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A Data-Driven Review of the Financial Performance and Environmental Compliance of Shariah-Compliant Businesses

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Abstract

In order to analyze their investment choices and achieve better impact investments, investors are increasingly considering environmental, social, and Governance aspects. Investors are under increasing pressure from society to make sure that, in addition to profitability reasons, the environment's effect, society's impact, and corporate governance standards are taken into consideration when allocating funds. As a result, there has been an increase in the divestment of firms that use forced labor, lack diversity in their workforces, and operate in highly polluting sectors. Islamic banking incorporates Shariah law's guiding principles, which place a heavy emphasis on protecting the environment and advancing society. It can be difficult to determine if firms are Shariah-compliant in terms of the environment since environmental ESG ratings could not accurately reflect all of a corporation's environmental effects or its compliance with Shariah. In addition to evaluating a company's financial success, this article introduces a new data-driven approach for assessing its Shariah-compliant environmental performance. The deep learning system uses an unsupervised-random forest learning method to classify environmental compliance while also measuring these firms' financial performance. Large Islamic-compliant US listed firms were the subject of an investigation, which revealed high clustering performance and a difference between Islamic environmental compliance and non-compliance.

Keywords*:* Islamic Compliance, ESG, Environmental Shariah Compliance, Deep Learning, Data Analysis

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Introduction

ESG (Environmental, Social, and Governance) has gained popularity as a way to consider numerous non-financial aspects that could have a long-term impact on an organization's performance when making investment decisions. ESG discussions also take into account environmental issues like those resulting from pollution and wildlife preservation in addition to social issues like those relating to unemployment rates and income inequality. Governments have a significant role in ESG through the regulation of labor and environmental laws, which is seen as a continuation of corporate social responsibility. In many cases, it is preferable to include these ESG management techniques in the main company plan rather than taking them into separate consideration. This suggests that the firm may be able to pinpoint industry sectors in which it might have a positive influence, which will enable it to reach its ESG objectives and adopt sustainable business practices (Yoon & Serafeim, 2022).

Many businesses actively disclose their activities to stakeholders and shareholders. The belief is that disclosing information to the public improves transparency and shows how seriously an organization takes investing in sustainable operations. This boosts consumer confidence and encourages an increase in the number of investors who want to put money into businesses that have environmental practices.

These CSR-related disclosures could not fully capture the company's operations, particularly when it comes to hazards associated with the environment. Environmental problems can include both changes in weather patterns brought on by flooding and drought as well as changes in biodiversity brought on by deforestation and illicit hunting. This could occur because of calamities like hurricanes and typhoons, as well as the deaths of people and animals. In addition, there were significant problems with the atmosphere's depletion as a result of the ozone layer's decline (Devie, Liman, Tarigan, & Jie, 2019; Lindgreen & Swaen, 2010).

Social problems include slavery, poor working conditions, and child labor. Underpayment of workers is also a problem. Poor working conditions and human rights abuses against whistleblowers and participants in peaceful demonstrations are also taken into consideration. Bribery, internal corruption in governments, and information asymmetry are examples of governance-related factors. Environmentally related corruption is particularly pervasive and alarming. When two parties enter into a transaction, information asymmetry may constitute an unfair advantage since it might disadvantage one party relative to the other. It's also possible that there has been price fixing, which would mean that prices have been intentionally maintained high, and that there has been a general lack of corporate openness (Armstrong, 2020).

Climate concerns pose a serious threat to human health, increasing the possibility of infectious illnesses as well as famine and poverty. Addressing climate change concerns might have a significant impact on the present and future success of some businesses. Severe weather

conditions, including floods and droughts, might harm the company's physical assets or make it more difficult to convey its products to customers. Recent storms and typhoons might have a further negative impact on agricultural production, or if they caused wildfires, they could diminish the amount of harvestable timber (Folqué, Escrig-Olmedo, & Corzo Santamaría, 2021).

1. Importance of ESG in Investment Decisions

Climate concerns pose a serious threat to human health, increasing the possibility of infectious illnesses as well as famine and poverty. Addressing climate change concerns might have a significant impact on the present and future success of some businesses. Severe weather conditions, including floods and droughts, might harm the company's physical assets or make it more difficult to convey its products to customers. Recent storms and typhoons might have a further negative impact on agricultural production, or if they caused wildfires, they could diminish the amount of harvestable timber (Williams & Nagy, 2020).

