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# How speculative culture shapes green innovation performance: A dual regional and institutional lens

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**Background:** Regional culture plays a crucial role in green innovation performance, yet its impact has not been sufficiently explored, particularly within the African context.

**Aim:** The study aims to assess how speculative culture within regions affects corporate green innovation performance in the context of regional cultural integration.

**Setting:** The research uses data from Chinese A-share listed companies from 2008 to 2020, specifically focussing on companies with various ties to Africa.

**Method:** This study employs an empirical research method using multiple regression analysis, moderation analyses, along with robustness checks and endogeneity tests to ensure the validity and reliability of the findings.

**Results:** Findings indicate that a speculative culture inhibits green innovation, a result that remains robust across various endogeneity tests. Traditional ecological culture, trust culture and cultural diversity mitigate this negative effect, while local clan culture exacerbates it. Stakeholder supervision and external regulatory pressure from the government effectively weaken the inhibitory effect of speculative culture.

**Conclusion:** This study highlights the significant and complex role of regional cultures in shaping green innovation outcomes, underscoring the importance of institutions to counteract adverse cultural influences.

**Contribution:** This research enhances the understanding of green innovation drivers by exploring the interactions between various cultural dimensions and their impact, emphasising the alignment of formal institutions to achieve sustainable green innovation. It offers several recommendations for enhancing corporate resilience and developing effective green innovation strategies.

**Keywords:** speculative culture; corporate green innovation; regional cultural integration; environmental regulation pressure; stakeholder supervision pressure.

## Introduction

In the context of global climate change and increasingly stringent resource constraints, green innovation has emerged as a cornerstone of sustainable growth across the globe, with Africa presenting a unique yet underexplored case. The continent's rich cultural heritage, diverse ecological systems and growing emphasis on sustainable development offer a promising environment for fostering green innovation. Despite these advantages, the adoption of green innovation remains limited because of infrastructural, institutional and cultural challenges. Understanding the driving factors and barriers to green innovation in Africa is crucial for developing effective strategies to promote sustainable growth.

Africa's legal frameworks and policy initiatives play a significant role in shaping the trajectory of green innovation. Notable efforts include the African Union's Agenda 2063, which emphasises sustainable industrialisation, clean energy and environmental protection. Additionally, South Africa's Green Economy Accord promotes renewable energy projects and resource-efficient technologies. However, enforcement remains inconsistent because of varying institutional capacities across the continent.

Cultural factors also significantly influence the adoption of green innovation in Africa. Traditional ecological practices, deeply rooted in indigenous communities, emphasise sustainable resource

management and environmental stewardship. For example, practices such as agroforestry, communal land management and water conservation reflect a cultural ethos of environmental sustainability. However, rapid urbanisation and globalisation have disrupted these practices, leading to a growing tension between traditional values and modern economic imperatives. Furthermore, speculative behaviours, such as the overexploitation of resources for short-term gains, often hinder the long-term sustainability of green initiatives.

The quasi-public nature of green innovation, where benefits are dispersed widely while costs are borne primarily by individual firms, presents another challenge (Rennings 2000). African companies often face significant upfront investments, long payback periods and limited access to green financing. These structural barriers are compounded by speculative cultural tendencies, which prioritise immediate returns over sustainable development. As a result, corporate engagement in green innovation remains insufficient, particularly in regions where speculative practices are prevalent.

Existing research on green innovation has predominantly focussed on government policies, market demands and corporate characteristics, often overlooking the influence of regional culture (Hojnik & Ruzzier 2016). While interest in the relationship between cultural settings and eco-innovation is growing, several gaps remain. Specifically, the impact of regional culture on green innovation, the role of speculative culture and the interaction between various cultural influences within a region are underexplored. Furthermore, the mediating role of formal and informal institutions in shaping cultural impacts on green innovation has been largely ignored.

This study seeks to address these gaps by examining the influence of speculative culture on corporate green innovation, with a particular focus on Africa. It explores key questions such as: How does speculative culture affect green innovation within firms? How should these effects be managed? How do regional cultural dynamics interact to shape green innovation outcomes? By investigating these issues, this research provides critical insights into the cultural drivers and barriers of green innovation, offering actionable recommendations for policymakers and corporate leaders.

The primary content of this study includes three main aspects. Firstly, it examines the role of regional cultural factors, particularly speculative culture, in influencing corporate green innovation. Secondly, it investigates the complex dynamics of regional multicultural integration and analyses how different cultural elements interact to influence green innovation outcomes. Thirdly, it explores how ormal institutions can mitigate the adverse effects of speculative culture, emphasising the alignment between formal and informal institutions to foster sustainable innovation.

This study contributes to the existing literature by highlighting the often-overlooked role of regional culture in shaping green innovation performance. Integrating perspectives on speculative culture, multicultural integration and institutional governance provides a nuanced understanding of the mechanisms driving green innovation in diverse cultural contexts. Moreover, the findings offer valuable insights and policy recommendations for corporate leaders and policymakers aiming to mitigate cultural barriers and enhance sustainable innovation strategies.

By focussing on Chinese companies with African ties, this research highlights the challenges and opportunities faced by firms engaging with African markets, which can be generalised to other multinational corporations with similar cross-regional operations. The study provides a valuable understanding of how speculative culture influences innovation strategies in emerging markets, particularly those with complex cross-border operations.

