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ORIGINAL PAPER

Impact of Corporate Culture on Environmental Performance

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Abstract
We examine the impact of corporate culture on environmental performance using a sample of 7199 firm-year observations over the period of 2002–2018. We find that stronger corporate culture improves environmental performance, measured by the amount of toxic chemical release (TCR). Our result is both statistically and economically significant. We also show that cultural norms of innovation, quality and teamwork as well as a technology-oriented corporate culture have a greater impact on enhancing environmental performance. Further analyses show that managerial competence and strong institutional ownership moderate the relationship between corporate culture and environmental performance. We introduce the decomposition of expected and unexpected components of TCR and document that firms with a strong corporate culture implement strategies to reduce the unexpected component of TCR in addition to the expected component of TCR. Finally, we document that strong corporate culture and environmental performance improve firms' financial performance. Our results are robust to several sensitivity tests and procedures to mitigate endogeneity and self-selection problems. From a practical point of view, our findings suggest that a firm's culture can determine its environmental sustainability and ethical practices.

Keywords Corporate culture · Environmental performance · Institutional ownership · Managerial ability · Toxic chemical release

Introduction

This study empirically examines the association between corporate culture and firms' environmental performance (EP). There are growing concerns about the environmentally unethical behaviour of firms. A recent report published in *The Lancet Planetary Health* shows that air, water and toxic chemical pollutions are causing approximately 9 million premature deaths every year globally (Fuller et al., 2022). Air pollution is responsible for over 6.5 million deaths per year, while lead and other chemicals are causing 1.8 million deaths per year (Fuller et al., 2022). According to Fuller et al. (2022), the US is among the top 10 countries for pollution-related fatalities.[1] Given the negative consequences of pollution, it is not surprising that regulators and agencies such as the US Environmental Protection Agency (EPA) have mandated firms to report their toxic chemicals release (TCR) as well as their pollution prevention activities aimed at improving EP.

Pollution prevention activities cannot be implemented successfully without a strong corporate culture that promotes ethical behaviour and considers the negative effects of a firm's activities on the environment. Examining EP is an ethical issue because, according to the theory of ethical consumerism, modern consumers make consumption decisions based on ethical criteria such as company values (corporate culture) or the environmental impact of business operations (Becker-Olsen et al., 2006; Castaldo et al., 2009). In addition, there are negative consequences of violating these ethical standards, for example, incurring environmental fines (Erwin, 2011; Thompson, 2003). Further, although pollution generally may occur in most businesses due to the nature of their operations, the release of toxic chemicals, an aspect of pollution, has direct negative consequences on the

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[1] https://www.theguardian.com/environment/2019/dec/18/us-top-10-countries-pollution-related-deaths-study.

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ecological environment, poses long-term health complications to humanity, and thus can be considered an ethical issue. Therefore, there is a strong incentive for firms to maintain high EP and understanding the drivers of EP is critical to both academics and policymakers.

Corporate culture[2] refers to the shared values and beliefs indicating what is important and the appropriate behaviours expected of members across all levels of an organisation when they are faced with choices (Crémer, 1993; Kreps, 1990; O'Reilly, 1989; O'Reilly & Chatman, 1996). For example, a firm with a strong corporate culture will endorse and encourage its members to implement ethical and efficient business processes that ensure quality outputs and long-term benefits. Strong corporate culture promotes ethical decision-making through ethical policy formulation which helps managers to make decisions when faced with moral dilemmas (Kim & Kim, 2010; Nwachukwu & Vitell, 1997).

Prior literature finds that strong corporate culture is associated with positive outcomes, such as improved ethical decision-making (Graham et al., 2022; Nwachukwu & Vitell, 1997), enhanced organisational productivity, firm value, employment relations, ability to attract quality talent (Guiso et al., 2015; Li et al., 2021a; O'Reilly & Chatman, 1996) and long-term orientation through R&D investments (Li et al., 2021a). Further research also shows that corporate culture plays a crucial role in shaping various firm policies and outcomes. For example, research shows that firms with a strong corporate culture prevail in times of crisis (Li et al., 2021a), take more risks (Li et al., 2021b), experience lower CEO turnover (Fiordelisi & Ricci, 2014) and have lower audit fees (Chen et al., 2022). In recent times, managers have been expected to promote not only ethical and professional standards but also cultures that enhance EP (Graham et al., 2022; Guiso et al., 2015; Wang et al., 2021).

We posit that corporate culture is associated with EP in two ways. First, environmental risk leads to higher litigation costs and greater scrutiny from regulators, which has long-term consequences on firms' financial performance. Anecdotal evidence shows that Chevron, BP and Volkswagen have suffered severe consequences from their environmental pollution (El Ghoul et al., 2018). Therefore, firms are aiming to be ethical by increasing their investment into more innovative and efficient production processes that reduce their negative environmental impact. A recent survey reveals that a strong corporate culture influences creativity, reduces firm risk and increases firm value (EY, 2020; Graham et al., 2022). Thus, firms with a strong corporate culture are expected to be ethical, innovative, exhibit quality in their production processes and consequently have better EP. Second, from a stakeholder value maximisation perspective, investors tend to consider corporate social responsibility (CSR) activities, including firms' environmental impact, as a signal of managerial altruism (Dutordoir et al., 2018). Such managers are likely to invest firms' resources in environmentally friendly technologies and promote ethical business processes to lower their carbon footprint.

To empirically examine the relationship between corporate culture and EP, we rely on a sample of 7199 firm-year observations over the period of 2002–2018. Our findings provide strong support for our prediction that strong corporate culture improves EP by reducing TCR; in other words, it enhances ethical behaviour. Our findings are both statistically and economically significant. We find that a one standard deviation increase in corporate culture score results in a reduction of 3.85%—equivalent to approximately 44,584 pounds—of toxic chemicals released by firms. We also find evidence that cultural values of innovation, quality and teamwork are the most effective mechanisms for enhancing EP. The positive effect of corporate culture on EP is driven mainly by the technology orientation of firms. Our findings are in line with the notion that employees are more likely to draw on a firm's corporate culture when faced with ethical dilemmas such as ensuring quality products and safe environments.

Further analyses reveal that greater managerial competence and strong institutional ownership moderate the association between corporate culture and EP. Due to the inherent nature of businesses, they may emit some toxic chemicals (expected TCR). Emission of toxic chemicals above the expected level (unexpected TCR) is unethical. Our empirical results provide strong evidence that firms with strong corporate culture endorse ethical behaviour and exert greater ethical standards by reducing both the unexpected TCR and expected TCR, thereby improving overall EP. We find that strong corporate culture and EP together enhance firms' financial performance. Our findings are robust to several sensitivity tests, including alternative measures of EP and several procedures to control for endogeneity and self-selection bias.

The existing literature examines the impact of a single dimension of corporate culture such as green organisational culture or integrity culture on CSR (e.g. Bao et al., 2023; Erwin, 2011; Galbreath, 2010; Wan et al., 2020) and the environment (e.g. Al-Swidi et al., 2021; Wang, 2019). However, empirical evidence on the association between corporate culture and firms' EP is scarce. Therefore, this study fills this gap in the literature and differs from prior research in three important ways.

First, prior research focuses on settings such as Qatar (Al-Swidi et al., 2021), China (Bao et al., 2023; Wan et al., 2020), Taiwan (Wang, 2019) and Australia (Galbreath,

[2] According to Li et al. (2021a) corporate culture comprises five core values, namely integrity, teamwork, innovation, respect and quality.

2010), which are different institutional settings to the US. We focus on the US market, which differs from other markets in terms of pressure from environmental activists, firm-level governance structures and country-level institutional factors. Moreover, the US is by far the highest emitter of greenhouse gases (GHGs) in the world, releasing about 421.9 bn tonnes (Wolf, 2023).

Second, we take a holistic approach and focus on the overall corporate culture of a firm because an organisation is an intricate mix of combined values. Corporate websites and annual reports tend to mention a vast array of cultural values because the ethical behaviour of a firm is likely to be evaluated against its combined corporate cultural values. The harmonisation of various dimensions of culture is likely to strengthen the overall corporate culture. Therefore, examining the impact of the overall corporate culture on EP is crucial. Moreover, we explore how the different dimensions of corporate culture affect EP, thereby offering more robust evidence.

Third, CSR or environmental, social and governance (ESG) encapsulate social activities that could be used for 'greenwashing' (Wu et al., 2020) or determine firms' CSR orientation as opposed to the direct measure of EP. Our measure, TCR, focuses on the effect on human health-related problems of long-term exposure to harmful chemicals, making TCR an ethical issue as opposed to other pollution activities of firms. Thus, TCR captures the direct long-term implications on human health caused by firms' environmental pollution. We obtain TCR data at the facility level (where pollution is generated and managed) from the Toxic Release Inventory (TRI) programme of the EPA. Importantly, it is the most comprehensive source of information on corporate pollution activities.

Our study contributes to the literature in several ways. First, we extend prior work on the determinants of EP. To the extent that better environmental practices positively affect firm performance, it is important to understand the antecedents of EP. For instance, our paper advances ongoing research on activities related to climate change such as the work of Chen et al. (2021), who find that borrowers consider firms' environmental records when making lending decisions. Our findings support the idea that firms with a strong corporate culture can promote ethical business practices and determine their response to protecting the natural environment.

Second, our findings show that strong corporate culture promotes ethical behaviour by endorsing environmentally friendly policies that positively affect EP. Our empirical findings indicate the importance of strong corporate culture in ensuring that a firm's activities are driven by ethical principles and the triple bottom line (i.e. social, environmental and financial motives), and not solely profit maximisation. Thus, our study responds to recent calls for research on the role of governance in EP rather than general CSR issues (for example, Zaman et al., 2022) as more institutions are concerned about environmental and climate-related issues at the expense of social issues.

Third, breaking down TCR into expected and unexpected components provides useful information about how firms manage climate-related activities based on the quality of corporate culture. The results in this regard highlight the application of firms' ethical standards in consciously reducing abnormal pollution. Lastly, our findings have implications for stakeholders. For instance, auditors are likely to incorporate culture and environmental factors when designing their audit procedures, thereby affecting audit fees. Stronger corporate culture and EP emphasise firms' ethical standards which could influence job satisfaction and retention of current employees and help firms attract high-quality employees.

The rest of the paper is organised as follows. We next present the literature and discuss the hypotheses. The third section presents the methodology, sample selection and empirical design. The results section discusses the main findings, additional analyses and robustness tests. The final section concludes the paper.

Related Literature and Hypotheses Development

Toxic Chemicals Release

Firms are shifting their focus to the triple bottom line (i.e. social, environmental and financial) and engaging in environmentally friendly behaviours by reducing TCR for several reasons. First, there has been pressure from media and environmental agencies on policymakers since big corporations such as the Pacific Gas and Electric Company and DuPont unethically discarded toxic chemicals into rivers, causing severe long-term and life-threatening diseases in the surrounding communities. Thus, policymakers are expected to monitor TCR by firms and formulate policies to promote environmentally friendly behaviour among corporations, thereby lowering overall climate risk. Second, by engaging in environmentally ethical behaviours, firms can lower the possibility of financial penalties from lawsuits and improve their overall reputation, leading to easy and cheap access to finance (Benlemlih et al., 2022; El Ghoul et al., 2018).

Firms that engage in environmentally friendly activities by reducing TCR affirm their commitment to the planet and people as well as stimulating the financial health of the firm. Prior research contends that EP is associated with firms' financial performance by providing a cushion against crises and lowering financial, regulatory and litigation risks associated with non-compliance and breaches (Benlemlih & Cai,

2020; Godfrey et al., 2009). For instance, Hamilton (1995) finds that the market penalises firms with excessive carbon emissions, while Connors et al. (2013) show that market reaction to changes in firms' emissions is dependent on the industry: increases in emissions in the chemical industry are penalised and decreases in the utility industry are rewarded through higher cumulative abnormal returns. In addition, firms with higher TCR are associated with a higher cost of equity (Connors & Gao, 2008), while environmentally sustainable firms enjoy greater tax savings (Benlemlih & Cai, 2020). Financial institutions incorporate carbon emissions into their credit assessment, thereby making lending expensive for firms with a high carbon footprint (Chen et al., 2021; Seltzer et al., 2022). Clarkson et al. (2011), King and Lenox (2001) and Konar and Cohen (2001) find that firms with sustainable environmental activities enjoy better financial performance. However, the effect of a firm's environmental practices on firm value is conditional on agency problems (Houqe et al., 2022). Benlemlih et al. (2022), Kanashiro (2020) and Kim et al. (2019) reveal that effective corporate governance mechanisms that inhibit agency problems and promote good environmental practices are associated with better EP.

Further, recent evidence shows that the demand for environmentally friendly stocks has increased owing to the associated low financial, regulatory and litigation risks (Dyck et al., 2019; Li et al., 2020). Consequently, investors are more likely to use the exit strategy (selling investments in high-polluting firms) and the selection strategy (buying investments in eco-friendly firms) to increase their portfolio value and reduce overall risk (Benlemlih et al., 2022). Prior research examining the determinants of TCR finds that they are driven by local institutional investors (Kim et al., 2019), business strategy (Magerakis & Habib, 2021), managerial ability (Sun, 2017), environmental rating (Chatterji & Toffel, 2010) and voluntary participation in environmental programmes (Bui & Kapon, 2012; Gamper-Rabindran, 2006; King & Lenox, 2000).

