International Journal of Cryptocurrency Research

Publisher's Home Page: https://www.svedbergopen.com/
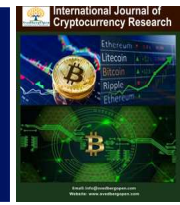
Research Paper

Open Access

The Impact of ESG on Startup ICO Fundraising: A Machine Learning Approach

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Abstract

Initial Coin Offerings (ICOs) have emerged as an alternative funding method for startups, bypassing the need for traditional financing. This study analyzes the relationship between Environmental, Social, and Governance (ESG) classification and the amount of funding startups raise through ICOs. The research also aims to identify other variables affecting fundraising through ICOs. The study examined 6,513 ICOs conducted between 2017 and 2021, using data collected from the ICOmark platform. A machine learning-based calculation mechanism was used to identify offers that target ESG, following the method proposed by Monsouri and Momtaz. Linear regression approach Ordinary Least Squares (OLS) and Generalized Least Squares (GLS) estimation methods were implemented to analyze the relationship between ESG rating and the funding raised through ICOs. The study found a negative relationship between ESG rating and the amount of funding raised through ICOs. Additionally, the study highlights that startups that adopt Know Your Customer (KYC) procedures tend to obtain more funding than others. Furthermore, the Minimum Viable Product (MVP) factor does not directly correlate with higher fundraising.

Keywords: ESG, ICOs, Startups, KYC, MVP

1. Introduction

ESG is an abbreviation for "Environmental, Social, and Governance," referring to practices adopted by organizations related to the environment, society, and governance. The term ESG has recently gained notable prominence due to the financial market's growing attention to sustainability. The environmental, social, and governance dimensions have become fundamental elements in risk analysis and investment decision-making, exerting considerable pressure on the business sector. In today's world, where various stakeholders meticulously

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monitor companies, adopting ESG practices is seen as a sign of robustness, reduced costs, improved reputation, and greater resilience in the face of uncertainties and vulnerabilities.

The ESG concept has consolidated itself as an essential element in the innovation agenda of several companies. According to a PwC consultancy report presented in 2020, by 2025, the share of mutual fund assets in Europe that will incorporate ESG criteria will reach 57%, totaling US$8.9 trillion. In this way, numerous organizations align their ESG strategies with consumer expectations, follow this path to obtain favorable results for their businesses, and justify adopting practices related to environmental, social, and governance issues.

In this context, startups play a crucial role as partners in introducing ESG-related solutions. They allow the measurement of results and facilitate the adoption of actions aligned with good practices toward corporate sustainability. This increased interest in the ESG topic originated from two sources: firstly, consumers began to prefer companies that demonstrate commitment to such practices; secondly, investors began to value and, consequently, pay more for shares in companies that incorporate ESG principles into their operations.

Therefore, although implementing the ESG agenda still represents a global challenge, this sector has aroused the interest of technology entrepreneurs, who have launched several startups in recent years, focusing on environmental, governance, or social issues.

While traditional companies generally rely on loans and financing and already have sufficient revenue to finance their operations from their operations and profits, startups often turn to angel investors, venture capital firms, crowdfunding, and other sources of financing for working capital, as many of them operate at a loss during the early stages. Thus, for many startups, Initial Coin Offerings (ICOs) have been an alternative way to raise funds for their projects. Instead of seeking traditional financing through venture capital investors or loans, early-stage startups can create a cryptocurrency or token and sell these tokens to investors in exchange for capital. This allows startups to obtain financing without giving up equity stakes or taking on debt.

Moxoto *et al.* (2024) findings reveal that countries with a strong emphasis on environmental sustainability and robust education and research institutions appear to host more ICOs considerations. This work is organized into the following chapters: literature review and formulation of hypotheses, methodological approach, analysis of results, conclusions, and finally, the list of references.

2. Literature Review and Hypotheses

2.1. ESG and Financial Performance

ESG is an acronym that stands for environmental, social, and governance. It refers to how companies and organizations manage environmental, social, and corporate governance issues. ESG practices have become essential in today's market as they benefit companies that adopt them, such as indicating solidity, lower costs, and better reputation. Investors and other interested parties also evaluate these practices to identify companies that adopt a responsible and sustainable stance.

There has been significant growth in the number of practices and research on sustainable investment due to the need to adapt to new global trends and the increasingly competitive market (Ji *et al.,* 2023). Many studies have been developed on the topic. Some researchers have addressed the relationship between risk and return on ESG investing (Cornell, 2021). It has been found that companies with lower ESG obtain higher returns than those with higher ESG. However, companies with a low ESG score are considered more risky as they are exposed to liabilities related to environmental, social, and corporate factors that increase the probability of default. ESG disclosure reduces the risks of corporate financial irregularities and helps to mitigate information asymmetry (Kim and Park, 2023). However, some companies use ESG concepts in bad faith, which is termed greenwashing (Sheehan *et al.,* 2023). A deceptive communication practice induces false positive perceptions of an organization's environmental performance. Other studies preferred to highlight the performance factor. Studies indicate that ESG performance can improve a company's market value and financial performance (Zhou *et al.,* 2022; Bashatweh *et al.,* 2023; Chen and Xie, 2022). Studies indicate that ESG performance can improve a company's market value and financial performance. However, companies that adhere to ESG do not necessarily have higher economic-financial performance than others do (Ren *et al.,* 2023). The discrepancies

result from variables such as differences in chosen methodologies, analysis techniques, time adopted for research, sectors analyzed, and countries studied. Investing in socio-environmental actions can guarantee companies' reduction of losses in times of crisis (Zhou *et al.*, 2022).

