3035***	0.3144***	0.3125***
	(9.0587)	(8.8315)	(9.1979)	(9.1291)
SOE	-0.1688	-0.1734	-0.1608	-0.1517
	(-1.4517)	(-1.4890)	(-1.3766)	(-1.2966)
Constant	-1.6230**	-1.6057**	-2.7805***	-3.1901***
	(-2.3750)	(-2.3682)	(-3.6916)	(-4.3901)
N	4832	4832	4832	4832

t statistics in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01

5. Discussion and conclusion

This study explores the relationship between BRI investment and MNEs' ESG performance, emphasizing the moderating roles of R&D intensity and environmental dynamics. BRI investment breadth and depth promote MNEs' ESG performance in the home country. Firms with more R&D intensity can obtain better ESG performance from BRI investment. Furthermore, when the environment is highly dynamic, the effect of firms gaining ESG

performance through BRI investment will be weakened.

5.1 Theory contribution

First, this study highlights the dual dimensions of BRI investment—breadth and depth—and their implications for ESG performance. Investment breadth, which reflects the number of host countries in which a firm operates, facilitates the accumulation of cross-border management expertise, including environmental management, cross-cultural CSR practices, and regulatory compliance. This finding aligns with the dynamic capability literature, which posits that diverse experiential learning enhances firms' ability to adapt to heterogeneous contexts (Teece, 2007). Investment depth, on the other hand, reflects firms' sustained operations in specific countries, enabling them to build long-term relationships, deepen local knowledge, and anticipate changes in the host country environment. By distinguishing between these two dimensions, this paper extends the literature on MNEs' internationalization strategies and their performance implications, particularly in the context of ESG.

Second, this study underscores the critical moderating role of R&D intensity in the relationship between BRI investment and ESG performance. Firms with higher R&D intensity are better equipped to address environmental challenges in diverse institutional contexts due to their access to cleaner technologies and innovative solutions (Alam et al., 2019). Moreover, R&D intensity enhances firms' ability to align with the expectations of host-country stakeholders by facilitating technology transfer and knowledge spillovers, which are highly valued in emerging economies (Padgett & Galan, 2010). These findings contribute to the broader debate on the role of innovation in enhancing firms' environmental and social performance, particularly in complex and resource-constrained environments.

Third, **this paper** examines the moderating effect of environmental dynamism on the relationship between BRI investment and ESG performance. The findings suggest that in highly dynamic environments, the positive effects of investment may be attenuated due to increased response lags and transaction costs associated with frequent strategy adjustments. This insight expands the dynamic capabilities perspective by highlighting the limits of experiential learning in volatile environments. While prior experience is valuable, highly dynamic contexts require firms to complement their investment with real-time sensing and adaptive learning capabilities to maintain ESG performance.

5.2 Managerial implications

The findings have several practical implications for managers of MNEs operating in the BRI countries. First, firms should adopt a balanced approach to investment breadth and depth. While broad investment allows firms to develop cross-border management capabilities, deep investment in specific countries fosters local embeddedness and long-term relationships that enhance ESG performance. Managers should align their investment strategies with the specific ESG priorities of host countries to maximize the benefits of both breadth and depth.

Second, R&D intensity emerges as a critical enabler of ESG performance in the BRI context. Managers should prioritize investments in innovation and technology development to address

environmental challenges, meet stakeholder expectations, and capture opportunities for sustainable value creation. High R&D intensity not only equips firms with the tools to comply with varying environmental standards but also strengthens their legitimacy in the eyes of stakeholders, particularly in emerging economies seeking technology spillovers.

Finally, managers must recognize the challenges posed by environmental dynamism and develop strategies to mitigate its impact on ESG performance. Firms should invest in adaptive governance mechanisms and real-time sensing capabilities to respond effectively to rapid changes in external conditions. For example, digital technologies and data analytics can be leveraged to monitor and predict environmental and social risks, enabling firms to implement proactive measures. By doing so, firms can enhance their resilience and maintain ESG performance even in highly dynamic environments.

5.3 Limitations and future research

While this study provides important insights, it has several limitations that open avenues for future research. First, the analysis focuses on the BRI context, which is characterized by significant institutional heterogeneity. Future studies could explore whether the findings are generalizable to other internationalization contexts, such as firms operating in developed markets or regions with different levels of institutional complexity.

Additionally, while this paper examines the moderating effects of R&D intensity and environmental dynamism, other contextual factors, such as political risk, cultural distance, or industry characteristics, may also influence the relationship between BRI investment and ESG performance. Future research could adopt a more comprehensive framework to account for these additional contingencies.

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