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The Impact of Anti-Corruption Measures and Human Resource Effectiveness in Combating Corruption, and the Role of Corporate Social Responsibility Dimensions in Achieving Sustainable Development: An Applied Study Using Artificial Intelligence (Bayes' Theorem)

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ABSTRACT

To test the impact of anti-corruption measures, human resource effectiveness, and corporate social responsibility (CSR) on the sustainability of economic institutions. To test the study's hypotheses, we used data from 45 institutions listed on the Gulf and Iraqi stock exchanges, covering the period from 2014 to 2022. We applied the generalized method of moments (GMM) and Bayesian methods for a more thorough analysis of the results. The study revealed that human resource effectiveness—in terms of skills, training, and engagement—is a key factor in preventing manifestations of institutional corruption. Furthermore, it indicated that the systematic and sustainable implementation of CSR programs contributes to improving an organization's reputation, increasing employee retention, and optimizing performance—all of which directly enhance sustainability. This study uniquely tests the importance of human resource effectiveness and corporate social responsibility (including environmental, social, and governance aspects) in preventing corruption and achieving sustainability using artificial intelligence.

Keywords: Corruption, Human Resources, CSR, Sustainability, Bayesian Method

INTRODUCTION

Corporate sustainability is one of the most significant challenges facing businesses in the modern era, particularly amid increasing ethical, economic, and environmental pressures that compel organizations to adopt responsible and transparent practices to ensure their long-term viability and success (Al Asfour 2025). In this context, issues of administrative and financial corruption have emerged as major obstacles that undermine institutional effectiveness, waste resources, and erode community trust (Kamanzi & Shiimi 2022).

Similarly, human resources play a crucial role in anti-corruption efforts. An effective, well-trained, and professionally engaged workforce constitutes the first line of defense against unethical practices within organizations. Human resource effectiveness is a key determinant of the quality of the regulatory environment (Watkins et al. 2025) due to their role in policy implementation, law enforcement, and promoting ethical business behavior, integrity, and transparency.

Corruption remains one of the major global challenges (George et al. 2016). It represents a significant barrier to economic growth in many countries (Mauro 1995) and undermines proper government functioning (Treisman 2007). Widespread corruption can erode trust in societal institutions (Rothstein & Uslaner 2005). Although difficult to quantify precisely, the World Economic Forum (2018) estimates that over $1 trillion is paid annually in bribes, reducing global GDP by more than 5%. For companies operating internationally, corruption is reported to increase project costs by over 10% (Bray 2007).

Corporate social responsibility (CSR) is no longer a voluntary option but a strategic necessity for strengthening an organization's reputation and sustainability. Recent studies show that organizations integrating social and ethical dimensions into their operations exhibit better long-term performance and achieve higher sustainability levels.

Institutions form a fundamental pillar of any society's economic and social development, directly contributing to raising standards and quality of life. However, their performance is influenced by several factors, including administrative and financial corruption and human resource effectiveness. Corruption is recognized as a primary barrier to development, weakening institutional trust and reducing efficiency. Conversely, skilled and effective human resources play a vital role in enhancing institutional performance and achieving strategic objectives.

Theories Explaining Corruption, Human Resource Effectiveness, and Corporate Social Responsibility

Agency Theory

The pursuit of self-interest is often considered the primary cause of corruption in the public sector, but this oversimplifies the complex relationships between individuals and the state. Several theories help analyze these relationships; among the most prevalent in economic literature are the principal-agent model and the related agency problem (e.g., Klitgaard 1988; Shleifer & Vishny 1993). The principal-agent model assumes that agents (public officials) act to protect the interests of their principal (whether the public, parliament, or regulatory authorities).

However, in practice, the interests of agents often diverge from those of the principal. While the principal-agent model describes the rules of remuneration in the agent-principal relationship, there is an information asymmetry favoring the agent, which can be exploited to their advantage (Groenendijk 1997). In this context, the agency problem arises when agents engage in corrupt transactions, pursuing their own interests at the expense of the principal's interests. To mitigate this problem, managers can design incentives and programs (e.g., monitoring systems and interdependence mechanisms) to limit the risk of such violations by agents.

Agency theory advocates the creation of effective monitoring mechanisms to control agent behavior, thereby increasing management efficiency and reducing corruption risk.

Institutional Theory

To understand corruption, institutional theory provides a social context and an analytical framework for explaining how corruption can become entrenched within organizations, institutions, and society, even when anti-corruption mechanisms are in place (Luo 2005).

Institutional theory posits that corruption is influenced by the nature, design, and transparency of political systems and their institutions. It also recognizes the complex relationships between corruption, institutions, political systems, culture, and gender (Debski et al. 2018; Stensöta et al. 2015).

This approach aligns with the "institutional" perspective on political corruption developed by (Thompson 1995) and (Lessig 2018), which argues that corruption can manifest not only at the individual level but also as institutional corruption—where institutions deviate from their original purposes.

A notable example is private campaign financing in the United States, where candidates receive financial support from various private sources such as citizens, businesses, and cultural or religious groups (Ceva & Ferretti 2017). Once elected, politicians supported by such donors may propose regulations benefiting those donors, such as tax reductions in their operating regions.

This practice, marked by unlimited financial support and lack of transparency, is problematic. Even if individual actions are legal, private donations can foster political corruption. It can be argued that the democratic electoral system is compromised by the institutional practice of accepting private funds for election campaigns, making it dependent on the arbitrary influence of financial forces (Ceva & Ferretti 2017).

Social Network Theory

Research traditions on social networks culminated in a coherent theoretical framework in the 1960s. Several sociologists significantly enriched this approach by synthesizing and developing earlier theories to better understand formal and informal social relationships. For instance, the sociological perspective on social networks emphasizes structural properties such as the relative position of individual nodes within the network.

During this period, researchers developed social network analysis techniques, including block modeling and multidimensional analysis. Block modeling examines the specific position of a node within a social network, identifying nodes that occupy similar positions or are structurally equivalent. Multidimensional analysis transforms

social relationships into metric distances, thereby mapping these relationships in social space (Wasserman & Faust 1994).

Three key concepts have structured research on network effects: centrality, cohesion, and structural equivalence. Freeman (1979) proposed three distinct measures of structural centrality: degree, proximity, and mediation.