Additionally, if employers give their staff a decent wage, this may have a big beneficial environmental impact since the workers can purchase good food, get enough rest, and become more ecologically conscientious. The relevance of ESG investments and their growing popularity are largely attributable to the creation of several ESG-compliant equities and investors' increasing willingness to invest in companies that are reliable and have a positive influence on society and the environment.

The effects of climate change and ESG-relevant factors are evident for many organizations. Since 1750, the atmospheric CO2 concentration has increased from 280 to 400 parts per million (ppm), which has exacerbated extreme weather events that have cost the world's economies billions of dollars in property damage. Hurricane Harvey and Hurricane Maria both inflicted damage of more than 125 billion USD and almost 90 billion USD, respectively. Climate change is one of the issues, but the evaluation must also take into consideration the specific acts of companies, such as the pollution of the area around their plants and the overall supply chain (Singhania & Saini, 2021).

For many firms, the consequences of climate change and ESG-relevant variables are clear. Since 1750, the atmospheric CO2 concentration has risen from 280 to 400 parts per million (ppm), exacerbating extreme weather occurrences that have caused billions of dollars' worth of property damage and harmed the world's businesses. More than 125 billion USD in damage was caused by Hurricane Harvey and about 90 billion USD by Hurricane Maria, respectively. One of the problems is climate change, but the assessment must also take into account the particular actions of businesses, such as the contamination of the region around their operations and the whole supply chain (Nelson, 2018).

There are a number of variables that have increased the appeal of ESG funds in recent years. Generally speaking, these funds are less risky than traditional financial investments and place a greater emphasis on environmental sustainability, workforce diversity, and governance-

related objectives. Although ESG has put a lot of emphasis on many aspects, it is unclear what sets Islamic environmental values apart from these ESG principles.

2. Islamic Environmental Values

Islamic ideals and human growth have always been centered on the environment. The world's temperature and weather patterns have changed significantly as a result of climate change, which has had a serious negative impact on both humans and animals (Abdelzaher & Abdelzaher, 2017).

Islamic traditions, beliefs, and values encompass a holistic approach to the environment and emphasize the value of conserving natural resources and the environment. Islamic law is quite clear that all living things, including humans, share ownership of the essential components of nature, including land, water, fire, forest, and light. The Quran and Sunnah serve as models for promoting sustainable development, and Allah orders people to refrain from misdeeds and resource waste that might harm the environment. Natural resource exploitation rights are granted on a guardianship basis. This suggests that ensuring that someone else's property won't be harmed or destroyed is a prerequisite for having the right to use it (Emari, Vazifehdoust, & Nikoomaram, 2017).

The teachings on Islamic sustainability as part of the trusteeship are guided by the Quran, which makes specific allusions to ecology and offers precepts for environmental protection. The guardian is responsible for ensuring that all entrusted assets are transferred to the following generation in their purest form. This means that the caretaker must coexist peacefully with other living things and that it is everyone's duty as Muslims to protect, preserve, and respect the environment (Islam, Yousuf, Hossain, & Islam, 2014).

Furthermore, Muslims must abstain from environmental corruption, which includes industrial pollution, environmental harm, and the careless exploitation and manipulation of natural resources. The implication is that excessive waste is severely discouraged. This suggests that protecting the environment is a social and religious commitment that cannot be waived. Accountability and resource upkeep are crucial (Gada, 2014).

3. Data-Driven Approach for Assessing Shariah-Compliant Environmental Performance

The environment, which encompasses resource conservation, land reclamation, and general environmental cleanliness, is a major concern of the hadiths. The prophet aggressively encouraged moderation in all facets of life and strongly criticized excessive consumerism, luxury, and extravagance. According to the most well-known hadith, mankind were chosen by Allah to serve as a protector of the earth's beauty because it is green and attractive. No trees or crops shall be destroyed, not even in times of conflict, according to the prophet, suggesting that sustainable land agriculture is actively supported. Additionally, it's crucial to reduce waste and treat animals with compassion (Ghernaout, 2017).