Corporate Culture and Ethics

There is no doubt that strong corporate culture fosters ethical decision-making in an organisation and promotes ethical policy formulation (Kim & Kim, 2010; Nwachukwu & Vitell, 1997). Whether a manager will act more or less ethically is dependent on the overall corporate culture. For instance, when managerial decision-making involves dubious situations such as product design that compromises quality for cost reduction, questionable working conditions that put the safety of employees at risk or business operations that increase profit but damage the environment, managers are likely to rely on the corporate culture to find the desirable and acceptable solution (Chen et al., 1997; Sinclair, 1993). Moreover, a corporate culture that discourages honest discussion allows unethical behaviours to fester. Thus, strong corporate culture plays a pivotal role as a control mechanism to shape managerial behaviour when encountering ethical dilemmas and to influence managerial decisions.

Wan et al. (2020) argue that managers in firms with strong cultural orientations tend to have long-term vision, uphold high ethical and moral standards and take responsibility for others and society. Consequently, such managers tend to avoid behaviours that do not meet those ethical or moral standards, such as polluting the environment (Koehn, 2005; Wan et al., 2020). Several studies have documented the consequences of firms' corporate culture. For example, prior studies have found that firms with strong corporate culture are associated with better firm performance (Guiso et al., 2015), increased resilience during crises (Li et al., 2021a), improved innovation (Wang et al., 2021), higher CSR performance (Erwin, 2011; Galbreath, 2010; Wan et al., 2020) and lower bank debt (Hasan, 2022). Our study examines the association between corporate culture and firms' EP.

Hypotheses Development

To explain the relationship between corporate culture and EP, we rely on three main arguments. First, according to legitimacy theory (Gray et al., 1995), organisations depend on society for resources and the licence to operate. Hence, firms have a social contract to operate within the perceived norms of society, and any breach of this social contract will damage firms' legitimacy and reputation, threatening their survival. Bansal and Roth (2000) reveal that firms that adopt environmental initiatives are motivated by the fact that their survival or existence depends on behaving ethically and complying with norms and regulations concerning the environment; therefore, legitimacy depends on the interaction between the organisation and the environment. Firms operate as economic and social institutions, so any departure from societal norms and values creates a legitimacy gap, which some managers tend to fill with either concealment or cloying apologies (Ashforth & Gibbs, 1990). A survey of executives shows that 83% of respondents consider corporate culture to be a source of trust (EY, 2020). Thus, firms that are keen on building trust and legitimising their existence as good corporate citizens are likely to promote green ethical practices, which are less harmful to the environment and society. Failure to meet this societal trust could threaten reputation and business operations and lead to financial penalties. Consequently, firms with a superior corporate culture tend to enhance their ethical legitimacy and reputation by releasing less or no toxic chemicals.

Second, related to the legitimacy theory, social norms theory prescribes that societies have norms and values that dictate appropriate behaviours for members of an entity

when they are faced with choices. Since these norms and values serve as social control mechanisms within an organisation, any deviations may result in 'punishment' (Elster, 1989; Guiso et al., 2015). Thus, a firm with a strong corporate culture may signal that it is willing to make responsible decisions by caring for the environment. Further, firms with a superior corporate culture are likely to draw attention from external stakeholders who set high expectations of acceptable behaviours to the extent that any deviation will result in boycotts and sanctions from these stakeholders (Guiso et al., 2015), thereby affecting firm value. As mentioned earlier, firms with a strong culture have high ethical and moral standards. Accordingly, such firms often have organisational goals that foster financial health and strategies that reduce environmentally polluting activities. Thus, taken together, firms with strong corporate cultures tend to satisfy the expectations of both internal and external stakeholders.

Third, based on signalling theory (Bhattacharya, 1979; Connelly et al., 2011; Spence, 1973), management can signal to investors the firm's commitment to protecting the environment by reducing TCR and the consequent reduction in the long-term health implications for humans. This can enhance a firm's corporate reputation and realise expected financial benefits in the long run (Flammer, 2021; Zerbini, 2017). Consequently, firms with a strong culture are likely to signal the ethical aspect of a business by adopting clean energy technologies to increase production efficiency, reduce harm to the environment and humans and meet investors' expectations (Andreou et al., 2022). Further, investors tend to consider eco-efficiency technologies as a signal of managerial altruism, consistent with the stakeholder maximisation hypothesis (Dutordoir et al., 2018).

Firms with weak corporate culture could also be associated with a lower level of TCR. For example, as reporting of TCR is mandated, rhetoric-based reporting (greenwashing) of environmental pollution is likely to increase (Erwin, 2011). Thus, similarly to earnings management, firms with weak corporate culture could find ways to under-report their TCR. However, such behaviour is unlikely to persist in the long term as currently there are more regulations and scrutiny by different stakeholder groups on reporting TCR. Moreover, Graham et al. (2022) suggest that strong corporate culture promotes ethical behaviour by discouraging short-termism.

It is therefore expected that firms with a strong corporate culture will exhibit greater environmental friendliness. From the above discussions, we expect that firms with a strong corporate culture will be more likely to be associated with higher EP. Therefore, we propose the following hypothesis:

H1 Strong corporate culture is positively associated with environmental performance.

To obtain a better understanding of corporate culture, we are also interested in the association between individual cultural dimensions and EP. It is difficult to establish a counterfactual argument against the positive association between a firm's overall strong corporate culture and EP. It can be argued that not all dimensions or orientations of corporate culture influence EP equally and positively; however, ethics is an integral part of each of these dimensions. Thus, one may contend that the impact of corporate culture on EP may vary depending on the dimension of corporate culture. In the management literature, there are various competing classifications of cultural dimensions or orientation. For instance, the competing value framework (CVF) broadly classifies corporate culture into an internal focus and an external focus (Cameron et al., 2006). A culture that has an internal focus consists of two dimensions, namely, collaborative culture and control culture. In contrast, a culture that has an external focus consists of creation culture and competition culture (Cameron et al., 2006; Fiordelisi & Ricci, 2014; Quinn & Rohrbaugh, 1983). We rely on the cultural dimensions (i.e. integrity, teamwork, innovation, respect, quality) used by Li et al. (2021a). Li et al. (2021a) draw on Guiso et al. (2015) and their work on cultural values widely mentioned by S&P 500 firms on their corporate websites. Such core values of a firm that are mentioned on firms' websites are more visible and better understood by various stakeholders compared with the CVF-based cultural orientations. Moreover, the cultural dimensions adopted by Li et al. (2021a) could be easily corroborated by stakeholders based on corporate actions and media coverage.

Innovation involves both process and product. Corporate culture that endorses ethical behaviour will engage in innovation that ensures the safety, privacy and wellbeing of both makers and users (Brusoni & Vaccaro, 2017; Häussermann & Schroth, 2020). Research contends that organisations' ethical culture promotes positive organisational outcomes (Riivari & Lämsä, 2014), such as green innovation. Green innovation is a strategy used to mitigate or avoid harm to the environment (Alyahya et al., 2023; Munerah et al., 2021). Innovation culture that promotes ethics tends to heavily invest in innovative processes and products that are more reliable, safe and environmentally friendly (Brusoni & Vaccaro, 2017; Häussermann & Schroth, 2020). Further, innovative firms are more likely to promote excellence and efficiency in the workplace and invest in better production processes (Li et al., 2021b). Such firms respond to the constantly changing business environment by adopting better technology (Li et al., 2021a) with lower emissions. Hence, firms with strong innovative culture may be associated with lower levels of TCR. However, firms with weak corporate

culture tend to engage in innovation that may encourage individuals to break boundaries and act unethically (Costa & Habib, 2023), and consequently, have low regard for the environment (i.e. lower EP). Further, Chu et al. (2023) find that top management relies on existing awards and advancements in green innovation as a justification for future less ethical decisions such as moral neglect of the environment. Moreover, an innovation culture may not be associated with TCR. This is likely to occur if investment in innovation is not directed towards actual reductions in TCR but rather towards improvements in general business processes. Thus, the impact of innovation culture on EP is an important empirical question.

Firms with quality culture tend to focus on ethical behaviours such as ensuring the safety of employees and the overall quality of products for customers. Strong corporate culture that promotes ethical values will endorse better product quality and higher safety by minimising the possibilities of any negative consequences to the user or society (Curlo, 1999; Marucheck et al., 2011). Moreover, demand for ethical products is on the rise (Crane, 2001). Thus, with the current surge in consumer awareness of environmentally friendly and energy-saving products, it is likely that firms with quality culture will be climate friendly. Further, firms with higher innovation and quality culture have the ability to meet customer preferences (Luo & Bhattacharya, 2006), which includes access to 'green products'. To achieve this, firms conveying ethical behaviour will take a long-term view by adopting eco-friendly business models that have lower long-term impacts on human health. To this end, we expect that firms with strong quality culture will be associated with lower EP.

Teamwork culture indicates employee involvement and employees are one of the key stakeholders of a firm. From the social identity theory perspective, employees prefer to be associated with socially responsible firms (Valentine & Fleischman, 2008), implying that teamwork culture enhances the EP of firms. Research also suggests that firms with a strong teamwork culture facilitate communication among employees, which increases productivity and production efficiency (Kosfeld & von Siemens, 2011). Corporate culture rooted in ethical values will foster teamwork with zero tolerance for wrongdoing (Smaili et al., 2023). Further, Peralta et al. (2021) find that team leaders' ethical predisposition (moral courage to go beyond compliance) enhances teamwork quality by signalling acceptable and undesirable behaviours in the team. This suggests that strong teams with high ethical standards would not only comply with acceptable levels of pollution but would implement ideas to significantly reduce pollution. In contrast, based on the social norms hypothesis, strong teamwork culture may have unintended negative consequences on firms' ethical behaviour (Liu et al., 2023; Reno et al., 1993). Prior studies show that managers recruit employees who share similar values as the firm as a way of developing a homogeneous culture in the firm (Van den Steen, 2005, 2010). Therefore, if the corporate culture is to reward employees for their loyalty to the team, this could incentivise participation in unethical behaviours perpetrated by a team-centred organisation (Liu et al., 2023; Singh, 2008). This suggests that stronger team-related culture is likely to be associated with higher levels of TCR. Taken together, the impact of teamwork culture on EP is unclear.

Integrity is closely linked with ethics, accountability, responsibility and safety (Li et al., 2021b). Therefore, it is expected that firms with stronger integrity culture will exhibit ethical standards, accountability and responsibility in their waste disposal, comply with any regulations governing the environment and ensure that their operations do not pose any safety concerns to the environment. Shu et al. (2018) find that corporate integrity improves the quality of internal control systems by encouraging firms to adhere to ethical principles. A culture of integrity helps top management not just be compliance-oriented (Verhezen, 2010) but rather, implement strategies aiming at actual reduction in environmental pollution. Such cultural norms help employees in making ethical decisions such as being environmentally friendly, implying that firms that exhibit integrity culture are likely to be associated with lower EP.

A cultural value of respect encompasses diversity, work-life balance, fairness in pay and promotion, and empowerment (Clarke, 2011; Emmott & Worman, 2008; Fleetwood, 2007; Lutgen-Sandvik et al., 2007). Thus, compared with other dimensions of corporate culture, respect may not have a direct impact on EP. However, corporate culture which spreads ethical values tends to respect and promote fairness and diversity. Prior studies document that firms respecting diversity have enhanced CSR performance (Emmott & Worman, 2008; Harjoto et al., 2015) and better financial reporting quality (Gull et al., 2018; Labelle et al., 2010) as such firms inhibit opportunistic behaviour. Further, people who respect laws and regulations are more likely to behave ethically and do the right thing (Price, 2008). Thus, firms with respect culture are likely to respect the environment and therefore be associated with lower pollution.

From the above discussion, we expect that different corporate culture dimensions may have different impacts on EP. Therefore, we hypothesise the following:

H2 The positive association between strong corporate culture and environmental performance is dependent on the dimension of corporate culture.

Table 1 Industry distribution

Code	Industry	N	%
1–14	Agriculture and mining	343	4.76
15–17	Building construction	57	0.79
20–21	Food and kindred products	403	5.60
22–23	Textile mill products and apparels	36	0.50
24–27	Lumber, furniture, paper and printing	582	8.08
28–30	Chemical, petroleum, rubber and allied products	1457	20.24
31–34	Metal	746	10.36
35–39	Machinery, electrical, computer equipment	3186	44.26
40–47	Railroad and other transportation	48	0.67
50–52	Wholesale goods, building materials	234	3.25
53–59	Store merchandise, auto dealers, home furniture stores	16	0.22
70–79	Business services	31	0.43
80–99	Other	60	0.83
	Total	**7199**	**100.00**

This table reports the sample breakdown by industry

Research Design

Data and Sample Selection

We retrieve TRI data from the EPA website.[3] Since 1987, US establishments have been mandated to report annual amounts of each chemical emission and manage these through recycling, energy recovery and treatments. We use a text-based measure of firm-level corporate culture developed by Li et al. (2021a).[4] This measure uses cultural value-related words and phrases in earnings call transcripts. We obtain firm financial data from Compustat and firm governance data from Board Analysts. Firms' institutional ownership data are extracted from Thomson Reuters, while demographic data are collected from the US Census Bureau. Other variables are obtained from publicly available sources.