Herzberg's Theory (1959)

In their book *Motivation at Work*, Herzberg, Mausner, and Snyderman (1959) identified two sets of factors influencing job satisfaction: intrinsic motivators (such as recognition, achievement, and responsibility) and extrinsic motivators (such as working conditions and safety), which primarily affect the work environment.

These two factors can enhance human resource management effectiveness by optimizing working conditions and providing opportunities for advancement, thereby reducing frustrations that may lead to corruption.

This pioneering work also defined the concept of centrality and established methodologies for developing new network metrics, both at the individual node level and network-wide. Freeman's (1979) article further stimulated research into how different forms of network centrality affect information flows. For example, Borgatti (2005) simulation study classified flow processes and demonstrated that the values of different centrality measures depend on the characteristics of the process, such as rumor spreading versus the delivery of goods.

Organizational Commitment Theory (1991)

Developed by Meyer and Allen (1991), this theory posits that organizational commitment rests on three dimensions:

- Affective commitment: emotional attachment to the organization and its values.
- Continuity commitment: awareness of the costs associated with leaving the company or a lack of commitment.
- Normative commitment: a sense of moral obligation toward the organization.

LITERATURE REVIEW

The Impact of Anti-Corruption on the Sustainability of Economic Institutions

Corruption is one of the major challenges facing the global community (George et al. 2016). It constitutes a major obstacle to economic growth in many countries (Mauro 1995), undermines the proper functioning of governments (Treisman 2007), and when widespread, can erode trust in societal institutions (Rothstein & Uslaner 2005; Ramos et al. 2025). Although difficult to measure precisely, the World Economic Forum (2018) estimates that over US$1 trillion is paid annually in bribes and that corruption reduces global GDP by more than 5%.

For companies operating internationally, corruption significantly increases business costs. For example, one-third of international resource companies estimate that corruption raises the cost of international projects by more than 10 percent (Bray 2007). Furthermore, corruption can increase public procurement costs by up to 25 percent in some countries, while relocating a company from a low-corruption country to one with medium or high corruption is equivalent to imposing a 20 percent tax on foreign companies.

Consequently, significant efforts are underway to combat corruption. Intergovernmental organizations have developed international agreements like the OECD Convention against Bribery (1997). National governments have enacted anti-corruption laws, such as the U.S. Foreign Corrupt Practices Act (1977). Non-governmental organizations have also contributed, for instance, Transparency International created the Global Corruption Barometer (2018) to assess corruption levels worldwide and monitor progress in fighting it.

Businesses have increasingly taken steps to eliminate corruption by promoting responsible practices, launching anti-corruption programs, strengthening ethical and compliance policies (such as the ISO 37001 standard for anti-bribery management systems), and fostering a culture of compliance (Venkatesan & Benton 2018; Kwainoe & Boateng 2024).

Current research has mainly focused on corruption within governments (Rose-Ackerman & Palifka 2016). However, corruption often involves both public and private actors; many cases of government corruption involve companies offering illicit incentives or official interference, blurring the lines between government and the private sector (Andvig et al. 2001).

In many government corruption cases, companies are key players supplying corruption. For example, a company executive may pay bribes to public officials for favors, even if this harms other societal segments. Corruption can also occur entirely within companies without public official involvement; for instance, executives falsifying safety test results under performance pressure, receiving bribes to permit illegal betting in gambling, or paying bribes to banks for favorable loan decisions.

While corruption itself may not directly harm human life or the environment, its consequences can severely damage competitiveness and human development (Holmqvist et al. 2009).

In contrast, issues such as human rights or the fight against corruption are not easily generated but rather emerge from information and data similar to those related to the environment or health and safety (Wilkinson 2006).

Holmqvist et al. (2009) argued that business leaders operating in developing countries have long been concerned about the negative impact of corruption on their reputation. However, they are increasingly aware of the additional costs and risks they face, including:

- Operational costs: Corruption leads to additional expenses throughout a company's value chain, with current studies indicating that corruption increases the cost of doing business by more than 10% in many countries (Errath et al.2005).
- Legal risks: Business corruption can result in heavy fines and exclusion from future public procurement opportunities.
- Competitive risks: Companies that refuse to pay bribes risk being at a competitive disadvantage and losing market share to less ethical competitors willing to pay to influence public procurement.

Beyond its impact on businesses, corruption is a significant obstacle to social, political, and economic development (USAID 2005). It imposes substantial costs on society, including (Holmqvist et al. 2009):

- Reduced government services
- Slower economic growth
- Decreased trust in government
- Diminished legitimacy of the market economy and democratic institutions

In anthropology and sociology, researchers have shifted from viewing corrupt public officials as solely rational actors to understanding them as embedded within social and cultural systems. This approach emphasizes the importance of context in a deeper sense (Muir and Gupta 2018). The study of corruption thus becomes an interpretative exercise aimed at understanding the cultural patterns of actors and the social structures in which corruption manifests (Fisman and Miguel 2007).

Finally, in political science, corruption is linked to government and the abuse of power for personal gain. However, it is worth noting that corruption can also manifest at the institutional level: "Institutional corruption occurs when systematic, strategic, legal, or even moral influence undermines the effectiveness of an institution by diverting it from its mission or weakening its ability to achieve its purpose" (Lessig 2013). This broader conception of corruption includes the state's takeover of government entities by private companies, as observed in some countries, or simply the adoption by elites of laws that serve their interests while discouraging the majority of citizens, even if these laws are deemed acceptable by them.

Organizations, of course, do not act independently of the people who lead them. Managers are influenced by the social environment in which they operate, particularly by the institutional practices specific to their field. Institutional factors influence the interpretation of corrupt acts and define the boundaries between ethical and unethical behavior within organizations (Scott 2001). These factors can also be normalized when corruption is widely recognized. In contexts where corruption thrives, it can be particularly difficult to curb institutionalized corrupt practices: "When a practice is widely perceived as the norm, even severe sanctions may not change behavior. Managers' perception of corruption as the norm may lead them to believe such acts are less likely to be detected or punished" (Collins et al. 2009). This is one reason why relevant accounting professionals often fail to identify the vast levels of corruption.