Questions about the relationship between Islamic-compliant equities and the environmental performance of companies, as measured by benchmark ESG scores, are raised given the focus on environmental preservation in both Islamic law and ESG. In order to maximize production and investment choices, whole sectors have relied heavily on machine learning and artificial intelligence. In addition, several funds and businesses have placed a strong emphasis on automation and AI-assisted decision making.

In addition to clustering, it is crucial to ascertain the connection of the features by looking at how different features affect the clusters and how they affect estimates of environmental performance. Decision tree methods have been effective at giving deep learning frameworks an explanatory context for the results (Audemard, et al., 2022).

The influence of environmental considerations of enterprises vs their adherence to Islamic values based on financial report information was analyzed using a novel empirical research approach. ESG is a crucial factor in how businesses are assessed, yet there are few clear guidelines on what makes a particular ESG score. ESG rating agencies provide investors a tool to assess companies' ESG performance, just how credit ratings let investors select companies based on their creditworthiness. However, these two are not at all like. First off, unlike creditworthiness, which can be roughly defined as a company's default risk, ESG performance is still a vague concept. Second, compared to financial reporting standards, which have been established and standardized over the course of the past century, ESG reporting is still in its infancy. Even while most relevant firms disclose in some way, there are still inconsistent reporting criteria, and none of them are now recognized as global norms. Companies are encouraged to establish policies that are socially and ecologically responsible and to report on how they are being implemented under the United Nations Global Compact. A collection of guidelines for evaluating and enhancing company governance is known as the OECD Principles for company Governance. Among other things, the Global Reporting Initiative defines a holistic perspective on a company's material challenges, impacts, and management, which helps to encourage sustainability reporting. The latest and most advanced method for categorizing actions that support environmental sustainability is the EU taxonomy, which has a smaller influence (Yoon & Serafeim, 2022).

The phenomenal development in interest in environmental, social, and governance (ESG) gained momentum during the 2008–2009 financial crisis, when companies with stronger social capital had stock returns several percentage points higher than those with lower corporate social responsibility intensity. A swarm of research articles analyzing the impact of ESG-related risks on financial markets quickly followed the global surge in ESG awareness. On the theoretical front, many research publications have examined an extension of the traditional Capital Asset Pricing Model (Pedersen, Fitzgibbons, & Pomorski, 2021). Investors follow the conventional efficient-frontier paradigm and take ESG factors into account when deciding how to assemble their portfolios. Numerous studies have found empirical support for the (yet negligible) influence of ESG data on the financial market. Pelizzon et al. (2021) use a quasi-natural experiment to demonstrate the existence of a temporary price pressure on stocks that

is caused by certain investors' inaccurate interpretation of the significance of the shift in ESG ratings (Pelizzon, Rzeznik, & Hanley, 2021). The effect of ESG rating adjustments on the ownership of mutual funds with specific ESG investing strategies is examined by Berg et al. in their research (Berg, Kölbel, & Rigobon, 2022). The authors discover a link between ratings upgrades and downgrades and stock performance over the long term. Additionally, they demonstrate that corporations only alter their behavior in relation to the Governance pillar score after receiving a downgrade, demonstrating that while ESG ratings appear to have an impact on financial markets, their influence on the actual economy is still very small.

The impact of CSR on Corporate Financial Performance (CFP), as determined by three distinct economic indicators, including Return on Equity (ROE), Return on Assets (ROA), and Return on Invested Capital (ROI), is covered by Lin et al. (2019). The findings confirm the notion that there is a trade-off between committing to the achievement of ESG objectives and maximizing the organization from an economic point of view in favor of shareholders (Lin, Law, Ho, & Sambasivan, 2019). The results demonstrate a negative relationship between CFP and CSR. The approach used in the ESG issuance reflects the lack of clarity and uniform definitions that characterize the field of sustainable investments and lead to weak or even uneven outcomes in revealing the financial effect of ESG ratings. Different sustainability ratings for the same firms are produced by each data provider's own ESG rating system, which has been established with its own unique features. Three distinct causes of divergence—scope, measurement, and weight— are noted as noteworthy in the ESG ratings of five main data suppliers (Berg, Kölbel, & Rigobon, 2022). The reasons for scope variation are the sustainable themes that each rater believes should be considered during the screening process.