Our sample period is 2002 to 2018 because the corporate culture data are available for this period. This also allows us to accommodate the calculation of lag variables. We sum the total amount of chemical releases for all plant-level TRI to obtain the parent-level TRI, which is merged with parent-level Compustat financial data. This process results in an initial sample of 16,400 firm-year observations. Our final sample consists of 7,199 firm-year observations excluding financial institutions (SIC 60–69), regulated industries (SIC 48–49) and missing firm-year observations. Table 1, Panel A shows that our sample observations come from a wide range of industries, with two-digit SIC codes 35–39 (44.26%) and 28–30 (20.24%) having the largest industry representation.

[3] https://www.epa.gov/toxics-release-inventory-tri-program.

[4] We thank Professor Kai Li for sharing the corporate culture data with us.

Regression Model

We develop the following regression model to test our hypotheses by including widely used control variables in the TCR literature (Benlemlih et al., 2022; Magerakis & Habib, 2021; Ott & Schiemann, 2022).

$$\begin{aligned} TC_{i,t} = {} & \beta_0 + \beta_1 Culture_{i,t} + \beta_2 Size_{i,t} + \beta_3 Lev_{i,t} \\ & + \beta_4 Roa_{i,t} + \beta_5 Mtb_{i,t} + \beta_6 Prod\_Vol_{i,t} \\ & + \beta_7 Ast\_Age_{i,t} + \beta_8 H\_Index_{i,t} + \beta_9 Div_{i,t} \\ & + \beta_{10} Share\_Rep_{i,t} + \beta_{11} Sales\_Grow_{i,t} \\ & + FixedEffects + \varepsilon_{i,t} \end{aligned} \quad (1)$$

Following prior studies (Chatterji & Toffel, 2010; Magerakis & Habib, 2021; Sun, 2017), the dependent variable TC is a proxy for EP and is measured in two measures: (i) Txc is the natural logarithm of the total amount of TRI's TCR (in pounds) and (ii) Txc_Wgt is weight-adjusted TCR scaled by total assets. Txc_Wgt accounts for variations in the level of toxicity of chemicals. The toxicity weights are based on human health problems related to long-term exposure to harmful chemicals and range from 0.02 to 1,400,000,000 for over 400 chemicals.

Corporate culture (Culture) is our variable of interest, which is defined as the weighted frequency count of words related to integrity, innovation, quality, respect and teamwork, scaled by the total number of words in firms' earnings call transcripts. According to Graham et al. (2022) and Guiso et al. (2015), corporate culture follows a top-down approach, with top management influencing and enforcing the shared values in the firm. If managers engage in actions that they promote, it is expected that their words in the earnings calls will reflect the shared values of the firm (Li et al., 2021a).

The corporate culture score created by Li et al. (2021a) uses extemporaneous question-and-answer segments of earnings calls rather than the management presentation segments, which are scripted, thereby reducing self-promotion. In the question-and-answer segments, managers are unlikely to have the chance to actively select discussion topics (Lee, 2016; Li et al., 2021a). Consequently, this measure is less likely to advertise certain values compared with firms' websites, press releases or annual reports, which are scripted to advertise values.[5] One of the major drawbacks of textual analysis, including the approach employed by Fiordelisi and Ricci (2014), is that it operates at the document level, and words are treated as independent tokens. Such approaches ignore the importance of tone (sentiment) and overlook the contextual meaning of words. Li et al. (2021a) overcome these limitations by training a neural network model to learn the contextual meaning of words and phrases. Finally, Li et al. (2021a) constructed corporate culture scores by assigning lower weights to more frequently occurring words and phrases and removing emotion-driven paragraphs (Larcker & Zakolyukina, 2012) from the transcripts to mitigate the concern that the culture score captures 'stated' value.

Our dependent and independent variables are contemporaneous (i.e. in year *t*) because although corporate culture may change, such change tends to be very slow. Once a corporate culture is formed, it is hard to change, especially when major changes tend to be challenging. Consequently, corporate culture has a propensity to be 'sticky' over time (Gorton & Zentefis, 2020; Kotter & Heskett, 1992). Based on prior studies (Chatterji & Toffel, 2010; Kong et al., 2020; Magerakis & Habib, 2021; Maniora, 2018; Sun, 2017), we control for a number of firm-level variables. Firm size, measured by the natural logarithm of total assets (Size), is expected to have a negative association with TCR (Chatterji & Toffel, 2010; Kong et al., 2020). Leverage (Lev), industry competition (H_Index), change in sales (Sales_Grow), cost of goods sold (Prod_Vol), non-current asset age (Ast_Age) and binary variable if a firm pays dividends (Div) are likely to have a positive association with TCR (Kong et al., 2020; Magerakis & Habib, 2021; Maniora, 2018; Sun, 2017). Profitability, measured by return on assets (Roa) and market-to-book ratio (Mtb), is likely to have a negative association with TCR (Kong et al., 2020; Magerakis & Habib, 2021; Maniora, 2018; Sun, 2017). Following Magerakis and Habib (2021), we do not predict any sign for share repurchases (Share_Rep). We winsorise all continuous variables at the 1st and 99th percentile to reduce the influence of outliers. Appendix A provides detailed variable definitions.

Empirical Results

Summary Statistics

Table 2, Panel A reports the descriptive statistics for the variables used in our main analysis. The mean (median) values of Txc and Txc_Wgt are 10.10 (10.63) and 11.75 (11.91), respectively. The reported mean and median values are comparable with those of Huang et al. (2019) and Magerakis and Habib (2021). The average (median) proportion of Culture is 4.53 (4.19). The average firm size in our sample is large (Size = 8.00), with strong growth opportunities (Mtb = 2.91) and positive mean profitability (Roa = 0.04). The leverage ratio is low (Lev = 0.27).

Table 2, Panel B presents the correlations between the variables. The two proxies for TCR are positively correlated with each other. Both TCR variables are significantly and negatively correlated with Culture. This indicates that strong corporate culture improves EP, in line with our expectations.

Regression Results: Corporate Culture and Environmental Performance

The regression result for our first hypothesis (H1) on the relationship between corporate culture and EP is reported in Table 3, Panel A. Columns (1) and (3) report the results for the dependent variables, Txc and Txc_Wgt, respectively, without any control variables. Columns (2) and (4) present the results with the control variables. The coefficient of Culture, our main variable of interest, is negative and significant at the 1% level in all four columns. This suggests that firms with a stronger corporate culture induce ethical behaviour by emitting lower amounts of toxic chemicals and therefore have better EP, consistent with our hypothesis. In terms of economic significance, the reported coefficient of Culture (column 2) suggests that a one standard deviation increase in Culture decreases Txc by 3.85% relative to its mean [(−0.208 (coefficient of Culture) × 1.87 (SD of Culture)/10.10 (mean of Txc)) × 100].[6] The mean TCR in our sample is 1,158,034 pounds (untabulated), translating into an average decrease in TCR of approximately 44,584 pounds—an economically significant decrease.

The coefficients of the control variables from the regression exhibit largely consistent signs and significance

[5] Firms are aware that the users of press releases and financial reports are increasingly utilising artificial intelligence; therefore, firms are scripting these documents by avoiding words that are considered negative by machine learning algorithms (Cao et al., 2020). This results in a limitation of textual analysis.

[6] Economic significance calculated from columns (2)–(4) suggests that a one standard deviation increase in Culture decreases Txc_Adj by 18.79% and Txc_Wgt by 6.02% relative to its mean, respectively.

Table 2 Summary statistics

Panel A. Descriptive statistics

Variables	N	Mean	Std. Dev	25%	Median	75%
Txc	7,199	10.10	3.76	8.13	10.63	12.61
Txc_Wgt	7,149	11.75	5.60	7.57	11.91	16.06
Culture	7,199	4.53	1.87	3.24	4.19	5.49
Size	7,199	8.00	1.58	6.88	7.90	9.04
Lev	7,199	0.27	0.17	0.15	0.25	0.36
Roa	7,199	0.04	0.08	0.02	0.05	0.08
Mtb	7,199	2.91	3.21	1.45	2.22	3.48
Prod_Vol	7,199	7.49	1.51	6.47	7.42	8.50
Ast_Age	7,199	0.49	0.14	0.39	0.47	0.57
H_Index	7,199	0.21	0.18	0.09	0.15	0.26
Div	7,199	0.69	0.46	0.00	1.00	1.00
Share_Rep	7,199	0.02	0.04	0.00	0.00	0.03
Sales_Grow	7,199	0.08	0.21	-0.02	0.06	0.15

Panel B. Correlation

Variables	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]
Txc [1]	1												
Txc_Wgt [2]	0.620***	1											
Culture [3]	−0.147***	−0.189***	1										
Size [4]	0.273***	−0.061***	0.033**	1									
Lev [5]	0.138***	0.034**	−0.035**	0.139***	1								
Roa [6]	0.003	−0.043***	−0.033**	0.166***	−0.225***	1							
Mtb [7]	−0.019	−0.080***	0.105***	0.098***	0.119***	0.243***	1						
Prod_Vol [8]	0.325***	0.027*	−0.022	0.895***	0.121***	0.146***	0.047***	1					
Ast_Age [9]	0.140***	0.051***	−0.097***	0.089***	0.161***	−0.031**	−0.059***	0.053***	1				
H_Index [10]	0.065***	0.074***	−0.017	−0.053***	0.038**	−0.027*	−0.012	0.031**	−0.035**	1			
Div [11]	0.177***	0.042***	−0.040***	0.325***	−0.054***	0.239***	0.089***	0.343***	−0.084***	0.050***	1		
Share_Rep [12]	−0.035**	−0.078***	0.059***	0.153***	−0.110***	0.352***	0.224***	0.122***	−0.139***	−0.022	0.078***	1	
Sales_Grow [13]	0.005	0.008	−0.011	−0.047***	−0.008	0.152***	0.032**	−0.048***	0.206***	−0.030*	−0.068***	−0.045***	1

Panel A of this table presents the descriptive statistics for the main regression variables. Panel B presents the correlation coefficients of the main regression variables. $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. Refer to Appendix A for variable definitions

Table 3 Baseline regression results: Corporate culture and environmental performance

Dependent variable	(1) Txc	(2) Txc	(3) Txc_Wgt	(4) Txc_Wgt
Panel A: Corporate culture score and environmental performance				
Culture	−0.278***	−0.208***	−0.484***	−0.378***
	[-5.35]	[−4.17]	[−6.46]	[−4.95]
Size	–	−0.149	–	−1.371***
		[−0.88]		[−4.90]
Lev	–	0.859	–	0.927
		[1.34]		[0.94]
Roa	–	−1.359	–	0.290
		[−1.45]		[0.22]
Mtb	–	−0.032	–	−0.041
		[−1.39]		[−1.20]
Prod_Vol	–	0.900***	–	1.532***
		[4.93]		[5.19]
Ast_Age	–	2.119***	–	1.855
		[2.73]		[1.52]
H_Index	–	0.429	–	2.071*
		[0.68]		[1.82]
Div	–	0.523**	–	0.669*
		[2.09]		[1.79]
Share_Rep	–	−2.293	–	−4.676
		[−1.05]		[−1.57]
Sales_Grow	–	0.394	–	0.103
		[1.59]		[0.28]
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Constant	13.089***	5.346***	15.518***	12.935***
	[10.65]	[3.50]	[9.95]	[5.84]
Observations	7,199	7,199	7,149	7,149
Adj. R-squared	0.11	0.23	0.13	0.17

Dependent variable	(1) Txc	(2) Txc_Wgt
Panel B: Strong corporate culture and environmental performance		
Strong_Culture	−0.752***	−1.159***
	[−4.12]	[−4.28]
Size	−0.169	−1.420***
	[−0.99]	[−5.11]
Lev	0.947	1.119
	[1.47]	[1.12]
Roa	−1.178	0.700
	[−1.26]	[0.52]
Mtb	−0.035	−0.049
	[−1.52]	[−1.42]
Prod_Vol	0.921***	1.584***
	[5.06]	[5.38]
Ast_Age	2.224***	2.077*
	[2.88]	[1.71]
H_Index	0.451	2.113*
	[0.72]	[1.86]

Table 3 (continued)

Dependent variable	(1) Txc	(2) Txc_Wgt
Div	0.538**	0.703*
	[2.13]	[1.87]
Share_Rep	−2.448	−4.982*
	[−1.11]	[−1.67]
Sales_Grow	0.395	0.098
	[1.58]	[0.26]
Industry	Yes	Yes
Year	Yes	Yes
Constant	4.647***	11.611***
	[3.10]	[5.40]
Observations	7,199	7,149
Adj. R-squared	0.22	0.17

This table reports the results from OLS regressions of the association between culture and environmental performance. Panel A uses Culture as a continuous variable while Panel B uses binary variable to capture strong versus weak corporate culture (Strong_Culture is coded 1 for strong and 0 for weak corporate culture). Robust t-statistics are in brackets and are based on standard errors that are clustered by firm. ***$p<0.01$, **$p<0.05$, *$p<0.10$. Refer to Appendix A for variable definitions

levels with those of the existing literature (Huang et al., 2019; Magerakis & Habib, 2021). Firms tend to be less environmentally friendly when they have higher production (Prod_Vol), own older property, plants and equipment (Ast_Age) and pay dividends (Div). The insignificant coefficients of Roa, Mtb, Lev and Share_Rep are consistent with the findings of Magerakis and Habib (2021). The highest variance inflation factor is 6.05 for firm size (Size), which is lower than the standard threshold of 10.00 (Andreou et al., 2020; Marquardt, 1970; Studenmund, 2016), thereby confirming that multicollinearity is not a concern in our model.