2.2. ICO and Research Hypotheses

Initial Coin Offerings (ICOs) emerged around 2013, but it was only in 2017 that they gained popularity, as they became an attractive alternative for financing innovative companies (Roosenboom *et al.*, 2018) ICOs are also often known as token sales (Casarella and Manfrè, 2019) Bitcoin, the pioneering cryptocurrency, often serves as the primary means of payment for ICO investments.

ICOs are blockchain-based crowdfunding campaigns where investors transfer fiat money or cryptocurrencies and, in return, receive tokens from the fundraising venture (Mansouri and Momtaz, 2022). Therefore, it is essential to highlight that the main difference between ICOs and other alternative financing mechanisms is the issuance of cryptographic tokens (Moxotó *et al.*, 2021). ICOs and equity crowdfunding are poised to lead the next stage in the evolution of business finance. They are consolidating themselves as the primary source of initial financing for blockchain platforms, although the path and speed of their evolution are yet to be determined (Alshater *et al.*, 2023).

Token offerings are a ripe field for better understanding the financing of sustainability-oriented startups for at least two reasons: Initially, individual investors with financial and non-financial goals predominantly populate this market. Second, unlike other corporate financing mechanisms, the institutional characteristics associated with token offerings enable a quantitative analysis of startups' valuation and environmental, social, and governance (ESG) performance (Mansouri and Momtaz, 2022; Fisch *et al.*, 2022).

Campino *et al.* (2022) identified the success factors of ICOs: having a well-structured and informative whitepaper; the proximity of specific markets with an abundance of financial resources and human talent; the significant dependence on cryptocurrencies and how their valuations affect the success of a venture; the relevance of social media in ICO projects, as well as the importance of human capital characteristics. Moxoto *et al.* (2021) compiled studies that address the crucial factors for the success of ICOs and identified four fundamental areas: human and social capital, technological characteristics, governance and legal aspects, and financial details of the campaign. These areas dealt with topics such as token distribution, rating, Ethereum platform, KYC, Whitelist, team size, campaign duration, USD restrictions, and the use of fiat currency.

Specific authors sought to investigate performance in the post-ICO period. According to Lyandres *et al.* (2022) operational performance after an ICO is positively correlated with contemporary token returns and generally has a negative association with token return volatility, indicating that post-ICO operational performance has financial implications. Fisch and Momtaz (2020) found that institutional investor support is associated with higher post-ICO performance. In turn, Wang *et al.* (2022) found that the entry of institutional investors causes a substantial increase in the equilibrium price of tokens during the public offering phase, as well as increasing the fluctuation in the prices of these tokens over time. Other studies indicate that ICOs, given their high-risk characteristics, do not prove to be a solid financial asset for a long-term investment.

Bellavitis *et al.* (2020) found that the growth of ICOs was initially correlated with the rise in the price of Bitcoin. However, even with this factor, the number of ICOs has declined recently. The authors attribute this slowdown to implementing regulations designed to protect investors, which ended up restricting more speculative or even fraudulent ICOs. Moxoto *et al.* (2024) findings reveal that countries with a strong emphasis on environmental sustainability and robust education and research institutions appear to host more ICOs. Conversely, nations with high country risk (perceived instability), concentrated banking systems, and frequent bank defaults negatively correlate with ICO adoption.

Due to the growth of ICOs and investors' preference for ESG companies, recent studies have emerged linking both. Bitetto and Cerchiello (2023) confirmed that ESG-oriented ICOs have a higher expectation of success in raising funds. Mansouri and Momtaz (2022) investigated the effect of startups' ESG scores on their valuations and performance after obtaining funding in blockchain-based crowdfunding campaigns, also known as token or initial coin offerings (ICOs). The results indicate that startups with relevant ESG

characteristics enjoy considerably higher valuations; however, startups with prominent ESG characteristics demonstrate lower performance during the first year after listing a token on an exchange platform. Given the above and based on the literature review, the hypotheses tested are:

> H_1: *There is a positive relationship between the ESG classification and the volume of funding raised by startups through ICOs.*

Initial Coin Offerings (ICOs) have become famous for startups to raise funds. However, this market comes with risks such as fraud, market manipulation, and lack of regulation. Knowing Your Customer (KYC) is vital to mitigating these risks. KYC involves verifying investors' identities and sources of funds by collecting information and documents. Momtaz (2020) found that gross revenues and nominal returns on the first day of the ICO decrease when the process involves KYC. This is because KYC increases the cost and time required to raise funds, which can limit the number of potential investors. However, Fisch (2019) argues that KYC restrictions on investors can benefit ventures by helping them build long-term relationships with the investors and ensuring they know who invests on their platform. Karpenko *et al.* (2021) suggest that KYC, along with publishing a white paper and involving guarantee agents, is the primary way to reduce the risks of an ICO.