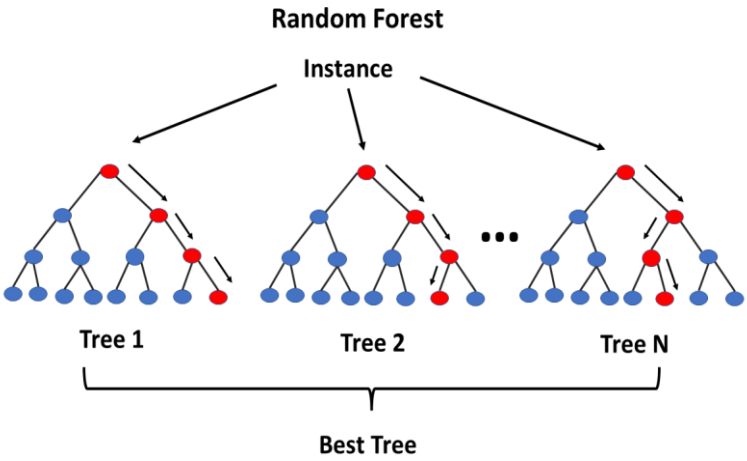
The collection of indicators the data provider chooses to evaluate the firm's quality for each pillar is the subject of measurement divergence. Last but not least, weight divergence refers to differences in how each agency assigns priority to qualities, which indicates that rating agencies have diverse opinions on the relative relevance of features. They discover that measurement divergence accounts for more than half of the entire disparity, whereas scope and weight are only somewhat less significant but still not insignificant. The authors demonstrate that conflicting definitions of E, S, and G components' characteristics, attributes, and standards result in heterogeneous ESG assessments by various rating agencies. Additionally, this absence of consistent findings scatters the effects of ESG investors' preferences on asset prices (Folqué, Escrig-Olmedo, & Corzo Santamaría, 2021).

A random forest technique has been used. The group of ensemble learning techniques includes random forest approaches (Tang, Cai, & Ouyang, 2019). The random forest used in these methods is made up of several decision trees that have either been trained via bagging or bootstrapping. An effective ensemble strategy for raising accuracy is bagging. Different bags are created by combining several decision trees. We choose the bag with the best accuracy out of these bags to be further branched out. The accuracy of the estimations or categorization is then increased as the number of trees included increases. The removal of decision tree

constraints, particularly those related to overfitting, is a significant advantage of random forest trees (Schonlau & Zou, 2020).

Our architecture benefits from the efficient handling of missing data by random forest techniques. Furthermore, they don't require extensive hyperparameter adjustment to provide accurate forecasts. In Figure 1, we show the many kinds of nodes that can be found when using a random forest technique. The root node comes first, then the decision nodes, and finally the leaf nodes. Multiple leaves or decision nodes may exist in one decision node. A decision node that has several leaves is a subtree (Schonlau & Zou, 2020).

Figure 1: Random Forest Graphical Illustration.



The operation of decision trees and random forests is explained by information theory. To maximize entropy, or information gain, which is a measure of uncertainty, is the primary goal for a decision tree. Entropy rises when the level of uncertainty is decreased for a group of independent variables. Higher entropy indicates that more uncertainty was eliminated from the data during decision tree training. The random isolation of the nodes by bagging is the primary benefit of the random forest approach. This method enables the use of various samplings throughout the training stage (Ghatasheh, 2014).

The integrated unsupervised-random forest framework technique allows for the analysis of both the primary components showing a high association with the environmental aspects and the distinction between the various firms in terms of their environmental compliance.

4. Results

A thorough list of equities from exchange traded funds that adhere to Shariah was used in the study. All of the stock investments in an exchange-traded fund must be in Shariah-compliant companies for it to be considered compliant. This indicates that all businesses must conform to Shariah law, which prevents them from engaging in activities relating to gambling, speculation, alcohol, and pigs. Therefore, businesses who possess a prohibited firm or have financial ratios higher than 33.33% are considered non-compliant. A more general summary of the illegal business activities includes adult entertainment, alcohol, gambling, and pork.