To corroborate our findings in Panel A, we follow Li et al., (2021a, 2021b) and create a binary variable that takes the value of 1 for strong corporate culture (Strong_Culture) if a firm in a given year has all five cultural values in the top quartile, and 0 otherwise. The result of this analysis is presented in Panel B of Table 3. The coefficients of Strong_Culture are negative and significant at the 1% level across both columns and support our results in Panel A. We conclude that firms with a strong corporate culture tend to have better EP.

Corporate Culture Components and Environmental Performance

The result related to H2 is reported in Table 4. Columns (1) and (2) use integrity, columns (3) and (4) use teamwork, columns (5) and (6) use respect, columns (7) and (8) use quality and columns (9) and (10) use innovation as explanatory variables. From columns (1) and (2), we provide some (weak) evidence that integrity culture marginally improves EP, while the other cultural values of teamwork, quality and innovation play a major role in reducing the emission of toxic chemicals. Although based on the prior literature, the cultural value of respect—which is characterised by diversity, fairness and empowerment—may not have a direct impact on TCR, our findings provide some evidence of a negative association. Also, prior studies provide evidence that employees are more motivated and exhibit a better work ethos if their beliefs match those of the firm (Henderson & Van den Steen, 2015). Thus, our findings could imply that employees—who are one of the key stakeholders of a firm—tend to be attracted to a company that respects the environment and empowers employees to make moral decisions involving the environment. The coefficients of Cultural_Dimension for quality have the greatest magnitude. The cultural dimension of quality captures value creation by implementing long-term goals and policies to improve process efficiency and enhance product quality, suggesting that firms with a stronger quality-focused culture tend to be more environmentally friendly.

Li et al. (2021b) and Hasan (2022) using the same culture variable as in this study also find insignificant coefficients of cultural dimension integrity in relation to their respective research questions. A plausible explanation for our weak result could be that our measure of integrity captures unethical behaviour, such as financial restatements, corporate financial misconduct or fraud related to options backdating, instead of ethical behaviour related to TCR. Some prior studies (Bao et al., 2023; Wan et al., 2020) show that corporate integrity culture enhances CSR or ESG performance. First,

Table 4 Corporate culture components and environmental performance

Cultural dimension and environmental performance										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Txc	Txc_Wgt	Txc	Txc_Wgt	Txc	Txc_Wgt	Txc	Txc_Wgt	Txc	Txc_Wgt
Dimension	Integrity		Teamwork		Respect		Quality		Innovation	
Culture_Dimension	−0.200	−0.505*	−0.411**	−0.994***	−0.301**	−0.276	−0.628***	−0.982***	−0.378***	−0.782***
	[−1.05]	[−1.66]	[−2.24]	[−3.67]	[−2.13]	[−1.20]	[−4.22]	[−4.02]	[−3.64]	[−5.02]
Size	−0.207	−1.474***	−0.180	−1.409***	−0.209	−1.486***	−0.228	−1.512***	−0.139	−1.333***
	[−1.21]	[−5.33]	[−1.06]	[−5.07]	[−1.22]	[−5.35]	[−1.35]	[−5.51]	[−0.80]	[−4.72]
Lev	1.052	1.262	0.973	1.076	1.016	1.259	0.896	1.042	0.974	1.109
	[1.63]	[1.26]	[1.52]	[1.08]	[1.58]	[1.26]	[1.41]	[1.05]	[1.51]	[1.12]
Roa	−0.955	0.969	−1.181	0.428	−1.013	1.042	−1.007	0.958	−1.071	0.756
	[−1.02]	[0.71]	[−1.26]	[0.32]	[−1.08]	[0.76]	[−1.09]	[0.71]	[−1.15]	[0.57]
Mtb	−0.041*	−0.058	−0.039*	−0.053	−0.040*	−0.057	−0.039*	−0.055	−0.031	−0.036
	[−1.74]	[−1.64]	[−1.68]	[−1.53]	[−1.71]	[−1.64]	[−1.65]	[−1.56]	[−1.32]	[−1.05]
Prod_Vol	0.963***	1.647***	0.939***	1.589***	0.951***	1.641***	0.956***	1.637***	0.900***	1.517***
	[5.27]	[5.58]	[5.14]	[5.37]	[5.20]	[5.55]	[5.28]	[5.59]	[4.88]	[5.12]
Ast_Age	2.343***	2.260*	2.354***	2.284*	2.332***	2.249*	2.267***	2.140*	1.976**	1.509
	[3.03]	[1.86]	[3.05]	[1.89]	[3.02]	[1.85]	[2.95]	[1.77]	[2.50]	[1.23]
H_Index	0.468	2.133*	0.443	2.073*	0.521	2.183*	0.407	2.031*	0.402	2.009*
	[0.73]	[1.85]	[0.70]	[1.82]	[0.81]	[1.89]	[0.64]	[1.79]	[0.64]	[1.78]
Div	0.559**	0.728*	0.532**	0.662*	0.564**	0.738*	0.514**	0.665*	0.555**	0.727*
	[2.20]	[1.93]	[2.10]	[1.76]	[2.22]	[1.95]	[2.05]	[1.77]	[2.20]	[1.93]
Share_Rep	−2.523	−5.113*	−2.643	−5.394*	−2.516	−5.077*	−2.338	−4.781	−2.104	−4.252
	[−1.15]	[−1.72]	[−1.21]	[−1.82]	[−1.15]	[−1.70]	[−1.07]	[−1.62]	[−0.96]	[−1.43]
Sales_Grow	0.340	0.017	0.394	0.147	0.356	0.031	0.367	0.044	0.351	0.034
	[1.36]	[0.05]	[1.59]	[0.39]	[1.43]	[0.08]	[1.48]	[0.12]	[1.41]	[0.09]
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	4.512***	11.476***	4.611***	11.712***	4.744***	11.578***	5.361***	12.742***	4.873***	12.179***
	[3.00]	[5.24]	[3.07]	[5.38]	[3.13]	[5.26]	[3.57]	[5.73]	[3.22]	[5.62]
Observations	7,199	7,149	7,199	7,149	7,199	7,149	7,199	7,149	7,199	7,149
Adj. R-squared	0.22	0.16	0.22	0.16	0.22	0.16	0.23	0.17	0.23	0.17

This table reports the results from OLS regressions of the association between cultural components and environmental performance. Reported results use individual cultural dimensions as an independent variable. Columns (1) to (2) use integrity, columns (3) to (4) use teamwork, columns (5) to (6) use respect, columns (7) to (8) use quality and columns (9) to (10) use innovation as explanatory variables. Robust t-statistics are in brackets and are based on standard errors that are clustered by firm. *** $p<0.01$, ** $p<0.05$, * $p<0.10$. Refer to Appendix A for variable definitions

CSR or ESG performance is usually developed based on some dichotomous score and covers social (i.e. charitable giving, support for housing and education, indigenous people relations etc.) and governance (board of directors, political accountability, internal control, public policy etc.) which are very different from our measure of TCR as highlighted earlier in our study. Moreover, several recent studies (Cao et al., 2022; Du, 2015; Sterbenk et al., 2022; Wu et al., 2020) document that such CSR or ESG activities are nothing but greenwashing (i.e. a marketing gimmick or stunt).

Second and most importantly, pollution reduction has become central to almost every business decision. For large organisations in particular, such decision-making authority is spread across various departments and levels of management. Therefore, the success of pollution reduction initiatives will depend on collaboration and coordination across different functional areas. Thus, integrity, which is an individual attribute is likely to have a latent impact on a firm's EP as opposed to teamwork. This explains why the level of significance for integrity and respect is lower than teamwork. Overall, our results are consistent with H2, which proposes that the positive association between corporate culture and EP is dependent on the dimension of corporate culture.

Moderating Role of Managerial Ability on Corporate Culture and Environmental Performance

We further examine the role of managerial ability in the relationship between culture and EP. According to Demerjian et al. (2012), managerial ability is defined as the talent or skill of top management to transform firms' resources such as capital, labour, inventory, fixed and intangible assets efficiently into revenue generation compared with industry peers. The key word in this definition proposed by Demerjian et al. (2012) is efficiency, which implies the manager's ability to minimise the resources utilised and maximise the revenue generated by using those resources. The prior literature documents that managerial ability and TCR are negatively related (Sun, 2017); thus, we expect that lower emission of TCR by firms with a strong corporate culture will be prominent for firms with more able managers. This is because competent managers are likely to better assess the business environment, fostering a stronger corporate culture and making the most effective decisions. Strong corporate culture is associated with managerial long-term orientation (Guiso et al., 2015; Li et al., 2021a) and more able managers are better at envisioning long-term goals. We rely on the managerial ability score developed by Demerjian et al. (2012)[7] to empirically test our prediction. Managerial ability is a score at the beginning of year *t*. We create a binary variable (Ability) that takes the value of 1 (top quartile) for high managerial ability, and 0 otherwise. We then interact Ability with Culture (Culture × Ability) as our variable of interest. In Table 5, the coefficient of Culture × Ability is negative and significant in both columns. This result indicates that managerial ability moderates the association between strong corporate culture and EP.

Table 5 Moderating role of managerial ability on corporate culture and environmental performance

	(1) Txc	(2) Txc_Wgt
Culture	−0.165***	−0.338***
	[−3.07]	[−4.16]
Ability	0.505	0.663
	[1.33]	[1.05]
Culture x Ability	−0.155**	−0.242**
	[−2.09]	[−1.97]
Size	−0.149	−1.304***
	[−0.88]	[−4.68]
Lev	0.712	0.757
	[1.12]	[0.77]
Roa	−1.377	0.435
	[−1.48]	[0.33]
Mtb	−0.030	−0.038
	[−1.33]	[−1.10]
Prod_Vol	0.923***	1.503***
	[5.11]	[5.10]
Ast_Age	2.045***	1.705
	[2.65]	[1.41]
H_Index	0.321	1.992*
	[0.51]	[1.73]
Div	0.505**	0.643*
	[2.03]	[1.73]
Share_Rep	−1.935	−4.592
	[−0.88]	[−1.54]
Sales_Grow	0.491**	0.226
	[2.02]	[0.61]
Industry	Yes	Yes
Year	Yes	Yes
Constant	5.162***	12.666***
	[3.37]	[5.72]
Observations	7,177	7,127
Adj. R-squared	0.23	0.17

This table reports the results from OLS regressions of the moderating role of managerial ability on the association between corporate culture and environmental performance. Ability is an indicator variable that takes the value of 1 (top quartile) for high managerial ability, and 0 otherwise Robust t-statistics are in brackets and are based on standard errors that are clustered by firm. ***$p<0.01$, **$p<0.05$, *$p<0.10$. Refer to Appendix A for variable definitions

Moderating Role of External Monitoring on Corporate Culture and Environmental Performance

Corporate culture complements the set of traditional control systems and is central to corporate governance, thereby enhancing internal controls, reducing managerial entrenchment and aligning managers' and shareholders' interests (Guiso et al., 2015; O'Reilly & Chatman, 1996). Although strong corporate culture mitigates agency problems, firms with strong corporate culture tend to be high-risk takers (Guiso et al., 2015; Li et al., 2021a) and therefore require external monitoring. Kim et al. (2019) document a negative association between institutional investors and TCR. This suggests that institutional shareholders have the ability to exert pressure on managers, influencing corporate decision-making (Amin et al., 2015). The authors argue from the delegated philanthropy theory perspective that firms tend to act in a socially responsible manner when stakeholders demand such behaviour from them. Therefore, we expect that the relationship between strong corporate culture and EP will be more prominent when external governance is strong. We

[7] Managerial ability data extracted from Peter Demerjian's website: https://peterdemerjian.weebly.com/managerialability.html.

Table 6 Moderating role of external monitoring on corporate culture and environmental performance

	(1) Txc	(2) Txc_Wgt
Culture	−0.237***	−0.385***
	[−3.92]	[−4.26]
Govern	0.690	1.298*
	[1.45]	[1.84]
Culture x Govern	−0.191**	−0.283**
	[−2.04]	[−2.10]
Size	−0.203	−1.348***
	[−1.11]	[−4.39]
Lev	0.955	0.828
	[1.44]	[0.77]
Roa	−2.462**	−0.736
	[−2.18]	[−0.43]
Mtb	−0.034	−0.042
	[−1.38]	[−1.11]
Prod_Vol	0.972***	1.583***
	[4.92]	[4.89]
Ast_Age	2.092***	1.942
	[2.67]	[1.52]
H_Index	0.178	2.577**
	[0.28]	[2.23]
Div	0.419*	0.529
	[1.65]	[1.33]
Share_Rep	−4.307*	−7.529**
	[−1.86]	[−2.26]
Sales_Grow	0.574**	0.519
	[2.05]	[1.18]
Industry	Yes	Yes
Year	Yes	Yes
Constant	5.117***	12.552***
	[2.79]	[5.38]
Observations	5619	5569
Adj. R-squared	0.26	0.19

This table reports the results from OLS regressions of the moderating role of external monitoring proxied by institutional ownership on the association between corporate culture and environmental performance. Govern is a binary variable coded 1 if the value of institutional investors is in the top quartile, and 0 otherwise Robust t-statistics are in brackets and are based on standard errors that are clustered by firm. ***$p<0.01$, **$p<0.05$, *$p<0.10$. Refer to Appendix A for variable definitions

use institutional ownership as a proxy for external governance. This is measured as the percentage of common shares held by institutional investors. We create a binary variable (Govern), coded as 1 if the value of institutional investors is in the top quartile, and 0 otherwise, and interact it with Culture. The result related to the moderating impact of external governance is reported in Table 6. We find that the coefficient of Culture × Govern is negative and significant in both columns, indicating that strong external monitoring by institutional investors moderates the association between corporate culture and EP.