# Literature review and theoretical hypothesis

## Does speculative culture affect green innovation?

While a universally agreed-upon definition of culture remains elusive, it is generally understood as the values, beliefs and behavioural attitudes shared by social groups (Bik 2010). Culture is passed down through generations via communication or imitation (Hofstede, Hofstede & Minkov 2005) and transmitted within groups (Bik 2010). In addition to organisational culture, both individuals and businesses are inevitably influenced by local social culture. Because regional culture shapes local perceptions of novelty, innovation and collective behaviour, as well as how risks and opportunities are perceived and responded to (Kaasa & Vadi 2010), it has a direct impact on firms' green innovation activities.

Speculative culture, which encourages a focus on quick and maximal returns with minimal effort (Christensen, Jones & Kenchington 2018), often drives entrepreneurs to prioritise short-term, high-yield projects. In contrast, green innovation presents a different dynamic. Because the ecological environment functions as a public good, the benefits of eco-innovation are distributed broadly across society, while the burden of environmental protection falls predominantly on individual firms. As a result, these firms face higher costs and extended capital recovery periods compared to their polluting competitors. Within the context of a speculative culture, this mismatch diminishes firms' willingness to invest in green innovation.

From the perspective of resource-based view (RBV), green innovation demands substantial investments in tangible and intangible resources, such as financial capital, human capital, specialised knowledge and technological expertise (Leonidou et al. 2013; Sarkis, Gonzalez-Torre & Adenso-Diaz 2010). Resource-based view argues that firms with valuable, rare,

inimitable and non-substitutable resources can develop a competitive advantage, and these resources enable firms to innovate in ways that align with long-term goals (Barney 2001). Green innovation is particularly resource intensive, requiring significant investment in R&D, skilled labour and advanced technology.

However, speculative culture tends to undermine these investments by prioritising short-term financial returns over long-term strategic development (Hu, Lian & Zhou 2019). It discourages the accumulation of essential resources for green innovation, such as skilled human capital and long-term R&D investments. Moreover, speculative behaviour often results in resource misallocation, where firms divert resources away from sustainable innovation projects in favour of high-yield, short-term projects. This misalignment between speculative culture and the resource requirements for green innovation can inhibit firms' willingness to invest in sustainability-oriented innovations, as the required resources are often seen as too costly or too slow to deliver returns (Garrett & Nichols 2008; Tang & Wu 2012).

Therefore, we hypothesise that the presence of speculative culture, by diverting resources and focussing away from long-term sustainability goals, reduces firms' commitment to green innovation. In this context, the following hypotheses are proposed:

**H1:** Regional speculative culture negatively affects the green innovation of local firms.

## Can formal institutions restrain the negative effect of speculative culture?

Institutional theory is a key framework for understanding the drivers of green innovation (Li 2014). It suggests that organisations are subject to external pressures from both regulatory and normative forces, which guide their behaviours to align with broader societal goals, such as environmental sustainability. These pressures create a 'structural constraint' on firms, compelling them to adhere to regulations and societal expectations in order to maintain legitimacy, ensure viability and secure access to essential resources (Govindan, Diabat & Shankar 2015; Hojnik & Ruzzier 2016). Such regulations include not only government mandates but also the expectations of external stakeholders, which companies must meet to secure financial support and ensure long-term growth (Li 2014).

Stronger regulatory and normative pressures on environmental issues have been shown to positively influence a firm's likelihood of engaging in environmental innovation (Berrone et al. 2013). Specifically, threats and demands from governments, consumers, investors and the general public are driving the widespread adoption of environmental management systems (Anton, Deltas & Khanna 2004) and green innovation initiatives (Wu et al. 2022). In response to increasing regulatory pressure from local governments and more rigorous environmental oversight from external stakeholders, companies are incentivised to enhance their green innovation efforts. This heightened focus on environmental compliance can mitigate the negative effects of speculative culture on green innovation.

Therefore, we propose the following hypotheses:

**H2a:** Environmental regulatory pressure from local governments reduces the negative effect of speculative culture on corporate green innovation.

**H2b:** Environmental monitoring pressure from external stakeholders reduces the negative effect of speculative culture on corporate green innovation.

## Does regional cultural integration affect the role of speculative culture?

Multicultural integration is a significant topic in cultural studies, particularly for understanding how diverse cultural elements interact to shape organisational behaviours and outcomes. Hofstede's Cultural Dimensions Theory (Hofstede 1980; Hofstede 2011) provides a valuable lens for analysing these interactions. This theory identifies key dimensions of culture – including long-term versus short-term orientation, individualism versus collectivism and uncertainty avoidance – that influence how organisations prioritise innovation, allocate resources and adapt to environmental challenges. These dimensions help explain the dynamics of cultural integration and their role in shaping responses to speculative behaviours.

Speculative culture, characterised by short-term orientation, individualistic values and low uncertainty avoidance, prioritises immediate financial gains over sustainable, long-term goals (Christensen et al. 2018). This often conflicts with the long-term investment and resource allocation required for green innovation. Regional cultural dimensions can either counterbalance or reinforce speculative tendencies, depending on their orientation. For instance, long-term orientation (associated with cultures valuing perseverance and future rewards) promotes sustainable innovation, while short-term orientation amplifies speculative behaviours (Hofstede 2011). Similarly, collectivist cultures, which emphasise group cohesion and shared goals, tend to reduce speculative risk-taking behaviours, whereas individualistic cultures exacerbate them (Hofstede 1980).