The chosen ETFs are shown in Table 1. These ETFs cover both established businesses and big businesses in the financial, retail, and technology sectors, among other industries. All of the companies represented by them are Shariah compliant. Duplicate holdings were eliminated and the holdings of the separate ETFs were combined.

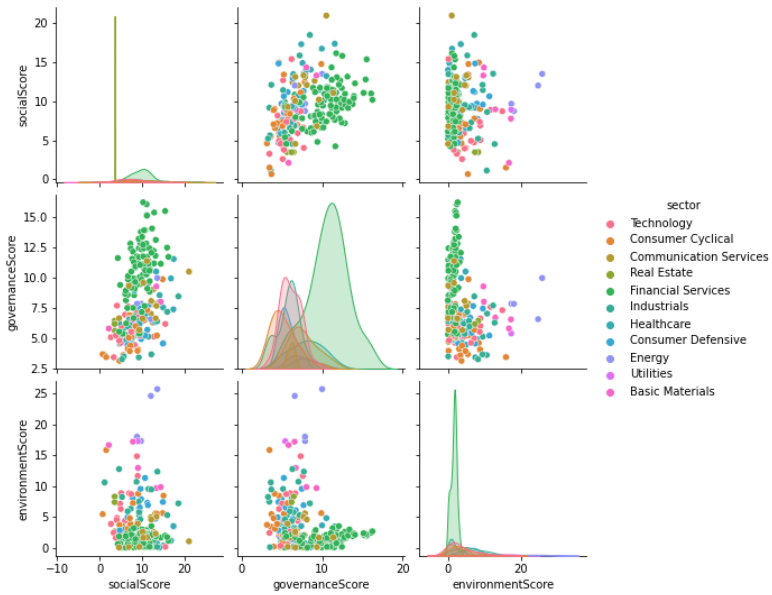
Table 1: Selected Shariah-Compliant ETF for the Selection of the Enterprises.

Ticker	EFT Name
METV	Roundhill Ball Metaverse ETF
IYF	iShares U.S. Financials ETF
DUHP	Dimensional US High Profitability ETF
XLC	Communication Services Select Sector SPDR Fund
IXP	iShares Global Comm Services ETF
IXG	iShares Global Financials ETF
EWCO	Invesco S&P 500 Equal Weight Communication Services ETF
EUFN	iShares MSCI Europe Financials ETF
ESPO	VanEck Video Gaming and eSports ETF
ISUS	iShares MSCI USA Islamic UCITS ETF
UMMA	Wahed Dow Jones Islamic World ETF

Corporate and stock-related data was obtained for each member from Yahoo Finance using its API. This contained typical company information like industry, name, and personnel count as well as important performance metrics like profit margin, EBITDA margin, beta ratio, etc. Additionally, extracts and records of the balance sheet, income statement, and cash flow statement were made. Additionally, sustainability indicators were extracted, including investment into specific items like arms and provided ESG ratings based on social, governance, environmental, and overall total ESG scores.

Figure 2 shows a summary of cross-plots between the social, governmental, and environmental scores. The cross-plot shows that there is a strong association between social score and governance, but only a minor correlation between social and the environment. Given the significant correlation between the social and governance scores, this is a crucial indicator for the use of the deep learning analytical approach.

Figure 2: Comparison Between Social, Government and Environment Score, Categorized by the Sector.



In general, the governance score increases when the social score decreases and vice versa. In contrast, because the distribution is more akin to a circular cloud than a narrow positively stretched point cloud, the environment score is somewhat independent of both social and governance factors. This shows that there is only a weak automatic association between environmental compliance and better social and governmental governance, necessitating a more thorough investigation to ascertain Islamic corporate environmental compliance.

While many companies have excellent social and governance scores, which may be reflected in their location and the composition of their boards, the organizations' operations may not have produced excellent environmental records. Banks may, for example, have close relationships to the community and adhere to tight governance guidelines, but they may also make substantial investments in environmentally risky enterprises.

It is crucial to pick the best cluster separation approach since a company's environmental compliance may not be accurately represented by its ESG compliance score alone. It is feasible to distinguish between organizations that uphold Islamic environmental beliefs and others that would find it challenging to do so thanks to the clustering.