Corporate Culture and Expected Versus Unexpected TCR

Toxic chemicals are harmful to the environment; however, their release cannot be ceased altogether due to the inherent nature of businesses. Thus, it may be considered unethical to emit toxic chemicals higher than the law allows. Ott and Schiemann (2022) broke down carbon emissions into expected and unexpected components. The expected component of carbon emission captures average carbon emissions resulting from the inherent nature of firms' business and operating environment. The unexpected component captures management efforts to implement strategies related to carbon management and control of carbon emissions. We follow Ott and Schiemann's (2022) methodology to break down total TCR into expected and unexpected components and explore the influence of strong corporate culture on these components. We expect that in a firm with strong corporate culture, management will induce higher ethical standards thereby reducing TCR to a lower level. If management puts in less effort to reduce TCR, a firm's actual levels of TCR will exceed the expected levels, and the unexpected levels will assume a positive value. We report the results of this analysis in Table 7 and find that strong corporate culture reduces both expected and unexpected TCR. The results for the unexpected component provide evidence that firms with strong corporate culture endorse ethical behaviour and exert greater ethical standards and efforts by lowering the unexpected component of TCR in addition to reducing the expected component. Therefore, we provide evidence that strong corporate culture improves overall ethical behaviour by reducing both the expected and unexpected TCR.

Corporate Culture and Environmental Performance: Robustness Tests

We first check the robustness of our results by controlling for additional firm-level variables. The results are presented in Table 8, Panel A. We include net CSR score (Csr_Net) as a control variable to proxy firm-level ethical behaviour (Erwin, 2011) in columns (1) and (2). We use the MSCI (formerly KLD) database to extract CSR-related strengths and concerns scores. Csr_Net is calculated as the difference between strengths and concerns. We observe that the coefficients of Culture remain negative and significant at 1% after controlling for Csr_Net. In columns (3) and (4), we include gross profit margin (Gross_Margin), asset intensity

Table 7 Corporate culture and expected versus unexpected TCR

	(1) Txc Expected	(2) Txc Unexpected	(3) Txc_Wgt Expected	(4) Txc_Wgt Unexpected
Culture	−0.162***	−0.074**	−0.256***	−0.123**
	[−5.25]	[−2.12]	[−5.19]	[−2.16]
Size	0.003	−0.172	−0.946***	−0.443**
	[0.03]	[−1.34]	[−5.86]	[−2.00]
Lev	−0.172	1.106***	−0.343	1.545**
	[−0.44]	[2.60]	[−0.55]	[2.09]
Roa	−3.289***	1.861***	−4.162***	4.265***
	[−5.03]	[2.78]	[−4.23]	[3.75]
Mtb	−0.007	−0.024	−0.009	−0.032
	[−0.54]	[−1.31]	[−0.44]	[−1.09]
Prod_Vol	0.822***	0.092	1.409***	0.133
	[7.04]	[0.71]	[7.77]	[0.60]
Ast_Age	2.494***	−0.618	3.925***	−2.026**
	[5.43]	[−1.14]	[4.77]	[−2.20]
H_Index	−0.059	0.436	0.492	1.369*
	[−0.14]	[0.90]	[0.67]	[1.76]
Div	0.190	0.371**	0.251	0.533*
	[1.27]	[2.05]	[1.08]	[1.82]
Share_Rep	−2.046	−0.661	−2.835	−1.965
	[−1.54]	[−0.42]	[−1.40]	[−0.92]
Sales_Grow	0.301*	0.143	−0.044	0.089
	[1.87]	[0.80]	[−0.17]	[0.30]
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Constant	5.860***	0.708	8.724***	2.810**
	[4.76]	[1.07]	[4.58]	[2.50]
Observations	7,048	7,048	7,046	7,046
Adj. R-squared	0.40	0.03	0.29	0.03

This table reports the results from OLS regressions of the association between corporate culture and expected versus unexpected TCR. Robust t-statistics are in brackets and are based on standard errors that are clustered by firm. ***$p<0.01$, **$p<0.05$, *$p<0.10$. Refer to Appendix A for variable definitions

(Ast_Int), operating income (Earnings) and capital expenditure intensity (Capx) in our model. Next, we control for firm-level corporate governance variables such as CEO tenure (Ceo_Ten), CEO duality (Ceo_Dual) and board independence (Board_Indp) in columns (5) and (6). Columns (7) and (8) include all the additional control variables. The coefficients of Culture are negative and significant across all the columns. Second, we add state-fixed effects to our model to control for state-level time-invariant heterogeneity. We report the results in Panel B. The coefficients of Culture continue to be negative and significant across all columns. Third, we use two alternative measures of the dependent variable. TxcAdj_Sale is measured as the total amount of TRI's TCR scaled by sales, while TxcW_Sale is the weight-adjusted TCR divided by sales. We present the results in Panel C. We find that the coefficient of Culture is significant and negative, consistent with our main findings.

We follow Li et al. (2021b) and group the five cultural values underlying a strong culture into people-oriented (a binary variable that takes the value of 1 if the sum of a firm's integrity, respect and teamwork score is in the top quartile across all firms in a year, denoting strong people-oriented culture, and 0 otherwise) and technology-oriented (a binary variable that takes the value of 1 if the sum of a firm's innovation and quality score is in the top quartile across all firms in a year, denoting a strong technology-oriented culture, and 0 otherwise). It can be argued that firms with a strong technology orientation are more innovative and therefore likely to invest in better, environmentally friendly technology, leading to lower TCR. Table 8, Panel D reports the results relating to strong people- and technology-oriented cultures. We show that both strong people-oriented culture and strong technology-oriented culture firms have better EP. However, the association between technology-oriented culture and EP is stronger based on the magnitude of the coefficients. Overall, our results are robust after controlling for additional firm-level variables, alternative model specifications and alternative proxies of EP.

Endogeneity Tests

A firm's corporate culture may be endogenous as stakeholders of a firm jointly determine its culture (Altamuro et al., 2022). Endogeneity could arise from reverse causality, omitted variable bias and self-selection bias. Thus, we address endogeneity concerns in our study in several ways. We use the two-step system generalised method of moments (GMM) approach (Arellano & Bover, 1995; Blundell & Bond, 1998) to mitigate endogeneity stemming from reverse causality or simultaneity (i.e. EP can influence firms' corporate culture). It is also possible that corporate culture is endogenously determined. The GMM approach mitigates such concerns. To validate the requirement that errors in levels should be serially uncorrelated, we expect AR1 (first-order serial correlation) to be significant but expect AR2 (second-order correlation in the first-differenced residuals) to be insignificant. The results of the two-step system GMM are presented in Panel A of Table 9. The coefficients of Culture are negative and significant in both columns, indicating that our baseline results are robust to endogeneity issues. The results also show that AR1 is statistically significant and AR2 is not significant. The Hansen J-statistics of over-identifying restrictions imply that the instruments are valid in the two-step system GMM estimation. Another approach to address simultaneity bias is to employ a lagged regression model. In

Table 8 Corporate culture and environmental performance: Robustness tests

Panel A. Additional control variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Txc	Txc_Wgt	Txc	Txc_Wgt	Txc	Txc_Wgt	Txc	Txc_Wgt
Culture	−0.235***	−0.433***	−0.126***	−0.294***	−0.258***	−0.466***	−0.137**	−0.373***
	[−3.88]	[−4.65]	[−2.61]	[−3.90]	[−3.35]	[−3.86]	[−1.97]	[−2.97]
Size	−0.099	−1.366***	0.642**	−0.321	−0.279	−1.716***	0.185	−1.066
	[−0.46]	[−3.93]	[2.08]	[−0.66]	[−1.15]	[−4.44]	[0.40]	[−1.40]
Lev	1.608**	1.224	0.984	0.952	2.351**	1.795	2.934***	1.858
	[2.05]	[0.98]	[1.57]	[0.96]	[2.47]	[1.13]	[2.97]	[1.13]
Roa	−0.320	1.448	1.740*	3.969***	−0.594	1.702	3.010*	5.107*
	[−0.27]	[0.78]	[1.77]	[2.58]	[−0.41]	[0.70]	[1.92]	[1.88]
Mtb	−0.058**	−0.040	−0.004	−0.007	−0.070**	−0.062	−0.076**	−0.036
	[−2.25]	[−0.97]	[−0.20]	[−0.20]	[−2.08]	[−1.20]	[−2.27]	[−0.68]
Prod_Vol	1.000***	1.736***	0.117	0.500	1.078***	1.961***	0.746	1.352*
	[4.47]	[4.72]	[0.35]	[0.99]	[4.18]	[4.67]	[1.60]	[1.71]
Ast_Age	1.749*	2.404	2.981***	2.418*	2.332*	3.242*	2.325	4.344**
	[1.83]	[1.62]	[3.33]	[1.72]	[1.89]	[1.80]	[1.65]	[2.01]
H_Index	0.359	2.585**	0.683	2.197*	0.287	2.694*	0.479	2.754*
	[0.52]	[1.98]	[1.08]	[1.91]	[0.35]	[1.86]	[0.56]	[1.81]
Div	0.502*	0.617	0.517**	0.683*	0.746**	0.913*	0.684**	0.881
	[1.79]	[1.41]	[2.16]	[1.84]	[2.28]	[1.73]	[2.35]	[1.64]
Share_Rep	−4.959**	−7.284**	−0.724	−2.639	−6.955**	−10.870**	−4.648*	−9.013**
	[−2.08]	[−2.06]	[−0.32]	[−0.87]	[−2.36]	[−2.42]	[−1.92]	[−2.03]
Sales_Grow	0.240	−0.031	0.585**	0.291	0.504	0.520	0.544	0.531
	[0.78]	[−0.06]	[2.40]	[0.78]	[1.17]	[0.75]	[1.45]	[0.75]
Csr_Net	−0.082*	−0.156**	–	–	–	–	−0.082*	−0.152*
	[−1.76]	[−2.00]					[−1.70]	[−1.72]
Gross_Margin	–	–	−3.131**	−4.525**	–	–	−0.569	−2.043
			[−2.21]	[−2.02]			[−0.29]	[−0.61]
Ast_Int	–	–	2.443***	2.147***	–	–	3.573***	3.112***
			[6.21]	[3.63]			[6.91]	[3.09]
Earnings	–	–	−0.000	−0.000	–	–	−0.000	0.000
			[−0.02]	[−0.33]			[−0.70]	[0.35]
Capx	–	–	0.436	−1.713	–	–	−6.105	−13.279
			[0.13]	[−0.34]			[−1.37]	[−1.50]
Ceo_Ten	–	–	–	–	0.030	−0.058	0.013	−0.066
					[1.01]	[−1.16]	[0.45]	[−1.32]
Ceo_Dual	–	–	–	–	−0.178	0.668	−0.185	0.681
					[−0.56]	[1.35]	[−0.67]	[1.36]
Board_Indp	–	–	–	–	0.991	3.377**	1.389	3.483**
					[0.74]	[2.08]	[1.09]	[2.03]
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	4.431**	9.810***	2.315	10.654***	1.889	9.534***	3.789*	6.199*
	[2.52]	[3.45]	[1.33]	[4.19]	[0.95]	[3.45]	[1.78]	[1.69]
Observations	5,270	5,220	7,199	7,149	3,014	2,997	2,916	2,899
Adj. R-squared	0.27	0.23	0.27	0.19	0.30	0.25	0.45	0.27

Table 8 (continued)

Panel B. State-fixed effect		
	(1)	(2)
	Txc	Txc_Wgt
Culture	−0.177***	−0.355***
	[−3.91]	[−4.82]
Size	0.014	−0.882***
	[0.08]	[−2.96]
Lev	0.699	−0.248
	[1.18]	[−0.26]
Roa	−1.412*	−0.566
	[−1.66]	[−0.46]
Mtb	−0.029	−0.033
	[−1.29]	[−0.97]
Prod_Vol	0.782***	1.161***
	[4.11]	[3.78]
Ast_Age	1.595**	0.896
	[2.08]	[0.76]
H_Index	−0.044	1.071
	[−0.06]	[0.89]
Div	0.416*	0.257
	[1.70]	[0.68]
Share_Rep	−2.345	−3.564
	[−1.20]	[−1.35]
Sales_Grow	0.371	0.297
	[1.47]	[0.84]
State	Yes	Yes
Industry	Yes	Yes
Year	Yes	Yes
Constant	4.970***	12.878***
	[3.25]	[5.77]
Observations	6,828	6,778
Adj. R−squared	0.31	0.28
Panel C. Alternative proxy for dependent variable		
	(1)	(2)
	TxcAdj_Sale	TxcW_Sale
Culture	−0.221***	−0.389***
	[−4.41]	[−5.08]
Size	−0.512***	−0.728**
	[−2.92]	[−2.57]
Lev	0.950	1.032
	[1.48]	[1.04]
Roa	−2.308**	−0.629
	[−2.49]	[−0.47]
Mtb	−0.038*	−0.049
	[−1.65]	[−1.42]
Prod_Vol	0.249	0.889***
	[1.33]	[2.98]
Ast_Age	2.352***	2.133*
	[3.01]	[1.74]