In the context of speculative culture's impact on green innovation, traditional ecological culture and trust culture reflect long-term orientation and collectivist values, serving to counteract speculative tendencies. Conversely, clan culture, while collectivist in nature, fosters inward trust and group alignment, which can amplify speculative behaviours. Finally, cultural diversity, by integrating varied perspectives and knowledge bases, introduces creative problem-solving mechanisms that mitigate speculative behaviours and promote innovation (Qian 2013). This section examines these interactions, guided by Hofstede's framework, and proposes hypotheses to explore their influence on green innovation.

### Traditional ecological culture

Traditional ecological culture aligns with Hofstede's long-term orientation dimension, emphasising perseverance, sustainability and balance between humans and nature. Traditional ecological culture refers to local cultural values that emphasise environmental protection and the sustainable use of resources. To measure this, we draw upon Taoist culture, which holds that Tao is the root of all things in the world and that the sky, earth, people and all living beings are interconnected. Taoism teaches that 'the sky is the father, and the earth is the mother', requiring humans to respect nature and condemn its destruction. Additionally, Taoist culture promotes a simple, harmonious lifestyle, valuing the balance between humans and nature as an ideal state. Rooted in ecological wisdom and a love for nature (Yang, Lin & Culham 2019), this culture helps to counteract the negative influence of speculative culture on corporate green innovation. Therefore, we propose the following hypothesis:

**H3a:** A stronger local traditional ecological culture leads to a smaller negative effect of speculative culture on corporate green innovation.

### Regional trust culture

Trust culture embodies Hofstede's collectivism dimension, emphasising mutual cooperation and shared goals. According to Francis Fukuyama (1996), trust is a social culture that fosters identity and public morality, providing the foundation for social communication and cooperation. A culture of social trust can promote extensive technical and financial collaborations within and outside the enterprise, compensating for the lack of innovation incentives in formal systems and alleviating financial constraints (Zak & Knack 2001). By reducing the cost of green innovation, a trust culture may also mitigate the negative effects of speculative culture on corporate green innovation. Hence, we propose the following hypothesis:

**H3b:** A stronger regional trust culture leads to a smaller negative impact of speculative culture on corporate green innovation.

### Regional clan culture

Clan culture is built on the foundation of kinship and typically benefits internal members while excluding non-clan members (Peng 2004). As the commercial economy evolves, traditional clan ties based solely on blood relations become insufficient for addressing social interaction and resource allocation needs. Consequently, clan networks have expanded to include broader connections, such as those based on common surnames that extend beyond direct kinship (Du 2019). Clan culture also aligns with Hofstede's collectivism dimension but introduces unique dynamics. While collectivist values promote trust within groups, clan culture's inward focus and exclusion of outsiders intensify speculative tendencies. This reflects low uncertainty avoidance, as clan networks often tolerate higher risks to achieve immediate group benefits (Peng 2004). Consequently, clan culture reinforces speculative behaviours, undermining the long-term commitment required for green innovation. Based on this reasoning, we propose:

**H3c:** A stronger regional clan culture corresponds to a more pronounced negative impact of speculative culture on corporate green innovation.

### Regional cultural diversity

Cultural diversity introduces Hofstede's uncertainty avoidance dimension in a unique way. Diverse cultural contexts promote creative problem-solving and adaptive behaviours, reducing reliance on any single cultural norm, including speculative culture (Qian 2013). This diversity fosters resilience and adaptability, encouraging firms to prioritise long-term innovation goals over short-term speculative behaviours. Consequently, cultural diversity may help mitigate the negative impact of speculative culture on green innovation. Based on this analysis, we propose the following hypothesis:

**H3d:** A higher degree of cultural diversity is associated with a smaller negative impact of speculative culture on corporate green innovation.

## Research design

### Sample selection and data source

To ensure the relevance of our data to Africa, we focussed on China's A-share listed companies from 2008 to 2020 that have direct or indirect ties to the continent. Direct ties were defined as trading relationships with African customers or suppliers, while indirect ties referred to participation in supply chains connected to African enterprises or investments in African-related projects. These ties encompassed relationships with African customers, suppliers or any component of the supply chain involving African enterprises, as well as companies with investments in Africa or partnerships with African-linked supply chains. This clear categorisation of ties not only aligns with the research's objective but also provides a structured basis for analysing cross-regional differences. Instead of relying on sampling techniques, we utilised an exhaustive dataset by including all publicly listed companies that met the criteria of having direct or indirect African connections. This comprehensive approach was intended to minimise potential biases associated with sample selection and offer a more complete representation of firms engaged with Africa.

We began by identifying all A-share listed companies in China during the 2008 to 2020 period, using publicly available data from the Wind and CSMAR databases. The initial dataset encompassed companies across all industries, ensuring that the entire spectrum of publicly listed firms during the study period was covered. Following this, we conducted an in-depth review of publicly available sources, including corporate reports, investment disclosures and news databases, to identify companies with direct or indirect ties to Africa. To ensure clarity in sample classification, firms were categorised based on their nature of ties to Africa. Direct ties were defined as transactional relationships with African customers or suppliers, while indirect ties referred to supply

chain involvement or investments linked to African markets. This classification allows for a nuanced analysis of how speculative culture influences green innovation across varying levels of regional integration. This grouping facilitates the examination of whether the nature of these connections moderates the impact of speculative culture on green innovation. To ensure the accuracy and comprehensiveness of the dataset, we cross-referenced multiple data sources, minimising the risk of omitting relevant companies.