From this perspective, corporate corruption is perpetrated by rational actors who engage in corrupt behavior due to the benefits they derive (Vogt 1997). These actors weigh the costs and benefits, the potential gains associated with acts of corruption, and the likelihood of being caught. At an extreme, this includes the perception of impunity and potential sanctions. The severity of these sanctions directly influences the gains an agent expects when deciding whether to engage in corrupt activities (Jeong & Weiner 2012). The size of the gain also affects the perceived attractiveness of corrupt behavior; for example, a large bribe is more tempting and increases the likelihood that an agent will act corruptly (Rabl & Kuhlmann 2008; Rabl 2011).

There is also evidence that corruption not only affects existing international companies but also plays a significant role in decisions regarding entry into new markets. When deciding to do business abroad, executives perceive corruption as an integral part of the game—a "pay-to-play" system or a "tax" factored into future plans (Jeong & Weiner 2012; Spencer & Gomez 2011). Rational analysis considers corruption an inherent cost of business activities, integrated into market entry decisions (Jensen, Li & Rahman 2010; Rose-Ackerman 1999).

However, unlike a tax, corruption presents additional complexity due to the secretive and illegal nature of corrupt acts (Shleifer & Vishny 1993). It can reduce the amount companies are willing to invest or the price they are prepared to pay for mergers and acquisitions abroad (Weitzel & Berns 2006).

While some societies manage to prevent corruption, others—lacking an effective bureaucracy and accountable institutions—may see corrupt practices flourish and become normalized over time. This process of institutionalization largely explains the difficulty in curbing corruption in regions where it has become widespread and accepted.

We conclude that corruption constitutes one of the main obstacles to economic development and institutional effectiveness. From this, our first hypothesis is as follows:

H1: There is a statistically significant relationship between an organization's anti-corruption policy and its sustainability.

Human Resource Effectiveness in Combating Corruption and Its Impact on Institutional Sustainability

Recruitment practices play a crucial role in building a skilled and ethical workforce aligned with an organization's values. According to Delery and Doty (1996), recruitment is a fundamental element of a strategic human resource management system and directly impacts organizational performance. Recruitment based on transparency, fairness, and competence fosters an ethical organizational culture.

Numerous empirical studies confirm that biased or nepotistic recruitment contributes to internal corruption. For example, Sartorova et al. (2022) found that non-merit-based recruitment systems in public institutions increase the risk of corrupt behavior.

Conversely, good recruitment practices—characterized by transparency, meritocracy, and integrity—reduce the likelihood of hiring individuals prone to deviant behavior. The World Bank (2019) emphasizes professionalizing human resources as a key structural lever to combat corruption in developing countries.

Human resource effectiveness is often evaluated by its ability to meet organizational goals, uphold professional ethics, and improve overall performance (Becker & Huselid 1998). When selected, trained, and managed appropriately, human resources become vital in promoting an anti-corruption culture (Transparency International 2021; Fazriyani et al. 2025).

Research shows a clear connection between quality human resource governance and organizational resilience to corruption (Mungiu-Pippidi 2015). Transparent, equitable, and participatory HR practices mitigate risks of nepotism, favoritism, and manipulation.

Paine (1994) distinguishes compliance-based control systems from values-based ones, with the latter proving more effective long-term, especially when integrated with ethical HR practices.

Consulting employees and unions in HR policy development fosters a culture of integrity essential for sustainable corruption prevention (Ashforth & Anand 2003; Kim & Wright 2020).

HR policies emphasizing organizational transparency and employee engagement build loyalty, trust, and ethical behavior (Zang & Guo 2022; Vian et al. 2022; Sertan et al. 2023, cited in Yusuf et al. 2024). Greater transparency strengthens employees' capacity to prevent corruption.

Reports like Transparency International UK's Impact 2023 highlight that motivation for ethical behavior depends on training and trust in systems, beyond formal codes of conduct. According to OECD (2025), 70% of member countries integrate HR management in national anti-corruption strategies, versus 44% in the private sector.

In conclusion, modern economic institutions must move beyond profit pursuit, embracing comprehensive development through effective human capital management and social/environmental commitments. Human resources are the institution's true capital, driving operations, service development, and innovation. Unlike physical capital, human capital's potential for growth is unlimited if managed wisely.

From this, we derive our second hypothesis:

H2 : There is a positive correlation between the effectiveness of human resource management in preventing corruption and the sustainability of economic institutions.

The Impact of the Relationship Between Environmental, Social, And Governance (ESG) Dimensions and Anti-Corruption Policies in Economic Institutions on Sustainability.

The Environmental Perspective

When an economic institution implements specific public policies and procedures to improve its anti-corruption index, it aims to strengthen its image, particularly in terms of transparency, integrity, and mutual respect among businesses, from two complementary perspectives: an ethical perspective and a governance perspective. Within this framework, we will examine the importance of environmental and social dimensions, as well as good governance within institutions. Leaders must commit to a corporate social responsibility approach to achieve anti-corruption goals—not to serve private interests, but to improve anti-corruption efforts and ensure the institution's sustainability in both the short and long term.

Environmental, health, and safety risks, along with risks related to civil liability and reputation, have a decisive impact on the competitiveness and sustainability of businesses (Aulia et al. 2025). Today, listed companies are

required to rigorously apply environmental and social management standards to comply with key international standards and principles.

Therefore, for energy companies, it is essential to consider potential environmental and social impacts when implementing their social responsibility practices. Energy companies face high risks of corruption, human rights violations, and health and safety hazards. They thus strive to meet high standards of social responsibility by prioritizing sustainable management practices and socially responsible activities (Chen et al. 2022). Key international standards addressing the social issues facing energy companies include the International Covenant on Civil and Political Rights; the United Nations Convention on Economic, Social and Cultural Rights; the United Nations Universal Declaration of Human Rights; the International Labour Organization Declaration on Fundamental Principles and Rights at Work; and the OECD Guidelines for Multinational Enterprises. Additionally, the ILO Tripartite Declaration on Multinational Enterprises and Social Policy; the United Nations Global Compact; the Global Reporting Initiative; the Council of Europe Social Charter; the UNCTAD Fair Trading Principles; the Multilateral Convention against Restrictive Trade Practices and its Chapter VI on combating corruption; the United Nations Convention against Corruption; among others.