Table 8 (continued)

Panel C. Alternative proxy for dependent variable

	(1)	(2)
	TxcAdj_Sale	TxcW_Sale
H_Index	0.571	2.188*
	[0.90]	[1.93]
Div	0.530**	0.674*
	[2.11]	[1.80]
Share_Rep	−3.056	−5.475*
	[−1.38]	[−1.83]
Sales_Grow	0.376	0.071
	[1.51]	[0.19]
Industry	Yes	Yes
Year	Yes	Yes
Constant	5.237***	12.754***
	[3.40]	[5.72]
Observations	7,199	7,149
Adj. R-squared	0.16	0.16

Panel D. People and technology orientation and environmental performance

	(1)	(2)	(3)	(4)
	Txc	Txc	Txc_Wgt	Txc_Wgt
	People Oriented	Technology Oriented	People Oriented	Technology Oriented
Culture	−0.443***	−0.709***	−0.589**	−1.275***
	[−2.64]	[−3.73]	[−2.27]	[−4.42]
Size	−0.190	−0.181	−1.458***	−1.431***
	[−1.11]	[−1.05]	[−5.27]	[−5.11]
Lev	0.990	0.945	1.201	1.089
	[1.54]	[1.47]	[1.20]	[1.09]
Roa	−1.109	−1.080	0.860	0.793
	[−1.19]	[−1.16]	[0.64]	[0.59]
Mtb	−0.040*	−0.036	−0.057	−0.049
	[−1.71]	[−1.54]	[−1.63]	[−1.41]
Prod_Vol	0.942***	0.929***	1.622***	1.588***
	[5.17]	[5.07]	[5.50]	[5.36]
Ast_Age	2.343***	2.185***	2.256*	1.982
	[3.04]	[2.82]	[1.86]	[1.64]
H_Index	0.482	0.446	2.154*	2.094*
	[0.76]	[0.71]	[1.87]	[1.85]
Div	0.556**	0.544**	0.729*	0.707*
	[2.20]	[2.15]	[1.93]	[1.88]
Share_Rep	−2.596	−2.213	−5.193*	−4.515
	[−1.18]	[−1.00]	[−1.75]	[−1.51]
Sales_Grow	0.376	0.363	0.063	0.052
	[1.52]	[1.46]	[0.17]	[0.14]
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Constant	4.584***	4.620***	11.492***	11.613***
	[3.05]	[3.09]	[5.27]	[5.40]
Observations	7,199	7,199	7,149	7,149

Table 8 (continued)

Panel D. People and technology orientation and environmental performance				
	(1)	(2)	(3)	(4)
	Txc	Txc	Txc_Wgt	Txc_Wgt
	People Oriented	Technology Oriented	People Oriented	Technology Oriented
Adj. R-squared	0.22	0.22	0.16	0.16

This table reports the results from OLS regressions of the association between corporate culture and environmental performance. Panel A includes CSR score (Csr_Net), gross profit margin (Gross_Margin), asset intensity (Ast_Int), operating income (Earnings), intensity of capital expenditure (Capx), CEO tenure (Ceo_Ten), CEO duality (Ceo_Dual) and board independence (Board_Indp) as additional control variables. Panel B controls for state-fixed effect. Panel C uses two alternative measures of dependent variables. TxcAdj_Sale is measured as the total amount of TRI's TCR scaled by sales. TxcW_Sale is the weight-adjusted TCR divided by sales. Panel D reports results for subsamples based on People orientation and Technology orientation. People-oriented culture is a binary variable that takes the value of 1 if the sum of a firm's integrity, respect and teamwork score is in the top quartile across all firms in a year, and 0 otherwise. Technology-oriented culture is a binary variable that takes the value of 1 if the sum of a firm's innovation and quality score is in the top quartile across all firms in a year, and 0 otherwise. Robust t-statistics are in brackets and are based on standard errors that are clustered by firm. *** $p<0.01$, ** $p<0.05$, * $p<0.10$. Refer to Appendix A for variable definitions

our lagged model, the dependent variables are in year *t* while the independent and control variables are in year *t-1*. The results presented in both columns of Panel B, Table 9, show negative and significant coefficients of Culture.

Next, we address potential endogeneity concerns caused by omitted variable bias. It is not feasible to include all the possible variables in a model due to the unavailability or quantifiability of a number of potential variables. Thus, we conduct firm fixed-effect regression to address firm-specific time-invariant unobservable characteristics and change analysis. The results related to firm fixed effects and change analysis are reported in Table 9, Panels C and D, respectively. It is evident from Panels C and D that the coefficients of the independent variable, Culture, remain negative and significant, which is consistent with our main findings.

Next, we alleviate endogeneity arising from both omitted variable and reverse causality using the two-stage least squares (2SLS) instrumental variable approach. It is difficult to identify a suitable instrumental variable that is correlated with the independent variable (corporate culture) while not correlating with the error term for corporate culture. Based on the existing literature, we obtain an external instrumental variable for 2SLS that affects corporate culture but is not directly related to our dependent variable, TCR. Therefore, following prior studies (Costa & Habib, 2023; Ucar, 2019), we use the county-level federal arts grants (Art_Grant).[8] Arts grants are likely to improve local innovation and enhance regional creativity (Ucar, 2019). Therefore, firms located in regions where more federal arts grants are awarded will seek better and innovative solutions to problems that will improve the quality of products, services and overall business processes. This instrumental variable would be significantly correlated with a focal firm's culture but unlikely to be influenced by an individual firm's environmental policy, thereby satisfying both exclusion and relevance conditions. The result for the 2SLS approach is presented in Panel E of Table 9. Columns (1) and (3) in Panel E report the first-stage regression results while columns (2) and (4) report the second-stage regression results. The results in columns (1) and (3) show that the coefficients of Art_Grant are positive and significant at the 1% level, providing evidence of the validity of the instruments. The underidentification test statistic indicates that the instruments are relevant for the first-stage regression. The untabulated Hansen J-statistic indicates that our model is exactly identified. The Cragg–Donald Wald F-statistic is higher than the Stock–Yogo critical value of 16.38, suggesting that our analysis does not suffer from the weak identification problem. In columns (2) and (4), the coefficients of Culture are negative and significant. The results from the second stage are consistent with our baseline regression results reported in Table 3.[9]

Finally, we use entropy-balancing regression to address endogeneity stemming from self-selection bias. Entropy-balancing is a generalised multivariate score weighting method that addresses the endogeneity problem arising from observable (instead of unobservable) differences in firm-level characteristics between firms with strong corporate culture compared with firms with weak corporate culture. Therefore, this approach corrects endogeneity arising from self-selection resulting

[8] Data are collected from The National Endowment for the Arts website: https://apps.nea.gov/grantsearch/

[9] Based on prior studies (Hasan, 2022; Jiang et al., 2019), we also use the state-level tightness–looseness index (Tightness_Index) as an instrument. The untabulated results from the second stage are consistent with our baseline regression results reported in Table 3.

Table 9 Endogeneity tests

Panel A: Two-step system GMM regression results		
	(1)	(2)
	Txc	Txc_Wgt
Culture	−0.187***	−0.245**
	[−2.96]	[−2.46]
Txc_Lag	0.768***	–
	[15.09]	
Txc_Wgt_lag	–	0.660***
		[13.23]
Control variables	Yes	Yes
Industry	Yes	Yes
Year	Yes	Yes
Constant	5.823***	10.296***
	[2.69]	[2.76]
Observations	5,441	5,407
AR1	−8.15***	−9.22***
	(0.00)	(0.00)
AR2	0.25	0.55
	(0.80)	(0.58)
Hansen J-statistics	35.46	43.07
	(0.87)	(0.60)
Panel B. Lagged regression model		
	(1)	(2)
	$Txc\_F_{(t)}$	$Txc\_Wgt\_F_{(t)}$
$Culture_{(t-1)}$	−0.216***	−0.376***
	[−4.24]	[−4.70]
$Control\ variables_{(t-1)}$	Yes	Yes
Industry	Yes	Yes
Year	Yes	Yes
Constant	5.724***	12.759***
	[3.98]	[5.68]
Observations	6,879	6,829
Adj. R-squared	0.23	0.17
Panel C: Firm fixed-effect regression		
	(1)	(2)
	Txc	Txc_Wgt
Culture	−0.045**	−0.091***
	[−2.00]	[−2.82]
Control variables	Yes	Yes
Firm	Yes	Yes
Industry	No	No
Year	Yes	Yes
Constant	6.656***	12.998***
	[7.48]	[7.51]
Observations	7,199	7,149
Adj. R-squared	0.07	0.07

Table 9 (continued)

Panel D: Change analysis		
	(1)	(2)
	ΔTxc	ΔTxc_Wgt
ΔCulture	−0.023**	−0.034**
	[−2.20]	[−2.27]
ΔControl variables	Yes	Yes
Industry	Yes	Yes
Year	Yes	Yes
Constant	−0.304	−0.445
	[−1.34]	[−0.93]
Observations	6,432	6,382
Adj. R-squared	0.01	0.01

Panel E: Two-stage-least-square (2SLS) regression results				
Dependent variables	(1)	(2)	(3)	(4)
	Culture	Txc	Culture	Txc_Wgt
	1st Stage	2nd Stage	1st Stage	2nd Stage
Art_Grant	0.000***	–	0.000***	–
	[3.77]		[3.83]	
Culture	–	−1.138*	–	−1.655**
		[−1.81]		[−1.96]
Control variables	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Constant	4.008***	6.451**	3.963***	15.313***
	[9.14]	[2.11]	[9.03]	[3.68]
Underidentification test:		–		–
Kleibergen-Paap rk LM statistic	11.96		12.29	
p	0.001	–	0.001	–
Weak identification test:		–		–
Cragg-Donald Wald F-statistic	72.17		74.54	
Stock-Yogo (2005) 10% maximal IV size (critical value)	16.38	–	16.38	–
Observations	4519	4519	4488	4488

Panel F: Entropy-balanced matching analysis

F.1: Covariates matching

Variables	Treatment variable: Culture								
	Treatment (Culture_D = 1)			Control (Culture_D = 0)			Control (Culture_D = 0)		
				before matching			after matching		
	Mean	Variance	Skewness	Mean	Variance	Skewness	Mean	Variance	Skewness
Size	8.07	2.87	−0.01	7.93	2.13	0.26	8.07	2.87	−0.01
Lev	0.26	0.03	0.71	0.27	0.03	0.83	0.26	0.03	0.71
Roa	0.04	0.01	−2.01	0.04	0.01	−1.76	0.04	0.01	−2.01
Mtb	3.18	11.08	2.47	2.64	9.44	2.58	3.18	11.08	2.47
Prod_Vol	7.47	2.50	−0.12	7.51	2.07	0.23	7.47	2.50	−0.12
Ast_Age	0.48	0.02	0.63	0.50	0.02	0.60	0.48	0.02	0.63
H_Index	0.20	0.03	2.10	0.21	0.03	2.23	0.20	0.03	2.10

Table 9 (continued)

Panel F: Entropy-balanced matching analysis									
F.1: Covariates matching									
Variables	Treatment variable: Culture								
	Treatment (Culture_D = 1)			Control (Culture_D = 0)			Control (Culture_D = 0)		
				before matching			after matching		
	Mean	Variance	Skewness	Mean	Variance	Skewness	Mean	Variance	Skewness
Div	0.67	0.22	−0.73	0.71	0.21	−0.92	0.67	0.22	−0.73
Share_Rep	0.02	0.00	1.09	0.02	0.00	0.56	0.02	0.00	1.08
Sales_Grow	0.08	0.04	1.86	0.08	0.05	1.53	0.08	0.04	1.86

F.2. Entropy-balanced regression result		
	(1)	(2)
	Txc	Txc_Wgt
Culture	−0.210***	−0.341***
	[−4.19]	[−4.44]
Control variables	Yes	Yes
Industry	Yes	Yes
Year	Yes	Yes
Constant	5.611***	13.889***
	[3.38]	[5.95]
Observations	7,199	7,149
Adj. R-squared	0.22	0.18