To assess and distinguish between those who adhere to Islamic environmental law and those who may encounter difficulties, another analysis technique is necessary. A comparison of the social, governance, and environmental scores forms the basis of the first study. The findings of the clustering technique are shown in Figure 3, where there is a clear distinction between the environmental score and the social and governance scores.

Figure 3: Comparison Of Social, Governance And Environment Score Separated into Clusters (EC – Environmentally Compliant, Non-EC – Not Environmentally Compliant).

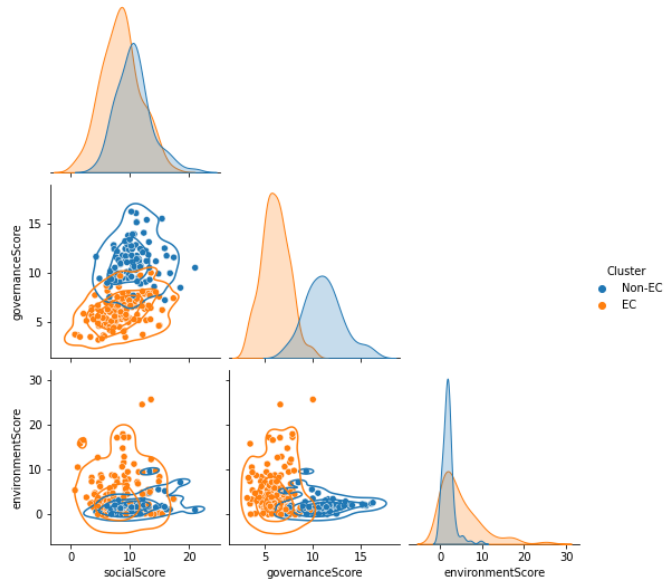
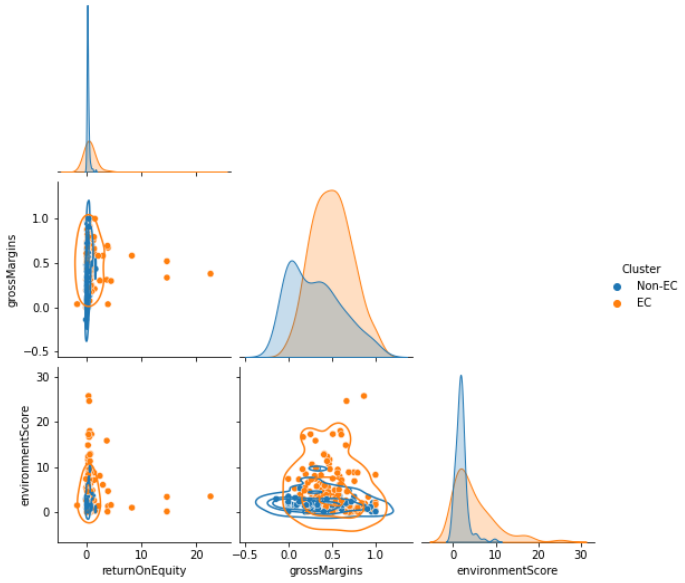


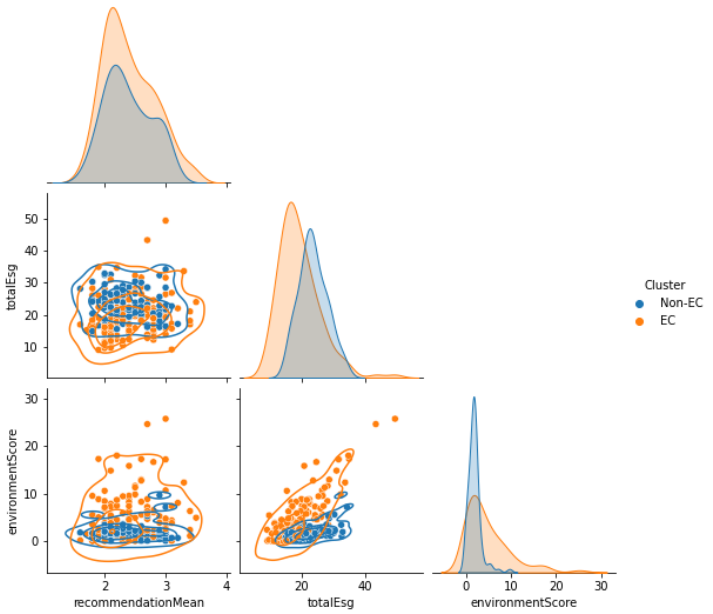
Figure 4 presents the return on equity, gross margins, and environment score in a separate comparison. According to the statistics, Islamic environmental compliance is favorably correlated with higher environmental and return on equity ratings. The contrast between gross margins, return on equity, and environmental score is particularly telling. There are certain companies with large gross margins but low environmental ratings whose adherence to Islamic environmental regulations may face difficulties.