Companies are increasingly integrating environmental protection into their sustainable development strategies, notably through practices such as:

Dual benchmarking, as demonstrated by the 2024 sustainability reports of Bolloré and Relyens, which align their environmental commitments with European ESRS standards. These initiatives also meet the requirements of the CSRD Directive, which came into force in January 2024 and requires companies with more than 250 employees to publish detailed information on their environmental, social, and governance (ESG) performance.

The Social Dimension

The success of institutions depends not only on an efficient market system, but also on a state that facilitates market activity and maintains order and stability. Since businesses benefit from the market system, and the normative justification for markets rests on their efficiency, they are obligated to act in ways that enhance market performance (Rose-Ackerman 2002).

Businesses, often a significant source of corruption, represent a major part of the problem and can benefit considerably from progress in solutions, particularly in terms of cost reduction, improved operational efficiency, and enhanced reputation. Therefore, the fight against corruption presents a major opportunity for strategic CSR programs to address a problem intrinsically linked to the interests of both businesses and society (Holmqvist et al. 2009).

Today, rejecting corruption is an integral part of any company's social responsibility. Corruption is considered incompatible with sustainable development because of the social, economic, and environmental damage it causes.

Guzman et al. (2006 : 739) state that "corporate social responsibility practices that establish anti-corruption standards hold promise for countering the frustrating persistence of corruption."

Williams (2004) argued that for the UN Global Compact to have a real impact, a Global Preparedness Initiative or similar body would be an essential complement. Isaksson and Steimle (2009) suggested that within a comprehensive approach to corporate social responsibility, aligning the Global Preparedness and Innovation Initiative guidelines with the principles of the UN Global Compact could be beneficial.

The original nine principles of the UN Global Compact cover topics such as human rights, labor, and the environment (UN Global Compact 2008a). A tenth principle, relating to the fight against corruption, was added in 2004, stipulating that "businesses must combat corruption in all its forms, including extortion and active bribery" (United Nations Congress 2008a).

The credibility of corporate social responsibility initiatives in the fight against corruption requires businesses to communicate and demonstrate greater transparency regarding their anti-corruption efforts to both internal and external stakeholders (Zhang et al. 2010).

The Governmental Perspective

The international business world faces major challenges in governance and ethical conduct, primarily due to widespread corruption scandals with profound economic and social repercussions. Researchers generally agree that corruption, which includes acts such as bribery, fraud, and embezzlement, is a harmful influence that hinders sustainable economic growth, disrupts market functioning, and undermines public trust (Rose-Ackerman & Palifka 2016). This unethical behavior not only erodes corporate integrity and reputation but also exacerbates inequality, deters foreign investment, and impedes the effective implementation of policies, thereby weakening the entire socio-economic fabric.

International organizations and national governments have collaborated to establish robust anti-corruption frameworks and regulatory systems to combat the serious consequences of corrupt activities. The United Nations Global Compact was established in 2009, with its anti-corruption components integrated into the initiative in 2016.

Two prominent examples of such frameworks are provided below. Both programs aim to encourage businesses to adopt proactive and socially responsible behaviors by promoting transparency and accountability.

Under the 1997 OECD Convention on Combating Bribery of Foreign Public Officials, member states are obligated to combat bribery of foreign public officials. This resolution underscores the importance of international cooperation in the global fight against corruption. The UK's Bribery Act of 2010 and the US Foreign Corrupt Practices Act of 1977 have profoundly influenced regulatory frameworks and compliance standards designed to deter bribery and promote ethical business practices across various sectors.

CSR committees are essential for integrating these frameworks within government institutions, ensuring that anti-corruption activities do not remain merely symbolic (Hess 2009). Several studies have examined the impact of anti-corruption efforts on the effectiveness of corporate governance in different contexts.

Claessens and Yurtoglu (2013) analyzed governance challenges in emerging markets and demonstrated that anti-corruption mechanisms significantly reduce conflicts of interest and improve governance by limiting opportunities for mismanagement, thereby encouraging investment in high-risk sectors. Hess (2009) emphasizes the importance of CSR committees for integrating anti-corruption mechanisms into corporate policies, particularly in the financial sector, promoting a culture of accountability and mitigating reputational risks (Rahim et al. 2025).

Kong et al. (2022) emphasize the importance of distinguishing between actual and symbolic legitimacy within Chinese companies. Their findings show that while high-level measures are ineffective, effective anti-corruption initiatives improve the effectiveness of partnerships with the government. This underscores the crucial importance of a genuine commitment to combating corruption to achieve sustainable improvements in governance. Boiral et al. (2020), through qualitative research and semi-structured interviews with 33 participants, determined that dedicated CSR committees demonstrate excellent governance outcomes, reinforcing the idea that genuine ethical commitment strengthens stakeholder trust. Kotsantonis et al. (2016) demonstrated that effective anti-corruption measures mitigate governance risks in the Forbes Global 500 ranking (March 2007), thereby improving transparency and strengthening shareholder relations. Conversely, Chen et al. (2015) examine the resilience of firms in Asian countries with strict anti-corruption regulations and find that these measures promote ethical management practices and improve corporate reputation.

Pinto et al. (2008) examine the impact of corporate social responsibility programs, including anti-corruption measures, on corporate governance, noting that anti-corruption frameworks link corporate actions to ethical standards and promote governance stability.

Stakeholder theory suggests that CSR, particularly in the fight against corruption, aligns a company's financial objectives with the broader interests of its stakeholders (Cardoni et al. 2024).

Integrating corporate governance (CGCI) into a company's ethical framework can strengthen its governance by fostering trust among stakeholders. Organizations that demonstrate a strong commitment to fighting corruption often build excellent reputations, foster stakeholder loyalty, and gain competitive advantages, such as increased customer loyalty and improved access to financing (Guzman et al. 2006).

Research on CSR emphasizes the importance of ethical governance so that leaders can fulfill their responsibilities to stakeholders (Gerged et al. 2023). Agency theory argues that leaders may prioritize their own interests by overinvesting in CSR initiatives, such as corporate governance action groups (GAGEs), thereby diverting resources from value-creating activities (Majeed et al. 2024). The underlying motivation for this may be the desire to enhance an individual's personal reputation rather than the long-term interests of the company.