This table reports results related to endogeneity tests. Panel A reports the two-step system GMM results of the association between corporate culture and environmental performance. Robust z-statistics are in brackets and are based on standard errors that are clustered by firm. Panels B, C and D report lagged regression model, firm fixed-effect regression results and change analysis, respectively. Robust t-statistics are in brackets and are based on standard errors that are clustered by firm. Panel E reports two-stage-least-square (2SLS) regression results using county-level arts grants (Art_Grant) as instrumental variable. Robust t-statistics (for first stage) and z-statistics (for second stage) are in brackets and are based on standard errors that are clustered by firm. Panel F reports the results of the entropy-balanced matching test. Sub-Panel F.1 reports the covariates matching while F.2 reports the regression results. Robust t-statistics are in brackets and are based on standard errors that are clustered by firm. ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$. Refer to Appendix A for variable definitions

from firm-level observable characteristics. It achieves this by considering a large number of variables that are likely to impact treatment firms differently than control firms. To deploy entropy-balancing, a specified set of covariates is matched between treatment and control sample groups based on the balance conditions (i.e. mean, variance and skewness) and a tolerance threshold (McMullin & Schonberger, 2020). We execute the entropy-balancing test in a three-step process. First, we divide our sample into two subsamples by creating a binary variable, Culture_D. Culture_D takes the value of 1, which is our treatment subsample, if the value of Culture is above the median corporate culture value, and 0, which is our control subsample, if the value of Culture is below the median corporate culture value. Second, we use the entropy-balancing technique to confirm that the balance conditions (i.e. mean, variance and skewness) between the treatment and control subsample are similar. The results reported in Panel F.1 of Table 9 indicate that by using the entropy-balancing technique, our desirable covariate balance has been achieved. Our third and last step in the implementation of the entropy-balancing technique involves executing the baseline pooled regression model by combining the matched pairs generated from the previous step. Panel F.2 of Table 9 presents the entropy-balanced regression results generated by executing the final step of the process. The results show that the coefficient of Culture is negative and significant at the 1% level in all columns. The findings of the entropy-balance approach confirm that our empirical results are robust to any potential endogeneity concerns stemming from observable factors instead of any unobservable

Table 10 Economic consequence of corporate culture and environmental performance

	(1)	(2)
Dependent Variable	$TobinQ_{t+1}$	$TobinQ_{t+1}$
Environmental Performance (Env_Perf)	Txc	Txc_Wgt
Strong_Culture	−0.028	−0.071**
	[−0.91]	[−2.28]
Env_Perf	0.118***	0.076*
	[2.60]	[1.73]
Strong_Culture x Env_Perf	0.154**	0.235***
	[2.21]	[3.50]
Size	−0.017	−0.030**
	[−1.27]	[−2.17]
Lev	−0.475***	−0.528***
	[−3.05]	[−3.40]
Mtb	0.117***	0.118***
	[11.32]	[11.59]
Capx	0.521	0.343
	[1.15]	[0.76]
Risk	−2.201***	−2.190***
	[−6.52]	[−6.63]
Sales_Grow	0.057	0.079*
	[1.39]	[1.85]
Industry	Yes	Yes
Year	Yes	Yes
Constant	1.494***	1.651***
	[8.63]	[9.10]
Observations	6,211	6,161
Adj. R-squared	0.37	0.36

This table reports the results from OLS regressions of strong corporate culture and environmental performance on firm performance. Strong_culture is an indicator variable that takes the value of 1 (top quartile) if a firm in a given year has all five cultural values in the top quartile, and 0 otherwise. Env_Perf is a binary variable that takes the value of 1 for being environmentally friendly, i.e. the amount of toxic chemicals release is in the bottom quartile, and 0 otherwise. Robust t-statistics are in brackets and are based on standard errors that are clustered by firm. ***$p<0.01$, **$p<0.05$, *$p<0.10$. Refer to Appendix A for variable definitions

factors. Overall, based on the reported results related to endogeneity concerns, we conclude that our results remain robust and are not sensitive to endogeneity problems.

For H2, we have performed all the above-mentioned endogeneity tests (i.e. GMM, lagged regression model, firm fixed effect, change analysis and entropy-balanced regression) for each of the cultural dimensions (integrity, teamwork, respect, quality and innovation). For 2SLS, we use Art_Grant as an instrument for cultural dimensions, quality and innovation, as theoretically, it is difficult to establish a relation between Art_Grant and the remaining cultural dimensions, integrity, teamwork and respect. For brevity, we report the results in Appendix B. The results are consistent with the regression results reported in Table 4; therefore, we conclude that our results remain robust and are not sensitive to endogeneity problems.

Economic Consequences of Corporate Culture and Environmental Performance

As discussed earlier, strong corporate culture induces positive outcomes, such as enhanced organisational productivity, firm value, employment relations, the ability to attract quality talent (Guiso et al., 2015; Li et al., 2021a; O'Reilly & Chatman, 1996) and long-term orientation through high investment in R&D (Li et al., 2021a). Therefore, strong corporate culture should enhance firm performance. The prior literature documents that EP is associated with firms' financial performance by cushioning against crises (Benlemlih & Cai, 2020; Godfrey et al., 2009), while Hamilton (1995) shows that the market penalises firms with excessive carbon emissions. Thus, we are interested in unearthing the joint economic consequences of strong corporate culture and EP. The regression results are reported in Table 10. The dependent variable, firm performance, is measured using Tobin's Q (TobinQ) in year $t+1$. We create a binary variable that takes the value of 1 for being environmentally friendly (Env_Perf) (i.e. the amount of TCR is in the bottom quartile), and 0 otherwise. We are interested in the interaction term, Strong_Culture × Env_Perf. Column (1) shows that the coefficient of Strong_Culture × Env_Perf is positive and significant (coefficient 0.154; $p<0.05$), indicating that strong corporate culture and better EP lead to enhanced firm performance. We find consistent results, as shown in column (2). Based on our empirical findings, we conclude that corporate culture has a positive economic impact on firms' financial performance through its beneficial effect on TCR. This finding supports our argument on signalling theory in H1 that managers of strong corporate culture can signal to investors their commitment towards EP by reducing TCR. This can enhance a firm's financial performance in the long run.

Conclusion

In this study, we examine the impact of firm culture on EP. From a sample of 7,199 firm-year observations over the period of 2002–2018, we provide evidence that strong corporate culture is associated with better EP. The results are both statistically and economically significant. We also find that the cultural norms of innovation, quality and teamwork improve EP. Managerial ability and institutional ownership play moderating roles in the association between strong

corporate culture and EP. Further, we explore the effect of corporate culture on the expected and unexpected components of TCR and find that managers in firms with strong corporate culture exert more effort to reduce the unexpected component of TCR in addition to reducing the expected component. Our results are robust to a battery of sensitivity analyses, including alternative measures of EP and corporate culture, controlling for additional variables, alternative model specification and several procedures to mitigate endogeneity problems and self-selection bias.

Our study contributes to the literature on both EP and corporate culture. We provide initial evidence on the effect of firm-level corporate culture on EP and contribute to ongoing research on firms' climate-related activities. To the extent that a firm's corporate culture is linked to its code of ethics, we contribute to the ethics literature by showing that a firm's environmental activities are based on its corporate culture. Finally, we introduce the breakdown of TCR into expected and unexpected components to highlight firms' application of ethical standards in reducing their overall TCR.

Despite these important contributions, our study has some limitations. First, only public firms report TCR to the EPA; therefore, our findings cannot be generalised to private firms. Future research can examine whether corporate culture differs between public and private firms or large and small firms and how this difference affects EP. Second, although we provide several procedures to mitigate selection bias, we cannot completely rule out its effect on our results since just like earnings management, firms may be able to come up with strategies to under-report TCR to EPA. Third is the measurement issue. The measure of corporate culture may not reflect the true shared culture in an organisation; instead, managers' choice of words could be only to 'advertise' certain values of the firm. The measure of integrity may not capture pollution-related issues. However, this is a common limitation of any text-based measure. Fourth, future research may consider exploring pollution-related misconduct (lawsuits, fines) which is beyond the scope of this current research. Even with these few limitations, our findings open avenues for future research to investigate other factors that might influence EP. Moreover, future research could also examine the moderating role of factors such as firm life cycle on the association between corporate culture and EP.

Appendix A

Variable	Abbreviation	Definition
Toxic chemical	Txc	Log of the total amount of TRI's toxic chemical releases (in pounds). It is measured at the parent company level
Toxicity-weighted chemical release	Txc_Wgt	Log of the total amount of toxicity-weighted chemical releases (in pounds) adjusted by total assets (AT). It is measured at the parent company level Log [(Total chemical release x Toxicity weights)/Total assets]
Corporate culture	Culture	Firm-level overall culture measured as the sum of weighted-frequency count of integrity, innovation, quality, respect and teamwork-related words in the QA section of earnings calls averaged over a 3-year window. Data developed by Li et al., (2021a, 2021b)
Size of firm	Size	Log of total assets (AT)
Leverage	Lev	Long-term liabilities (DLTT) plus current liabilities (DLC) divided by total assets (AT)
Return on assets	Roa	Income before extraordinary items (IB) divided by total assets (AT)
Market to book value	Mtb	Market value of common shares (CSHO)x(PRCC_F) scaled by the total book value of common shares (CEQ)
Production volume	Prod_Vol	Log of cost of goods sold (COGS)
Age of assets	Ast_Age	Net value of property, plant and equipment (PPENT) scaled by the gross value of property, plant and equity (PPEGT)
Herfindahl index	H_Index	The sum of squares of market shares of all firms in a specific industry (3-digit SIC)
Dividend payout	Div	A binary variable that equals one if dividend-paying (DVC + DVP > 0), and zero otherwise
Shares repurchase	Share_Rep	Share repurchases (PRSTKC) minus any reduction on the value of preferred stock outstanding (PSTKRV), divided by total assets (AT)
Sales growth	Sales_Grow	Annual growth in sales (SALE)
Capital expenditure	Capx	Capital expenditure (CAPX) scaled by total assets (AT)
Firm risk	Risk	Firm risk is calculated as the standard deviation of monthly share returns (CRSP)

Appendix B: Endogeneity Tests

Dimension	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Txc	Txc_Wgt	Txc	Txc_Wgt	Txc	Txc_Wgt	Txc	Txc_Wgt	Txc	Txc_Wgt
	Integrity		Teamwork		Respect		Quality		Innovation	
Panel A: Two-step system GMM regression results										
Culture	−0.296	−0.993*	−0.904**	−1.011	−0.546*	−0.498	−0.861***	−1.254***	−0.344***	−0.491**
	[−0.47]	[−1.85]	[−2.55]	[−1.54]	[−1.87]	[−0.94]	[−3.23]	[−3.18]	[−2.75]	[−2.19]
Txc_Lag	0.817***	–	0.787***	–	0.797***	–	0.766***	–	0.779***	–
	[16.09]		[15.57]		[15.74]		[15.75]		[15.77]	
Txc_Wgt_lag	–	0.803***	–	0.675***	–	0.682***	–	0.657***	–	0.662***
		[13.27]		[13.78]		[13.23]		[14.30]		[13.45]
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	3.273*	6.423**	4.757**	8.256**	4.620**	8.364**	4.937**	10.306***	4.478**	8.918**
	[1.66]	[2.30]	[2.46]	[2.38]	[2.23]	[2.12]	[2.49]	[2.96]	[2.34]	[2.57]
Observations	5,441	5,407	5,441	5,407	5,441	5,407	5,441	5,407	5,441	5,407
AR1	−8.15***	−8.00***	−8.12***	−9.13***	−8.29***	−9.05***	−8.17***	−9.48***	−8.16***	−9.27***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
AR2	0.53	0.53	0.46	0.56	0.32	0.38	0.19	0.53	0.12	0.42
	(0.59)	(0.59)	(0.64)	0.58	(0.75)	(0.71)	(0.85)	(0.60)	(0.90)	(0.68)
Hansen J-statistics	50.77	71.22	41.67	47.35	40.64	49.36	34.94	39.34	37.99	42.41
	(0.29)	(0.17)	(0.65)	(0.42)	(0.70)	(0.34)	0.88	(0.75)	(0.79)	(0.62)
Dimension	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$Txc\_F_{(t)}$	$Txc\_Wgt\_F_{(t)}$	$Txc\_F_{(t)}$	$Txc\_Wgt\_F_{(t)}$	$Txc\_F_{(t)}$	$Txc\_Wgt\_F_{(t)}$	$Txc\_F_{(t)}$	$Txc\_Wgt\_F_{(t)}$	$Txc\_F_{(t)}$	$Txc\_Wgt\_F_{(t)}$
	Integrity		Teamwork		Respect		Quality		Innovation	
Panel B: Lagged regression model										
$Culture_{(t-1)}$	−0.243	−0.526*	−0.407**	−1.047***	−0.282*	−0.165	−0.653***	−0.970***	−0.401***	−0.801***
	[−1.24]	[−1.65]	[−2.16]	[−3.77]	[−1.93]	[−0.69]	[−4.33]	[−3.80]	[−3.80]	[−4.98]
$Control\ variables_{(t-1)}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	4.847***	11.283***	4.936***	11.550***	5.050***	11.263***	5.689***	12.472***	5.246***	12.049***
	[3.40]	[5.09]	[3.48]	[5.24]	[3.53]	[5.04]	[3.98]	[5.50]	[3.69]	[5.50]
Observations	6,879	6,828	6,879	6,828	6,879	6,828	6,879	6,828	6,879	6,828
Adj. R-squared	0.22	0.16	0.22	0.16	0.22	0.16	0.23	0.16	0.23	0.17
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Txc	Txc_Wgt	Txc	Txc_Wgt	Txc	Txc_Wgt	Txc	Txc_Wgt	Txc	Txc_Wgt
	Integrity		Teamwork		Respect		Quality		Innovation	
Panel C: Firm fixed-effect regression										
Culture	0.006	−0.184**	−0.140*	−0.216**	−0.144**	−0.078	−0.084**	−0.101*	−0.064**	−0.162***
	[0.07]	[−2.09]	[−1.86]	[−2.38]	[−1.99]	[−0.81]	[−2.30]	[−1.68]	[−2.50]	[−3.87]