Figure 4: Comparison of Clusters for the Return on Equity, Gross Margins and the Environment Score.



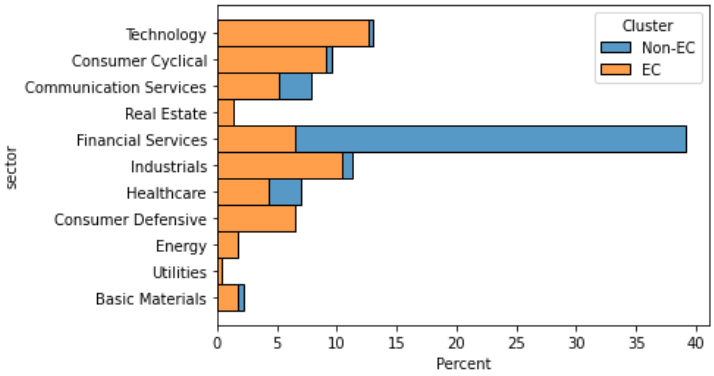
Additionally, Figure 5 shows a comparison of the investor recommendation, environmental, and overall ESG ratings. The findings show that the investment advice could not be in line with environmental score results. To get a better separation in relation to the environment score, the clustering is still rather high.

Figure 5: Recommendation Mean, Total ESG and Environmental Score.



The division of clusters into sectors is the subject of the last comparison. since can be seen, there is a clear division between financial services firms, since some of these institutions may engage in commercial activities that are not always conducive to attaining environmental sustainability goals.

Figure 6: Histogram Comparison Based on Clusters.



We compare the mean key performance metrics for both clusters in Table 2 to give an overview of the framework's performance. The results unmistakably show that Islamic ecologically compatible businesses do far better financially than non-compliant businesses while also scoring significantly higher in terms of the environment. Compared to non-EC compliant businesses, EBITDA margin is more than twice as high, while return on equity and gross margins are also much higher. This demonstrates the significance of accurately assessing

Shariah environmental compliance as this may promote environmental goals while also resulting in improved financial success.

Table 2: Comparison of Key Performance Indicators for Shariah Environmentally Compliant and Non-Compliant Enterprises.

	EC	NON-EC
Ebitda Margin	0.278631	0.123591
Return On Equity	0.995997	0.212491
Gross Margins	0.494910	0.310714
Environment Score	4.774130	1.825978

Conclusion

Investors are increasingly taking into account environmental, social, and governance factors in order to examine their investment decisions and achieve greater impact investments. Investors are coming under more and more social pressure to ensure that when allocating capital, the environment's impact, society's impact, and corporate governance standards are taken into account in addition to profitability considerations. Due to this, there has been an increase in companies being divested from those engage in highly polluting industries, forced labor, and lack of diversity in the workforce. Islamic banking embraces Shariah law's tenets, which heavily emphasize promoting society and preserving the environment.

It can be difficult to determine if firms are Shariah compliant in terms of the environment since environmental ESG ratings could not accurately reflect all of a corporation's environmental effect or its compliance with Shariah. In addition to evaluating a company's financial success, this article introduces a new data-driven approach for assessing its Shariah-compliant environmental performance. The deep learning system uses an unsupervised-random forest learning method to classify environmental compliance while also measuring these firms' financial performance. Large Islamic-compliant US listed firms were the subject of an investigation, which revealed high clustering performance and difference between Islamic environmental compliance and non-compliance.

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