After identifying the companies, we conducted a rigorous data cleaning and refinement process to enhance the reliability of the dataset. Firms operating in the financial sector were excluded, as their regulatory environments and business models differ fundamentally from those in the industrial and service sectors, making comparisons in innovation studies challenging. For example, financial firms are subject to stricter governance mechanisms and less influenced by regional cultural factors, which makes their inclusion less relevant to the study's objectives. Additionally, companies that were newly listed during the same year of the study period were excluded because they often lacked sufficient historical data for reliable trend analysis. Special treatment (ST) companies, which are subject to heightened regulatory scrutiny because of financial distress, were also removed to maintain consistency and avoid skewing the results. These exclusions helped to ensure that the dataset focussed on firms with stable operational histories and comparable market dynamics.

Next, we collected green innovation data, concentrating on the patents held by the selected companies. Patent data were obtained from the China Research Data Service Platform (CNRDS), with particular attention paid to patents indicating green innovation. Green patents were identified using the International Patent Classification (IPC) system, which categorises innovation types based on functionality and purpose. We cross-referenced these classifications with the World Intellectual Property Organisation's (WIPO) Green List to ensure alignment with internationally recognised standards. To further improve the accuracy of our classification, we employed a hybrid approach that combined automated classification with manual verification. This ensured that green patents were accurately distinguished from non-green patents, particularly in cases where patent descriptions lacked detail or where automated algorithms were prone to errors.

Finally, a comprehensive data completeness verification was conducted to ensure the robustness of the dataset. Companies with incomplete financial or patent data were identified and excluded from the analysis, as missing information could compromise the integrity of the findings. In instances where critical data were missing, supplementary information was manually collected from corporate filings and other secondary sources to ensure that the dataset was as complete as possible. These verification steps were essential for reducing biases and maintaining data reliability, particularly given the complexity of measuring innovation outcomes across diverse regional contexts. This meticulous approach to dataset construction aimed to provide an accurate representation of Chinese A-share companies with African connections, thereby offering credible insights into the dynamics of green innovation in this context.

## Variables

### Dependent variable: Corporate green innovation

Corporate green innovation is measured by the total number of green patent applications (*Green_apply*). To assess the quality of green innovation, we use the number of green invention patent applications (*GreenInv_apply*). Because the distribution of green patent applications is right skewed, we added 1 to each value and applied a natural logarithm transformation to normalise the data.

### Independent variable: Speculative culture

Speculative culture is captured through local lottery consumption, specifically the ratio of local lottery sales to regional gross domestic product (GDP), which reflects speculative preferences. For robustness, we also utilise per capita lottery sales in each province. Data on welfare and sports lottery sales from 31 Chinese provinces (2008–2020) are sourced from the Ministry of Finance of China.

### Moderating variables

Traditional ecological culture: This is represented by Taoist culture, which is measured by the number of key Taoist temples within a 300-km radius of a company's headquarters. Taoist principles, emphasising harmony with nature, may positively influence corporate green innovation.

Regional trust culture: Measured using data from the China General Social Survey (CGSS), which evaluates social trust based on respondents' agreement with the statement that most people in society are trustworthy.

Regional clan culture: This variable is measured by the number of genealogy volumes per square kilometre of a city, which reflects the cultural strength of local clans.

Regional cultural diversity: Measured by the number of dialects spoken in each city, using data from Xu Xianxiang's dialect diversity database (Chen 2013).

Environmental regulatory pressure from local governments (*GovPressure*): Measured by discharge levels of pollutants such as wastewater, $SO_2$ and smoke, as reported in the 'China City Statistical Yearbook'. These values are standardised to account for the characteristics of each pollutant. Higher levels of emissions pressure force local governments to impose stricter environmental regulations, which in turn affects corporate behaviour towards green innovation.

Environmental monitoring pressure from stakeholders (*StkPressure*): Measured by the number of analyst tracking

teams following each company, calculated as the natural logarithm of (1 + the number of analyst tracking teams). Analyst scrutiny helps reduce information asymmetry and promotes effective supervision by stakeholders (Frankel & Li 2004), which can drive companies to adopt sustainable practices (Healy & Palepu 2001).

### Control variables

To account for potential confounding factors, we included several company-specific and regional control variables based on the existing literature (Adhikari & Agrawal 2016; Amore & Bennedsen 2016; Chen et al. 2014). Corporate control variables include annual R&D expenditure as a percentage of total assets, institutional shareholding ratio, whether the chairman also serves as CEO, proportion of independent directors on the board, book-to-market ratio (total assets divided by market value), cash and cash equivalents as a percentage of total assets, total liabilities divided by total assets, investment ratio, asset tangibility, return on assets, number of employees, Tobin's Q and company age. Regional control variables include the natural logarithm of the regional population, the natural logarithm of gross regional product per capita, the marriage ratio and the gender ratio. Industry and year-fixed effects were also incorporated to control for unobserved heterogeneity across sectors and time periods, ensuring a robust analysis of the factors influencing green innovation.

## Research model

To investigate the influence of regional speculative culture on corporate green innovation, we formulate the regression model as follows, in Equation 1:

$$\text{Green} = \alpha_0 + \alpha_1\, lottery + \alpha_j\, CVs + \sum Industryfe + \sum yearfe + \varepsilon \quad \text{[Eqn 1]}$$

Dependent variables (Green) represent the variables *Green_apply* and *GreenInv_apply*. CVs are the control variables. $\alpha_0$ is a constant term. $\alpha_1$ and $\alpha_j$ are regression coefficients and $\varepsilon$ is a residual term. We mainly examine the regression coefficient of *lottery*, specifically, if $\alpha_1$ is significantly negative, the H1 hypothesis is proven, that is, a negative impact of speculative culture on corporate green innovation. To test hypotheses H2 and H3, we will mainly use the method of group regression on the basis of the baseline model.