	(1) Txc	(2) Txc_Wgt	(3) Txc	(4) Txc_Wgt	(5) Txc	(6) Txc_Wgt	(7) Txc	(8) Txc_Wgt	(9) Txc	(10) Txc_Wgt
	Integrity		Teamwork		Respect		Quality		Innovation	
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	No	No	No	No	No	No	No	No	No	No
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	9.536***	17.570***	6.442***	17.293***	9.382***	17.570***	6.467***	12.752***	9.489***	17.381***
	[12.07]	[31.57]	[7.18]	[30.20]	[12.20]	[14.13]	[12.03]	[14.40]	[27.79]	[31.23]
Observations	7,199	7,149	7,199	7,149	7,199	7,149	7,199	7,149	7,199	7,149
Adj. R-squared	0.02	0.05	0.08	0.05	0.02	0.04	0.08	0.08	0.02	0.05
	(1) ΔTxc	(2) ΔTxc_Wgt	(3) ΔTxc	(4) ΔTxc_Wgt	(5) ΔTxc	(6) ΔTxc_Wgt	(7) ΔTxc	(8) ΔTxc_Wgt	(9) ΔTxc	(10) ΔTxc_Wgt
	Integrity		Teamwork		Respect		Quality		Innovation	
Panel D: Change analysis										
ΔCulture	0.017	−0.133**	−0.109***	−0.121**	−0.099***	−0.044	−0.071***	−0.108***	−0.069***	−0.075**
	[0.40]	[−2.18]	[−3.47]	[−2.38]	[−3.22]	[−0.93]	[−2.70]	[−2.64]	[−3.32]	[−2.41]
ΔControl variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.324	−0.466	−0.309	−0.458	−0.318	−0.434	−0.300	−0.441	−0.293	−0.425
	[−1.43]	[−0.97]	[−1.36]	[−0.97]	[−1.41]	[−0.91]	[−1.30]	[−0.94]	[−1.30]	[−0.88]
Observations	6,454	6,411	6,454	6,411	6,454	6,411	6,454	6,411	6,454	6,411
Adj. R-squared	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02

Dependent variables	(1) Quality	(2) Txc	(3) Quality	(4) Txc_Wgt	(5) Innovation	(6) Txc	(7) Innovation	(8) Txc_Wgt
	1st Stage	2nd Stage	1st Stage	2nd Stage	1st Stage	2nd Stage	1st Stage	2nd Stage
Panel E: Two-stage-least-square (2SLS) regression results								
Art_Grant	0.000***	–	0.000***	–	0.000***	–	0.000***	–
	[2.83]		[2.85]		[4.48]		[4.58]	
Culture	–	−4.414*	–	−6.410*	–	−2.107*	-	−3.057**
		[−1.75]		[−1.77]		[−1.78]		[−2.00]
Control variables	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
Constant	1.315***	7.687**	1.313***	17.108***	0.984***	3.962**	0.948***	11.656***
	[8.84]	[2.06]	[8.81]	[3.20]	[4.84]	[1.99]	[4.68]	[4.33]
Underidentification test:		–		–		–		–
Kleibergen-Paap rk LM statistic	7.18		7.27		15.78		16.32	
p	0.007	–	0.007	–	0.000	–	0.000	–

Dependent variables	(1) Quality	(2) Txc	(3) Quality	(4) Txc_Wgt	(5) Innovation	(6) Txc	(7) Innovation	(8) Txc_Wgt
	1st Stage	2nd Stage	1st Stage	2nd Stage	1st Stage	2nd Stage	1st Stage	2nd Stage
Weak identification test:		–		–		–		–
Cragg-Donald Wald F-statistic	45.25		45.89		88.98		92.79	
Stock-Yogo (2005) 10% maximal IV size (critical value)	16.38	–	16.38	–	16.38	–	16.38	–
Observations	4,519	4,519	4,488	4,488	4,519	4,519	4,488	4,488

Panel F: Entropy-balanced matching analysis

F.1: Covariates matching

Variables	Treatment variable: Integrity								
	Treatment (Integrity _D = 1)			Control (Integrity _D = 0) before matching			Control (Integrity _D = 0) after matching		
	Mean	Variance	Skewness	Mean	Variance	Skewness	Mean	Variance	Skewness
Size	8.13	2.81	0.02	7.87	2.17	0.18	8.13	2.81	0.02
Lev	0.27	0.03	0.79	0.26	0.03	0.76	0.27	0.03	0.79
Roa	0.04	0.01	−1.85	0.05	0.01	−1.98	0.04	0.01	−1.85
Mtb	2.93	11.14	2.36	2.89	9.52	2.70	2.93	11.14	2.36
Prod_Vol	7.60	2.53	−0.03	7.38	2.02	0.05	7.60	2.52	−0.03
Ast_Age	0.49	0.02	0.60	0.48	0.02	0.65	0.49	0.02	0.60
H_Index	0.20	0.03	2.21	0.21	0.03	2.13	0.20	0.03	2.21
Div	0.68	0.22	−0.80	0.70	0.21	−0.85	0.68	0.22	−0.80
Share_Rep	0.02	0.00	0.62	0.02	0.00	0.97	0.02	0.00	0.62
Sales_Grow	0.08	0.05	1.81	0.08	0.04	1.57	0.08	0.05	1.81
Variables	Treatment variable: Teamwork								
	Treatment (Teamwork_D = 1)			Control (Teamwork_D = 0) before matching			Control (Teamwork_D = 0) after matching		
	Mean	Variance	Skewness	Mean	Variance	Skewness	Mean	Variance	Skewness
Size	8.10	2.91	−0.01	7.90	2.09	0.24	8.10	2.91	−0.01
Lev	0.26	0.03	0.79	0.27	0.03	0.75	0.26	0.03	0.79
Roa	0.04	0.01	−1.90	0.05	0.01	−1.84	0.04	0.01	−1.90
Mtb	2.95	10.25	2.61	2.87	10.41	2.43	2.95	10.26	2.61
Prod_Vol	7.51	2.62	−0.09	7.46	1.95	0.19	7.51	2.62	−0.09
Ast_Age	0.50	0.02	0.53	0.48	0.02	0.72	0.50	0.02	0.54
H_Index	0.20	0.03	2.23	0.22	0.03	2.13	0.20	0.03	2.23
Div	0.66	0.22	−0.67	0.72	0.20	−0.99	0.66	0.22	−0.67
Share_Rep	0.02	0.00	0.44	0.02	0.00	1.18	0.02	0.00	0.44
Sales_Grow	0.09	0.05	1.78	0.07	0.04	1.49	0.09	0.05	1.78

Variables	Treatment variable: Respect								
	Treatment (Respect_D = 1)			Control (Respect_D = 0)			Control (Respect_D = 0)		
				before matching			after matching		
	Mean	Variance	Skewness	Mean	Variance	Skewness	Mean	Variance	Skewness
Size	7.97	2.79	0.06	8.03	2.22	0.21	7.97	2.79	0.06
Lev	0.26	0.03	0.71	0.27	0.03	0.82	0.26	0.03	0.71
Roa	0.04	0.01	−2.00	0.05	0.01	−1.73	0.04	0.01	−2.00
Mtb	2.96	9.40	2.55	2.86	11.26	2.49	2.96	9.40	2.55
Prod_Vol	7.44	2.49	−0.02	7.54	2.08	0.11	7.44	2.49	−0.02
Ast_Age	0.49	0.02	0.64	0.49	0.02	0.61	0.49	0.02	0.64
H_Index	0.21	0.03	2.14	0.20	0.03	2.20	0.21	0.03	2.14
Div	0.68	0.22	−0.78	0.70	0.21	−0.87	0.68	0.22	−0.78
Share_Rep	0.02	0.00	0.88	0.02	0.00	0.75	0.02	0.00	0.88
Sales_Grow	0.08	0.05	1.75	0.08	0.04	1.63	0.08	0.05	1.75
Variables	Treatment variable: Quality								
	Treatment (Quality_D = 1)			Control (Quality_D = 0)			Control (Quality_D = 0)		
				before matching			after matching		
	Mean	Variance	Skewness	Mean	Variance	Skewness	Mean	Variance	Skewness
Size	7.82	2.58	0.12	8.18	2.37	0.15	7.82	2.58	0.11
Lev	0.25	0.03	0.67	0.28	0.03	0.91	0.25	0.03	0.67
Roa	0.04	0.01	−1.95	0.04	0.01	−1.86	0.04	0.01	−1.95
Mtb	2.93	8.99	2.68	2.89	11.68	2.38	2.93	8.99	2.68
Prod_Vol	7.30	2.32	0.04	7.67	2.18	0.04	7.30	2.32	0.04
Ast_Age	0.48	0.02	0.62	0.50	0.02	0.61	0.48	0.02	0.62
H_Index	0.19	0.03	2.10	0.22	0.03	2.21	0.19	0.03	2.10
Div	0.65	0.23	−0.64	0.73	0.20	−1.03	0.65	0.23	−0.64
Share_Rep	0.02	0.00	1.12	0.02	0.00	0.50	0.02	0.00	1.12
Sales_Grow	0.08	0.04	1.65	0.08	0.05	1.74	0.08	0.04	1.65
Variables	Treatment variable: Innovation								
	Treatment (Innovation_D = 1)			Control (Innovation_D = 0)			Control (Innovation_D = 0)		
				before matching			after matching		
	Mean	Variance	Skewness	Mean	Variance	Skewness	Mean	Variance	Skewness
Size	8.17	2.72	−0.06	7.83	2.24	0.28	8.17	2.72	−0.06
Lev	0.26	0.03	0.66	0.27	0.03	0.85	0.26	0.03	0.66
Roa	0.05	0.01	−2.10	0.04	0.01	−1.75	0.05	0.01	−2.09
Mtb	3.34	11.82	2.46	2.48	8.48	2.55	3.34	11.82	2.46
Prod_Vol	7.56	2.34	−0.18	7.41	2.22	0.25	7.56	2.34	−0.19
Ast_Age	0.47	0.02	0.67	0.51	0.02	0.53	0.47	0.02	0.67
H_Index	0.20	0.03	2.06	0.21	0.03	2.24	0.20	0.03	2.06
Div	0.70	0.21	−0.87	0.68	0.22	−0.78	0.70	0.21	−0.87
Share_Rep	0.02	0.00	1.14	0.01	0.00	0.49	0.02	0.00	1.12
Sales_Grow	0.07	0.04	1.92	0.09	0.05	1.50	0.07	0.04	1.92

F.2. Entropy-balanced regression result

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Txc	Txc_Wgt	Txc	Txc_Wgt	Txc	Txc_Wgt	Txc	Txc_Wgt	Txc	Txc_Wgt
	Integrity		Teamwork		Respect		Quality		Innovation	
Culture	−0.177	−0.436	−0.425**	−0.842***	−0.301**	−0.254	−0.629***	−0.892***	−0.350***	−0.754***

F.2. Entropy-balanced regression result

	(1) Txc Integrity	(2) Txc_Wgt	(3) Txc Teamwork	(4) Txc_Wgt	(5) Txc Respect	(6) Txc_Wgt	(7) Txc Quality	(8) Txc_Wgt	(9) Txc Innovation	(10) Txc_Wgt
	[−0.94]	[−1.43]	[−2.30]	[−3.06]	[−2.15]	[−1.12]	[−4.07]	[−3.65]	[−3.27]	[−4.59]
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	4.742***	11.982***	5.376***	12.893***	5.009***	11.794***	5.512***	12.935***	5.173***	13.222***
	[3.28]	[5.53]	[3.42]	[5.84]	[3.16]	[5.37]	[3.36]	[5.43]	[3.42]	[5.68]
Observations	7,199	7,149	7,199	7,149	7,199	7,149	7,199	7,149	7,199	7,149
Adj. R-squared	0.22	0.17	0.22	0.18	0.22	0.16	0.23	0.17	0.23	0.17

This table reports results related to endogeneity tests. Panel A reports the two-step system GMM results of the association between corporate culture and environmental performance. Robust z-statistics are in brackets and are based on standard errors that are clustered by firm. Panels B, C and D report lagged regression model, firm fixed-effect regression results and change analysis, respectively. Robust t-statistics are in brackets and are based on standard errors that are clustered by firm. Panel E reports two-stage-least-square (2SLS) regression results using county-level arts grants (Art_Grants) as an instrumental variable. Robust t-statistics (for the first stage) and z-statistics (for the second stage) are in brackets and are based on standard errors that are clustered by firm. Panel F reports the results of the entropy-balanced matching test. Sub-Panel F.1 reports the covariates matching while F.2 reports the regression results. Robust t-statistics are in brackets and are based on standard errors that are clustered by firm. ***$p<0.01$, **$p<0.05$, *$p<0.10$. Refer to Appendix A for variable definitions.

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