Corporate governance working groups (CGWs) can serve as symbolic measures to influence stakeholder opinion. Companies often use these measures for superficial purposes rather than for genuine governance improvements (Stoeckl & Luedicke 2015). This can lead to greenwashing, where companies display ethical intentions without making significant progress (Kammouh et al. 2020). Sometimes, the objective of a corporate ethical commitment, such as CGWs, is as much about administrative efficiency as it is about influencing public opinion, particularly concerning governance practices in developing countries like China (Xue et al. 2022). The direct impact of corporate ethical commitments, such as CGWs, on governance performance remains understudied. Therefore, further research is needed to understand the impact of trade agreements on corporate governance in different countries and contexts, drawing on these theoretical frameworks.

Stakeholder theory emphasizes the importance of independent CSR reporting and CSR committees to promote ethical governance practices among stakeholders. Ensuring transparency in social and ethical initiatives strengthens a company's brand image and, consequently, its reputation (Moussa & Elmarzouky 2022). The growing demand for transparency, supported by national and international frameworks, has led to wider adoption of CSR and sustainability reporting (Tschopp & Huefner 2015).

The usefulness of a CSR committee for monitoring the link between information and communication technology (ICT) analysis and governance performance appears to depend on its concrete implementation, as evidenced by conflicting results in the literature. Previous studies have shown that establishing a CSR committee can significantly improve accountability and transparency, two essential elements of good governance (Gerged

2021; Ponmalara et al. 2024). A KPMG study (2020) indicates that companies with a dedicated CSR committee are more likely to adopt sustainable practices consistent with their governance objectives. Aguinis and Glavas (2012) argue that CSR initiatives improve governance structures by strengthening relationships with stakeholders. Understanding the mediating role of the CSR committee in the relationship between the ATIC (Action, Technology, and Innovation) and governance performance is crucial for assessing how companies can reconcile stakeholder interests with sound management practices.

Given that the concept of sustainable development is essential to the development of the modern energy sector, its practical implementation faces numerous obstacles. These obstacles stem primarily from the inability of markets to resolve monopoly problems, environmental concerns, public utility issues, lack of information, social inequalities, and other problems inherited from the energy sector. Although energy sector liberalization has been achieved in many developed countries, improving the transparency and efficiency of energy industries, the free market alone cannot guarantee the achievement of the social and environmental objectives of sustainable energy development. Therefore, government intervention in energy markets is necessary to address these issues, even if international regulations do not fully cover them.

Various studies have demonstrated that CSR has a positive impact on the economic viability of organizations, not only by improving their financial performance but also by establishing lasting relationships with the community, the environment, and investors. Therefore, adopting CSR is not an option but a strategic necessity in today's business environment.

Furthermore, human resources play a crucial role in combating corruption and improving the profitability and sustainability of economic institutions. They directly influence the performance, productivity, and competitiveness of organizations. High-performing institutions rely on effective human resource management strategies, including skills development, fostering a positive work environment, and motivating employees to achieve excellence. This, in turn, contributes to enhancing the institution's image, building customer loyalty, and promoting economic sustainability. Human resources are considered the most important element for achieving an institution's objectives, as its success depends on the efficiency and competence of its employees.

Our third hypothesis is as follows:

H3: *There is a statistically significant relationship between the dimensions of social responsibility and non-corruption, and their role in achieving organizational sustainability; therefore, the dimensions of social responsibility have a positive impact on organizational sustainability.*

H3.1: *There is a statistically significant relationship between an organization's commitment to environmental responsibility, the reduction of corruption in its operational processes, and its organizational sustainability.*

H3.2: *There is a statistically significant relationship between training programs, raising awareness of ethics, and promoting resistance to corruption among employees of economic institutions.*

H3.3: *There is a statistically significant relationship between a decrease in the level of corruption within the institution and an increase in stakeholder (employees, customers, partners) trust and their support for the continuity of the economic institution.*

METHODOLOGY

Sample and Data

We based our analysis on a sample of 45 institutions listed on the Gulf and Iraqi stock exchanges, covering the period 2014–2022.

We used annual balance sheet data from a sample of industrial economic institutions listed on the Iraqi Stock Exchange and Gulf financial markets. Financial institutions were excluded due to the specific nature of their accounting methods.

This study uses ESG scores extracted from the Thomson Reuters Asset 4 database to measure corporate social responsibility performance.

We collected financial data from DataStream. Information on human resource effectiveness was gathered from annual reports. The anti-corruption index for the countries studied comes from the International Platform for Transparency Against Corruption (IPC), the Global Coalition Against Corruption.

Model

$$ESGit = \alpha + \beta 1\ ENVit + \beta 2\ GOVit + \beta 3\ SOCit + \beta 4\ HRIit + \beta 5\ NMit + \beta 6\ ROEit + \beta 7\ TDTAit + \beta 8\ EQTCit + \beta 9\ NDit + \beta 10\ CPIit + \varepsilon it$$

With:

ESGit: Environmental, Social, and Governance (ESG) Score

- Envit: Environmental Pillar Score
- Govit: Governance Pillar Score

- Social: Social Pillar Score
- HRIit: Human Resources Corruption Resilience Index (Aggregate)
- NMit: Net Profit Margin
- ROEit: Return on Equity
- TDTAit: Total Debt to Total Assets Ratio
- EQTCit: Equity to Total Capital Ratio
- NDit: Net Debt
- CPIit: Corruption Perceptions Index
- α: Fixed Threshold
- β1, ..., β10: Coefficients to be Estimated
- εit: Margin of Error

Descriptive Analysis of Variables

The average ESG score is approximately 33.129, with a mean of 31.165. These scores are relatively modest, showing significant heterogeneity (standard deviation = 17.144). This positive variance indicates that while many companies have moderate ESG scores, a high-performing minority pulls the mean upward, with values ranging from a minimum of 3.55 to a maximum of 79.86.

Regarding skewness, the value representing the ESG score measures the homogeneity of the distribution relative to its mean, which is 0.507604. It indicates whether the data are evenly distributed around the mean. For this variable, skewness is greater than 0 (positive skewness), meaning the distribution is more concentrated to the right (extreme values on the right). This means that the majority of values are concentrated to the left of the mean. A skewness between 0.5 and 1 indicates moderate heterogeneity.