For hypotheses H1, H2 and H3, the analysis involves subgroup regressions to examine differences between firms with direct ties to Africa and those with indirect ties. This approach ensures that the proposed relationships are evaluated within distinct contexts, capturing any potential variations arising from the nature of a firm's connection to African markets. These subgroup regressions allow for a nuanced understanding of how speculative culture and its moderating factors influence green innovation under varying relational conditions.

# Empirical analysis

## Baseline analysis

The estimation results for the baseline model are presented in Table 1. Specifically, columns (1) and (2) represent the regression analysis of local speculative culture on the number of green patent applications, while columns (3) and (4) focus on the regression analysis of speculative culture on green invention patent applications. The findings reveal that the coefficients associated with speculative culture are all statistically significant at the 1% level and demonstrate a negative impact on corporate innovation. Thus, H1b is validated. More specifically, a one-thousandth increase in the proportion of regional lottery sales to regional GDP leads to an average reduction of approximately 0.02% in the number of green patent applications by companies, a statistically significant result at the 1% level.

## The moderating effect of formal institutions

In Table 2, columns 1, 2 and 3 present the results of the moderating effect of environmental regulatory pressure from local government. In column (1), the coefficient of the interaction term between government pressure and speculative culture (lottery#GovPressure) is significantly positive at the 1% level, indicating that the environmental protection pressure imposed by the local government weakens the inhibitory effect of speculative culture on green innovation. To ensure the reliability of the findings, we conducted cross-sectional data analysis as well. In columns (2) and (3) of Table 2, we observe that when the environmental pressure from local government is below the median (i.e. in regions with lower environmental stress), the coefficient of speculative culture is

**TABLE 1:** Regression results for lottery culture and corporate green innovation.

| Variables | Green_apply | | | | GreenInv_apply | | | |
|---|---|---|---|---|---|---|---|---|
| | (1): Green_apply | | (2): Green_apply | | (3): GreenInv_apply | | (4): GreenInv_apply | |
| | Coef. | *t* | Coef. | *t* | Coef. | *t* | Coef. | *t* |
| Lottery | -0.0511*** | -9.0780 | -0.0203*** | -3.4605 | -0.0467*** | -9.9497 | -0.0212*** | -4.3182 |
| RDexpenses | - | - | 9.2433*** | 22.1266 | - | - | 8.3035*** | 23.6906 |
| CVs | Yes | - | Yes | - | Yes | - | yes | - |
| Industry | Yes | - | Yes | - | Yes | - | yes | - |
| Year | Yes | - | Yes | - | Yes | - | yes | - |
| Adjusted $R^2$ | 0.177 | - | 0.317 | - | 0.133 | - | 0.270 | - |
| $F$ | 173.8049 | - | 247.4857 | - | 124.1850 | - | 197.2291 | - |

***, representing statistical significance at the 1% level.

Coef., coefficient; *t*, *t*-statistic; CV, control variables; $F$, $F$-statistic.

significantly negative at the 1% level. However, in regions with higher environmental pressure from local governments, the estimated coefficient of the lottery becomes positive and loses significance. This result reaffirms that the government's environmental pressure lessens the negative impact of speculative culture on green innovation. Thus, hypothesis H2a is supported.

Columns 4, 5 and 6 of Table 2 report the moderating effect of environmental monitoring pressure from external stakeholders. Based on the baseline model, we introduced the intersection item (*lottery*StkPressure*) for regression. In column 4 of Table 2, we observe that the regression coefficient of the interaction term (lottery*StkPressure) is significantly positive at the 1% level. This result indicates that external supervision of enterprises can alleviate the inhibitory effect of speculative culture on green innovation. To ensure the robustness of our findings, we conducted cross-sectional data analysis, and the outcomes are reported in columns 5 and 6 of Table 2. In the group with fewer analyst teams (column 5), representing firms with less external supervision, the coefficient of speculative culture is negative and significant at the 1% level. On the other hand, in the group with more tracked analyst teams, representing firms with higher levels of external supervision, the estimated coefficient of lottery decreases and is not statistically significant. The above empirical results show that monitoring pressure from external stakeholders can effectively reduce the negative effects of speculative culture, and so hypothesis H2b is supported.

## Effect analysis of regional cultural integration

Columns 1 and 2 of Table 3 show the impact of traditional ecological culture on the effect of speculative culture. The sample companies are divided into two groups based on the median of the Taoist culture index: one group located in areas with stronger Taoist cultural influences and the other in areas with weaker influences. The cross-sectional data analysis reveals that in areas with weaker ecological culture (columns 1), the coefficient of speculative culture remains significantly negative. However, in stronger regions (columns 2), the impact of speculative culture on green innovation is smaller and no longer significant. Therefore, H3a is supported, indicating that the stronger the local traditional ecological culture, the smaller the negative impact of speculative culture on corporate green innovation.

Columns 3 and 4 of Table 3 present the influence of regional trust culture on green innovation. The cross-sectional data analysis reveals that the coefficient of speculative culture is significantly negative in areas with lower levels of trust culture. However, in regions with higher trust cultures, the negative impact of speculative culture becomes smaller and loses significance. Therefore, these findings support H3b, indicating that a stronger regional trust culture mitigates the negative effect of speculative culture on corporate green innovation.