The average score for the environmental pillar is approximately 20.815, with a mean of 21.17165. This result is significantly lower than the ESG score. Companies generally score poorly on environmental practices, resulting in a long, straight distribution indicating that only a small number of companies demonstrate exceptional performance in sustainable development.

The wide dispersion (standard deviation greater than the mean) reflects significant variation in companies' environmental efforts in the Gulf countries and Iraq. The score of 21.17165 covers a range of values from 0 to 88.92.

Regarding skewness, the value representing the environmental pillar score measures the symmetry of the distribution relative to its mean, which is approximately 0.71396. It indicates whether the data are evenly distributed around the mean. For this variable, a skewness greater than 0 (positive skewness) means the distribution is right-skewed (extreme values on the right). This means that the majority of values are concentrated to the left of the mean. Skewness between 0.5 and 1 indicates moderate skewness.

We observe that the companies studied generally exhibit poor environmental practices, with a long and linear distribution, suggesting that only a small number of companies achieve exceptional results in sustainable development.

The skewness value is approximately 0.161622, and the kurtosis (flatness) value is 1.04338.

This is the most effective pillar, indicating that governance mechanisms are more decisive than environmental or social dimensions.

The average score for the governance pillar is approximately 30.51884, with a mean of 25.205. This score is higher than the averages for the environmental, social, and overall ESG criteria and is even very high compared to the environmental dimension. This reflects significant efforts by companies to incorporate the social dimension and equity, thereby ensuring their sustainability and social stability in their respective countries.

In general, companies achieve relatively high social scores, reflecting the increasing importance of this type of investment for listed companies, especially regarding working conditions and purchasing power.

Regarding the strengthening of human resources in the fight against corruption, as measured by the Human Resources Index (HRI), calculated from various variables, the following points are essential: First, HR practices (recruitment, promotion, training, performance evaluation, compensation, and recognition) must reflect the company's commitment to this program. Second, HR policies and practices related to this program are developed and implemented in consultation with employees, unions, or other employee representative bodies. Third, the company clearly states that no employee will be demoted, disciplined, or suffer any other negative consequences for refusing to pay bribes, even if this refusal results in a loss of revenue for the company.

The final variable indicates the percentage of employees within the organization who have been trained in anti-corruption policies and procedures. The HRI is calculated using the clustering method.

The average net profit margin is -1015.1, the median is 16.1, and the standard deviation is 15,094.91.

The negative average can be explained by significant net losses recorded by some companies, likely due to financial shocks following crises such as the health crisis, sector-specific difficulties, or restructuring.

he median is positive (16.1%), indicating that the majority of companies are profitable and demonstrating their financial strength.

The very high standard deviation (-13.1425) reveals the presence of a long tail of companies experiencing significant losses.

The unusually high kurtosis (172.3056) indicates that the distribution has very thick tails. A few outliers dominate the data set.In conclusion, we observe that while the majority of the companies studied are performing well, some are experiencing significant difficulties, resulting in a substantial decrease in the average.

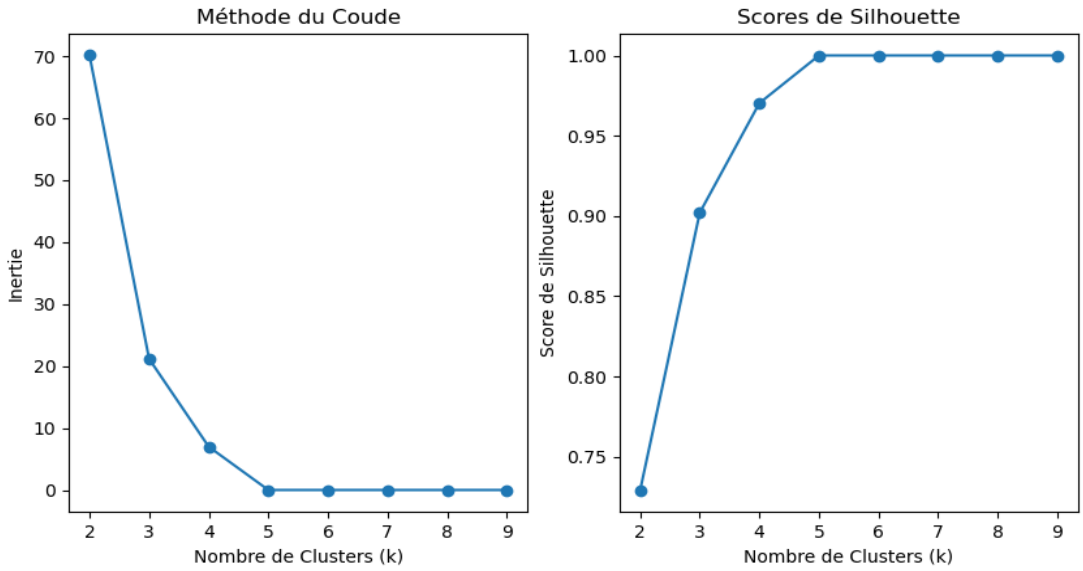

Figure 1: Graphical distribution of variables

Table 1. Descriptive statistical analysis

	Mean	Median	Std	Min	Max	Skewness	Kurtosis		
ESG	33.129	31.165	17.144	3.55	79.86	0.507604	--0.47037		
Degree of environmental substrate		24.866	20.815	21.171	0	88.92	0.71396	--0.3175	
Degree of the governance pillar		42.904	41.19	21.820	0.04	91.51	0.161622	--1.04338	
Degree of social support		30.518	25.205	21.292	1.66	86.09	0.727874	--0.37081	
Human Resources Index		0.4743	0.5	0.182	0.25	1	0.504838	0.030767	
Net margin	--1015.1	16.1	15094.91	-202268	20021.53	--13.1425	172.3056		
Return on equity		6.646	7.44	41.247	--655.22	135.61	--12.2465	188.0405	
Total Debt % Total Assets		27.180	15.725	50.00	--41.78	333.48	3.9404	17.810	
Equity % total capital		70.441	84.885	48.832	--196.63	105.41	--3.75	17.289	
Net debt	68056	79403.5	1.6	(-1.3)	+0.9	(-0.9)	1.25	-1.908	35.98392
Corruption Perception Index		49.519	51.5	16.755	16	71	--0.563	--0.57131	

RESULTS OF BAYESIAN REGRESSION

The experimental strategy employed in this study relies on a Bayesian estimation framework, specifically the No-U-Turn Sampler (NUTS), which utilizes artificial intelligence. This method is an adaptive extension of the Hamiltonian Monte Carlo (HMC) algorithm. It was chosen for its ability to efficiently sample complex posterior distributions, especially in models with high-dimensional parameter spaces and nonlinear relationships.