Columns 5 and 6 of Table 3 demonstrate the impact of regional clan culture. When the number of genealogical volumes per square kilometre in a city surpasses the median, it indicates a stronger presence of clan culture and vice versa.

**TABLE 2:** Moderating effect of formal institutions.

| Variables | (1): Full sample | | (2): Less government pressure | | (3): High government pressure | | (4): Full sample | | (5): Low stakeholder pressure | | (6): High stakeholder pressure | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coef. | *t* | Coef. | *t* | Coef. | *t* | Coef. | *t* | Coef. | *t* | Coef. | *t* |
| Lottery | -0.0214*** | -3.6940 | -0.0281*** | -3.5068 | 0.0205 | 1.5421 | -0.0206*** | -4.7225 | -0.0277*** | -4.0067 | -0.0152 | -1.6192 |
| GovPressure | -0.1942*** | -4.0724 | - | - | - | - | - | - | - | - | - | - |
| lottery#GovPressure | 0.0294*** | 2.7723 | - | - | - | - | - | - | - | - | - | - |
| StkPressure | - | - | - | - | - | - | 0.0100*** | 4.7570 | - | - | - | - |
| lottery#StkPressure | - | - | - | - | - | - | 0.0012*** | 2.6758 | - | - | - | - |
| CVs | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - |
| Industry | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - |
| Year | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - |
| Adjusted $R^2$ | 0.303 | - | 0.333 | - | 0.289 | - | 0.314 | - | 0.218 | - | 0.358 | - |
| $F$ | 234.9322 | - | 143.3107 | - | 113.0212 | - | 248.4715 | - | 83.0477 | - | 150.4192 | - |

***, representing statistical significance at the 1% level.
Coef., coefficient; *t*, *t*-statistic; CV, control variables; $F$, $F$-statistic.

**TABLE 3:** Influence of other regional culture.

| Variables | (1): Areas with weaker ecological culture | | (2): Areas with stronger ecological culture | | (3): Areas with weaker trust culture | | (4): Areas with stronger trust culture | | (5): Areas with weaker clan culture | | (6): Areas with stronger clan culture | | (7): Areas with low cultural diversity | | (8): Areas with high cultural diversity | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coef. | *t* | Coef. | *t* | Coef. | *t* | Coef. | *t* | Coef. | *t* | Coef. | *t* | Coef. | *t* | Coef. | *t* |
| Lottery | -0.025*** | -3.203 | -0.009 | -0.908 | -0.024*** | -2.802 | -0.009 | -0.896 | -0.005 | -0.569 | -0.022** | -1.983 | -0.020*** | -3.098 | -0.007 | -0.294 |
| CVs | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - |
| Industry | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - |
| Year | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - |
| Adjusted $R^2$ | 0.336 | - | 0.292 | - | 0.310 | - | 0.322 | - | 0.311 | - | 0.290 | - | 0.299 | - | 0.467 | - |
| $F$ | 158.408 | - | 91.068 | - | 118.043 | - | 124.490 | - | 101.766 | - | 92.023 | - | 180.224 | - | 66.091 | - |

***, **, representing statistical significance at the 1% and 5% levels, respectively.
Coef., coefficient; *t*, *t*-statistic; CV, control variables; $F$, $F$-statistic.

The results indicate that under higher clan culture, the negative relationship between regional speculative culture and green innovation becomes more pronounced (as shown in column 6). However, in the lower group, the relationship loses significance (as shown in column 5). This supports H3c, suggesting that a stronger regional clan culture intensifies the negative impact of speculative culture on corporate green innovation.

Columns 7 and 8 of Table 3 examine the impact of regional cultural diversity. When the number of dialects in a city exceeds the median, it signifies greater cultural diversity; otherwise, it indicates lower diversity. The results indicate that under higher cultural diversity, the negative relationship between regional speculative culture and green innovation becomes insignificant (as shown in column 8), while it remains significant in the lower group (as shown in column 7). This supports H3d, indicating that stronger regional cultural diversity weakens the negative impact of speculative culture on corporate green innovation.

## Subgroup analysis and unified interpretation

To further explore potential variations, subgroup regressions were conducted across all hypotheses to compare firms with direct ties to Africa and those with indirect ties. However, the results indicate no significant differences between these two subgroups across the baseline model, moderating effects and cultural integration dimensions. For example, the coefficients for speculative culture in the direct ties group were -0.0205 and -0.0211 for green patent applications and green invention patent applications, respectively, while the indirect ties group yielded coefficients of -0.0198 and -0.0203, all significant at the 1% level. Similarly, no distinct patterns emerged in the interaction effects across the moderating and cultural integration variables.

The lack of subgroup differences suggests that speculative culture's influence and its interactions with moderating and cultural integration variables operate consistently across both direct and indirect African relational contexts. This may be attributed to the overarching homogeneity in speculative culture and its regional drivers across Chinese firms, regardless of their specific African linkages. Additionally, the mechanisms of green innovation, being predominantly shaped by internal corporate and local environmental factors, might overshadow nuanced variations in the nature of African ties.

## Endogeneity and robustness test

### Endogeneity test

We also consider the possible omitted variables of the model as much as possible. We introduce specific indicators into the model to control possible omitted variables and then examine whether the estimated results of the model are consistent with the previous conclusions. The specific control variables introduced are as follows: (1) Considering the influence of executive characteristics on green innovation and referring to Arena, Michelon and Trojanowski (2018), we further controlled the personal characteristics of CEOs, including CEO education, CEO age and CEO gender. (2) Considering the influence of industry characteristics on innovation and referring to Adhikari and Agrawal (2016), we add control variables Herfindahl index, institutional investor shareholding ratio and analyst tracking number variables. (3) We also more fully control the characteristic indicators at the region level, including per capita education level and per capita road freight volume. As observed in columns 6, 7 and 8 of Table 4, the coefficient of speculative culture remains consistently negative in all these scenarios.

### Robustness test

Robustness tests were conducted to ensure the reliability of the findings. Firstly, in the set of tests, we replaced the dependent variable with two alternative measures: (1) Add 1 to the number of annual green patents granted and then take the natural logarithm (LnGreen_Granted); (2) add 1 to the number of annual green invention patents granted and then take the natural logarithm (LnGreenInv_Granted). As reported in columns 1 and 2 of Table 4, the research outcomes remained consistent and unchanged after conducting these re-regressions. This reinforces the validity of our initial findings.

Secondly, as the output of R&D green patents requires a certain period, this article also replaces the dependent variable with the future 1st period and performs regression again. The regression results presented in columns 3 and 4 of Table 4 demonstrate that even when considering a longer period, the inhibitory effect of speculative culture on green innovation persists.

Thirdly, as demonstrated in column 5 of Table 4, our research findings remain consistent when using per capita lottery sales as a proxy variable for local speculative culture.

**TABLE 4:** Endogeneity and Robustness test.

| Variable | (1): LnGreen_ Granted | | (2): LnGreenInv_ Granted | | (3): F.Green_ apply | | (4): F.GreenInv_ apply | | Green_apply | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | (5) | | (6) | | (7) | | (8) | |
| | Coef. | *t* | Coef. | *t* | Coef. | *t* | Coef. | *t* | Coef. | *t* | Coef. | *t* | Coef. | *t* | Coef. | *t* |
| lottery | -0.0203*** | -3.8415 | -0.0168*** | -4.7735 | -0.0149** | -2.3514 | -0.0171*** | -3.2021 | - | - | -0.0162** | -2.2610 | -0.0245*** | -3.8389 | -0.0215*** | -3.6236 |
| AVGlottery | - | - | - | - | - | - | - | - | -0.0674*** | -3.1400 | - | - | - | - | - | - |
| CVs | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - |
| Industry | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - |
| Year | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - | Yes | - |
| Adjusted $R^2$ | 0.314 | - | 0.190 | - | 0.312 | - | 0.267 | - | 0.320 | - | 0.312 | - | 0.320 | - | 0.317 | - |
| $F$ | 244.377 | - | 126.025 | - | 210.068 | - | 169.086 | - | 225.857 | - | 157.950 | - | 183.687 | - | 238.007 | - |

***, **, representing statistical significance at the 1% and 5% levels, respectively.

Coef., coefficient; *t*, *t*-statistic; CV, control variables; $F$, $F$-statistic.

The robustness of these findings further strengthens the validity and reliability of our conclusions.

# Conclusion and suggestion

## Research conclusions

This study examines the impact of speculative culture on corporate green innovation, using data from Chinese-listed companies between 2009 and 2020, with a particular focus on firms that have direct or indirect ties to Africa. The results yield several key findings. Firstly, speculative culture has a detrimental effect on corporate green innovation. Secondly, regional traditional ecological culture, trust culture and cultural diversity help mitigate the negative impact of speculative culture on green innovation, while clan culture intensifies it. Thirdly, formal institutions – specifically government regulation and stakeholder supervision – play a significant role in alleviating the harmful effects of speculative culture on corporate green innovation.

## Implications

**Mitigate the negative impact of speculative culture on green innovation locally:** To mitigate the negative impact of speculative culture on green innovation, companies should take a comprehensive approach by strengthening internal governance and incorporating environmental, social and governance (ESG) criteria into their decision-making processes. Establishing strong internal controls and risk management systems can help counter speculative pressures while linking executive compensation to long-term sustainability goals can incentivise a greater focus on green innovation. Additionally, fostering a corporate culture centred on sustainability, supported by employee training and awareness programmes, can reduce the influence of speculative behaviour. Companies should also actively engage with local stakeholders and communities and form strategic partnerships with organisations focussed on sustainability to build external support for green initiatives. Using data analytics to predict speculative tendencies and clearly communicating sustainability goals to investors and stakeholders will further help firms navigate the uncertainties associated with speculative culture while maintaining a long-term commitment to green innovation. Together, these measures create a stable foundation for promoting sustainable innovation.

**Enhance external regulatory supervision:** Our analysis shows that formal institutions, through both governmental regulation and stakeholder supervision, are crucial in mitigating the negative impact of speculative culture on corporate green innovation. In regions of Africa where speculative culture is prevalent, it is essential to strengthen regulatory efforts by implementing stricter environmental policies, offering financial incentives such as tax breaks for green investments and increasing penalties for non-compliance. Stakeholder oversight should also be enhanced by promoting transparency through mandatory environmental disclosures and independent third-party audits, which can help reduce information asymmetry and build investor confidence. Additionally, companies should be encouraged to adopt voluntary environmental standards like ISO 14001, which can align internal processes with both regulatory requirements and market expectations. By combining stronger government regulation, market-based supervision and voluntary standards, a more supportive environment for green innovation can be created, allowing firms to thrive despite speculative pressures.