The Bayesian approach allows for the integration of prior information and provides a comprehensive probabilistic interpretation of the coefficient estimates, thereby offering a better understanding of the uncertainty and reliability of the inferred relationships. Based on the Bayesian analysis, we employed the generalized method of moments (GMM) to verify the robustness of the results.

This study aims to analyze the impact of anti-corruption efforts, human resource effectiveness, and CSR on corporate sustainability. It uses an artificial intelligence methodology, specifically the Bayesian method, to examine the interactions among these variables in publicly traded Gulf and Iraqi institutions.

GMM analysis is particularly suitable for handling potential internal interference and measurement errors in panel data. By utilizing automated variables and conditions of moment, GMM enables consistent and efficient estimation even in the presence of heteroskedasticity or autocorrelation.

Similarly, this applied study emphasizes the importance of addressing issues such as heterogeneity of variance and autocorrelation, as highlighted by the relevant tests. Therefore, the focus will be on the significance of the GMM method and its limitations when interpreting results. This approach permits us to obtain relevant estimates for accurate regression analysis.

However, classical methods have limitations, making the Bayesian approach vital for analyzing results. Over the years, dynamic measurements of inputs and outputs, or outputs alone, have become increasingly valuable. Identifying characteristic patterns—involving low-amplitude frequency patterns, damping ratios, and participation factors—becomes essential, particularly for modeling the low-frequency dynamics of mechanical or structural systems.

In particular, updating models using ambient vibration surveys is crucial. This approach is significant because it allows for cost-effective, efficient dynamic data collection without resorting to expensive and complex dynamic experiments, such as using motors. Ambient vibration surveys measure natural vibrations caused by wind, traffic, micro-shocks, and other environmental factors.

Bayesian methods and dynamic panel data models serve distinct roles in statistical analysis, particularly in addressing individual heterogeneity and temporal dynamics. Bayesian methods incorporate prior distributions for parameter estimation, allowing greater flexibility in modeling complex data structures. Dynamic panel models, on the other hand, focus on relationships between variables over time, considering both static and random effects.

The Bayesian regression results, obtained from the NUTS sampler, reveal several important insights regarding the predictors of the ESG score. The mean intercept (α) is 33.09, representing the baseline ESG score when all predictors are held constant.

Among the dimensions of CSR, the three pillars—environmental, social, and governance (ESG)—are positively and significantly correlated with the ESG score. The table below shows that the environmental dimension has a positive impact on sustainability in 537 cases. This is in accordance with the work of Amchaarou, (2025). This positive correlation is significant for institutions in the Gulf and Iraq. We conclude that this variable is statistically significant, as the HDI for 3% is 4.44 and for 97% is 26.6. The absence of zeros in the confidence interval underscores the statistical significance of the relationship between the environmental dimension and sustainability, strengthening the reliability of this correlation. Furthermore, the table shows that the effective sample sizes (ESS) for the sum and tails of the posterior distributions are significantly larger than the recommended limits, generally exceeding one thousand. For this environmental dimension, the effective sample sizes are 83,401.7 and 67,299.2, respectively. This indicates excellent mixing of the Markov chains and reliable exploration of the posterior distributions.

This underscores the financial imperative for companies listed on Gulf and Iraqi stock exchanges to use resources in ways that prevent depletion and minimize the negative environmental impacts of their industrial and commercial activities. This goal is achieved through the rationalization of water, energy, and natural resource consumption by utilizing green buildings and sustainable transportation, as well as through periodic assessments by committees, particularly the ESG committee, to reduce emissions. This statistical significance also demonstrates substantial variation in the environmental efforts of the companies in our study and their compliance with international environmental standards. This activity is economically viable and ensures the sustainability of these companies, thereby strengthening stakeholder confidence, reducing legal risks, improving economic efficiency, and providing a competitive advantage, as indicated by numerous studies.

The table below also shows that the governance dimension, measured through internal and external governance mechanisms such as the role of the board of directors, internal and external audits, etc., has an average score of 4.5 and a positive impact on sustainability. This underscores the importance of good governance practices for publicly traded economic institutions in the Gulf and Iraq. We also conclude that this variable is statistically significant, with the 3% HDI equal to 3.22 and the 97% HDI equal to 96.4. The absence of zero within these bounds in the credible interval confirms the statistical significance of the link between the governance dimension and sustainability and strengthens the reliability of this relationship.

The results also show that the social dimension, measured by internal and external mechanisms used within the company (role of the board of directors, internal and external audits, etc.), has an average index of 8.96. This result positively impacts sustainability, highlighting the importance of good governance practices for publicly listed Gulf and Iraqi economic institutions. We also conclude that this variable is statistically significant, with the HDI at 3% equal to 7.85 and at 97% equal to 10.07. The absence of zero within this credible interval confirms the statistical significance of the link between the social dimension and sustainability and strengthens the reliability of this relationship.

The table also indicates that the Human Resources Effectiveness Index in the fight against corruption is statistically significant but negative (-1.7). Although this human resources indicator, which combines four key variables to assess efforts to combat corruption and promote sustainability, yielded a negative result, this can be explained by the accuracy of the data collected. Human resources and their effectiveness are considered strategic factors in the fight against corruption and in strengthening institutions' contributions to development, profitability, and sustainable growth. Indeed, human resources and their effectiveness are essential variables for supporting anti-corruption efforts and ensuring institutional sustainability.

This effectiveness is particularly achievable when institutions develop their employees' skills through training, planning, education, skills development, encouragement of initiative, and offering career advancement opportunities. These elements enable employees to participate more actively, interact more transparently, and improve productivity. This contributes to combating corruption, continuously improving organizational performance, and ensuring sustainability.

However, this role can be diminished by a lack of administrative independence and heavy bureaucracy, which complicate human resource management and performance. In conclusion, it is crucial to strengthen the human resources of the institutions studied through comprehensive training. Transparent practices and an ethical framework are indispensable for combating corruption and ensuring institutional sustainability.

Regarding the financial variables—namely, net profit margin, return on equity, total debt-to-total-asset ratio, equity ratio, and net debt—most are statistically significant, except for net profit margin and net debt, due to the presence of zero within the 3% and 97% thresholds of the HDI. Other financial variables, such as the total debt ratio and return on equity, are statistically significant, with either positive or negative implications.

The final variable is the anti-corruption index, for which we collected government-related data. This variable falls under the macroeconomic category, and the data were obtained from the Platform for Transparency and Integrity of Countries (PTIC) due to the limited availability of anti-corruption data in our sample. The study found that the non-corruption rate was 0.83, indicating a statistically significant positive impact on sustainability. This is supported by the 3% HDI threshold of 0.8 and the 97% HDI threshold of 11.70, with no zero values within this credible interval during the considered period. This highlights the positive and statistically significant relationship between anti-corruption and sustainability. Therefore, we conclude that the hypothesis demonstrating a statistically significant relationship between anti-corruption and organizational sustainability is valid.

Institutional corruption constitutes one of the most serious challenges threatening development efforts and undermining public trust in the organizational structures of these economic institutions. It negatively affects economic and social stability in general and the sustainability of institutions in particular.

Furthermore, analysis of the governance variable reveals that the effective sample sizes for the sum and tails of the posterior distributions are significantly larger than the recommended limits, generally exceeding one thousand. For this governance dimension, the effective sample sizes are 3,552.28 and 3,106.72, respectively. This indicates excellent mixing of Markov chains and reliable exploration of the core parts. This is similar to the work of Hamliri and Errachdi 2025.

This underscores the importance of ensuring that the resources used by companies listed on the Gulf and Iraqi stock exchanges are not depleted, and that the negative environmental impacts of their industrial and commercial activities are minimized.

The social pillar score revealed the most significant impact ($\beta = 8.96$), demonstrating a statistically significant positive effect on the sustainability of the industrial companies in our sample. According to our results, there is a 94% probability that this actual impact occurred during this period. This indicates, based on our sample of publicly traded companies in the Gulf Cooperation Council (GCC) countries and Iraq, that sustained efforts in social areas, such as occupational health and safety, continuing education, and the improvement of working conditions—particularly in terms of income, social justice, and equal opportunities—have contributed to achieving these objectives.

Social dialogue has a tangible and positive impact on key industrial performance indicators such as productivity, quality, reduced absenteeism, and employee engagement, thereby influencing long-term sustainability and performance. This positive impact is fully manifested through the maintenance and strengthening of social commitments, even during periods of crisis or budget constraints.

In the most optimistic scenarios (effect close to 10.07), the results reveal a strong multiplier effect, indicating that companies' social initiatives are well integrated and can contribute to a significant competitive advantage in the industrial sector, particularly in terms of innovation, the retention of rare skills, and the reduction of social conflict. The absence of zero in the confidence interval reinforces the reliability of the observed correlation and supports the institutionalization of the social dimension. This consolidates and supports the company's strategic objectives, especially its commitment to sustainable development.

Table 2. Results of the Bayesian model (NUTS)

Parameter	Mean	SD	hdi_3%	hdi_97%		mcse_mean	mcse_sd	ess_bulkess_tail
Alpha	33.09	0.37	32.39	33.79	0.01	0.01	4903.7	2719.43
beta[0]	5.37	0.5	4.44	6.26	0.01	0.01	4017.83	2992.67
beta[1]	4.05	0.46	3.22	4.96	0.01	0.01	4076.72	2982.7
beta[2]	8.96	0.59	7.85	10.07	0.01	0.01	3552.28	3106.72
beta[3]	-1.07	0.44	-1.89	-0.27	0.01	0.01	4276.58	3244.72
beta[4]	0.33	0.4	-0.46	1.06	0.01	0.01	4997.75	3234.47
beta[5]	-1.02	0.4	-1.8	-0.32	0.01	0.01	4762.97	2739.06
beta[6]	-1.59	0.71	-2.91	-0.27	0.01	0.01	3786.02	3022.22
beta[7]	-3.82	0.71	-5.17	-2.55	0.01	0.01	3887.94	3237.9
beta[8]	-0.39	0.41	-1.17	0.38	0.01	0.01	4499.43	3044.39
beta[9]	0.83	0.44	0.08	1.71	0.01	0.01	4468.11	3166.22
Sigma	7.15	0.28	6.64	7.66	0.0	0.01	4839.24	2990.53

CONCLUSION

Recent trends indicate that the sustainable organizations of tomorrow will be those that integrate artificial intelligence into their governance processes. Therefore, the development of an AI-based regulatory system represents a promising tool for strengthening transparency, consolidating institutional structures, and ensuring a safe and sustainable economic environment.

The results of this study concretely demonstrate the use of artificial intelligence, specifically a data analysis methodology applied to data collected from economic institutions via international platforms generating annual reports in the Gulf countries and Iraq. The objective was to measure the impact of anti-corruption efforts, human resource effectiveness, and social responsibility on combating corruption and ensuring the sustainability of economic institutions.

The main findings show that anti-corruption efforts have a direct positive impact on reducing financial and administrative corruption and on strengthening customer and investor confidence. Human resource effectiveness increases institutions' capacity to detect corruption early and rigorously enforce the law. Social responsibility plays a preventive role by promoting ethical values and encouraging institutions to commit to transparency. Furthermore, the dimensions of social responsibility contribute significantly to achieving sustainability.

The relationship analysis concludes that there is a strong direct correlation between anti-corruption efforts and sustainability achievement. When an institution strives to improve the effectiveness of its human resources and focuses on the dimensions of social responsibility, corruption rates decrease, and its chances of sustainability in a competitive environment increase.

The results of this study do not mark the end of research in this area but pave the way for more in-depth and comprehensive studies that could address the psychological and cultural dimensions of human resources, or compare different sectors or organizational environments, thus contributing to building a fair and sustainable economic institutional system. Furthermore, the growing challenges facing economic institutions in the modern era underscore the urgency of establishing effective governance systems based on the principles of integrity, transparency, and fairness as fundamental approaches to achieving overall sustainability.

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