**Leverage diverse cultures to promote green innovation:** Our study shows that when traditional ecological knowledge, trust culture, social responsibility and external cultural influences are strong, the negative impact of speculative culture on green innovation weakens. Companies should actively integrate these cultural strengths into their green innovation strategies. In Africa, leveraging local cultural values and traditional ecological knowledge can significantly enhance the effectiveness of these strategies. Governments can support this by developing policies that encourage businesses to incorporate traditional knowledge into sustainable practices, offering financial incentives such as tax breaks or subsidies for eco-friendly projects and establishing recognition programmes for businesses that successfully integrate local cultural elements into green innovation. Additionally, partnerships with local leaders, universities and cultural organisations can help promote ecological education, highlighting the value of traditional knowledge in environmental management. Communities can also play a key role by organising grassroots initiatives, such as local sustainability projects or cooperatives, that facilitate collaboration on green innovation. By aligning international sustainability standards with local cultural strengths, a more conducive environment for long-term green innovation can be created.

## Addressing regional differences in speculative culture and green innovation

While this study primarily focusses on Chinese companies with ties to African markets, it is essential to acknowledge the potential differences between Chinese and African firms in terms of how speculative culture impacts green innovation. Although the analysis does not directly compare these two sets of firms, understanding their distinct economic, institutional and cultural contexts can provide important insights into the findings.

### Economic and institutional contexts

China and many African nations operate within very different economic and institutional frameworks, which can significantly influence how speculative culture affects corporate green innovation. Chinese companies benefit from a well-developed infrastructure, robust government policies supporting innovation and relatively stable institutional conditions, which provide them with the necessary resources to navigate speculative pressures and pursue green

innovation. In contrast, many African companies face infrastructural challenges, limited access to capital and less supportive regulatory environments, which may hinder their ability to invest in sustainable innovation. The impact of speculative culture may, therefore, be more pronounced in African firms because of these additional constraints, as speculative behaviour may divert attention and resources away from long-term innovation strategies.

#### Cultural differences and innovation incentives

Speculative culture, though present in both regions, manifests differently because of the distinct cultural and social environments in China and Africa. In China, speculative behaviour may be driven by rapid economic growth, government intervention and high levels of competition, which often result in short-term profit-seeking strategies. In African countries, speculative culture may be influenced by varying levels of market maturity, less developed financial systems and differing perceptions of risk. These factors could shape the way firms in both regions approach innovation. For instance, Chinese companies may prioritise technological innovation and business model adaptations driven by government incentives, while African companies may be more focussed on overcoming basic infrastructure challenges before committing to more ambitious green innovation goals.

#### The role of external institutions and regulatory frameworks

As discussed in the section 'Implications', external regulatory supervision plays a critical role in mitigating the negative effects of speculative culture on green innovation. In China, strong government policies such as subsidies for green technologies and environmental regulations provide a supportive environment for corporate green innovation. In Africa, however, regulatory frameworks may vary significantly across countries, with some governments offering limited incentives or enforcement mechanisms to drive sustainable innovation. The differing levels of regulatory support between the two regions can lead to different outcomes in terms of how speculative culture influences green innovation, with African firms potentially facing greater challenges in aligning with sustainability goals.

These regional differences underscore the importance of contextualising the impact of speculative culture on green innovation. While this study highlights the experiences of Chinese firms with African ties, future research could expand the scope to include direct comparisons between Chinese and African companies. Such comparisons would provide a clearer picture of how regional cultural, economic and institutional factors shape the relationship between speculative culture and innovation in diverse global contexts.

### Limitations and future research directions

This study provides valuable insights into the role of regional speculative culture in shaping green innovation performance, particularly among Chinese companies with ties to African markets. However, several limitations should be addressed in future research to enhance the generalisability and depth of the findings.

Firstly, while this study focusses on Chinese companies with African ties, it does not directly compare the green innovation outcomes of Chinese firms with those of African firms. Future research could expand this analysis to include African companies or multinational firms operating across both Chinese and African markets. A cross-regional comparison would provide a clearer understanding of how the impact of speculative culture on green innovation differs between firms based in China and those based in Africa. This would help determine whether the observed effects are consistent across emerging markets or if regional factors – such as local economic conditions, institutional frameworks and cultural contexts – play a significant role in shaping these outcomes.

Secondly, the study primarily relies on quantitative data, which may not capture the full complexity of how speculative culture affects corporate decision-making and innovation strategies. Future studies could benefit from incorporating qualitative methods, such as interviews with company leaders or in-depth case studies, to explore how speculative culture shapes organisational decision-making processes and innovation strategies, both in Chinese companies and their African counterparts.

Thirdly, while this study primarily examines firms with ties to Africa, expanding the scope to include companies from other regions, such as Europe or Latin America, with similar cross-border operations to Africa, could offer valuable comparative insights. Exploring how speculative culture influences green innovation in companies with ties to both Africa and other regions would contribute to a more comprehensive understanding of the relationship between speculative culture and corporate innovation across diverse cultural and economic contexts.

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### Authors' contributions

H.J. contributed to the conceptualisation, methodology, formal analysis, data curation, writing the original draft and reviewing and editing of the study. L.S. contributed to data analysis and methodology development. Y.Y. contributed to

the validation of the study, data interpretation and parts of the original draft writing.

## Ethical considerations

This article does not contain any studies involving human participants performed by any of the authors.

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## Data availability

The data used in this study are available from the China Research Data Service Platform (CNRDS), the World Intellectual Property Organization (WIPO), the CSMAR database and the Wind database.

## Disclaimer

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