> H_2: *There is a positive relationship between KYC and the volume of funding raised by startups through ICOs.*

Among all sample ventures, 19.8% already had a minimum viable product (MVP) available at the ICO start and 66.1% published their code on GitHub (Fuchs and Momtaz, 2023). This MVP or open-source code was a working prototype (Chod *et al.*, 2019). Investors believe having an MVP or open-source code available before the ICO campaign positively influences a startup's survival. Developing an MVP is an essential step for ICOs seeking to validate their ideas, gather valuable feedback, and optimize resource utilization. While the average timeline for MVP completion in ICO projects is around three months, some ventures may require more time due to factors such as technical complexity, team size, and funding availability. By embracing an MVP-centric approach, ICOs can increase their chances of success in the dynamic and competitive world of cryptocurrency and blockchain-based ventures (Bourveau *et al.*, 2022).

> H_3: *There is a positive relationship between MVP and the volume of funding raised by startups through ICOs.*

According to Fahlenbrach and Frattaroli (2021), participating in initial coin offerings (ICOs) may be motivated by speculation rather than the intention to use the final product. When companies sell tokens before developing their product, it questions their motivations. It is a valid concern since pursuing short-term profit instead of long-term utility may be the primary objective. If companies hold a more significant fraction of tokens, it signals a commitment and aligns the interests of owners, employees, and investors. Generally, companies reward their employees with tokens. Examining the financial details of an ICO, such as the percentage of tokens held by the issuers, strongly indicates the entrepreneurs' dedication to the business's success. Therefore, a positive correlation exists between higher levels of business trust in companies and the percentage of tokens they maintain. Fuchs and Momtaz (2023) investigates how token governance mechanisms influence the success of Initial Coin Offerings (ICOs). ICOs are a fundraising method where projects issue new crypto tokens to investors. Investors often face uncertainty about the project's future, making ICOs risky. They highlight that projects retaining a higher percentage of tokens tend to secure more funding, indicating investor preference for long-term project commitment. Conversely, resale restrictions on tokens correlate with a decrease in token value over time, likely due to reduced liquidity. These findings are crucial for understanding investor behavior and the impact of governance mechanisms on ICO success.

> H_4: *There is a positive relationship between the distribution of tokens and the volume of funding raised by startups through ICOs.*

Studies by Roosenboom *et al.* (2018) and Samieifar and Baur (2021) have shown that ICOs with above-average ratings tend to outperform token sales compared to those with lower ratings. Bourveau *et al.* (2022) concluded that ICOs with higher ratings are more likely to raise funds successfully, have more liquid tokens, and are less likely to fail after the ICO ends. Feng *et al.* (2018) analyzed the voluntary disclosures of ICO issuers in their "white papers" and found that ICO projects with a higher rating raised more funds than their competitors. Therefore, ICOs with a high rating are more likely to have their digital coins/tokens listed on a cryptocurrency exchange within 180 days after the end date of their ICO campaigns.

H_5: *There is a positive relationship between rating and the volume of funding raised by startups through ICOs.*

Adhami *et al.* (2018) discovered that the short duration of an ICO and its being a blockchain-based token on Ethereum positively influenced the amount of financing raised. Burns and Moro (2018) analyzed over 100 ICOs to identify factors contributing to their success, and they found that the Ethereum platform negatively affects first-day returns.

H_6: *There is a positive correlation between the Ethereum Platform and the amount of funding raised by startups through ICOs.*

Lyandres *et al.* (2022) examined the determinants of ICO success, post-ICO returns, long-term returns, volatility, liquidity, the evolution of project-related social media activity, and the output of projects around the ICOs. They stated that whitelist and KYC requirements are associated with a greater probability and degree of ICO success.

H_7: *There is a positive relationship between Whitelist and the volume of funding raised by startups through ICOs.*

Several authors researched to identify the factors that contribute to the success or failure of an ICO project, but their findings were different. While Fenu *et al.* (2017) stated that team size does not affect the success or failure of an ICO project, Campino *et al.* (2022) and Aslan *et al.* (2023) concluded that the more specialists and members a development team has, the higher the chances of success and fundraising.

H_8: *A positive relationship exists between the size of the team and the volume of funding raised by startups through ICOs.*

Both Aslan *et al.* (2023) and Roosenboom *et al.* (2020) found that ICOs with a shorter token sale duration are more likely to raise funds successfully. Czaja and Röder (2022) also argued that the short duration of the ICO, set before the token sale event, indicates the project team's confidence in their ability to raise the necessary funds in a short period, similar to crowdfunding capital.

H_9: *There is a positive relationship between the campaign's duration and the volume of funding raised by startups through ICOs.*

Studies indicate that projects that impose restrictions on specific countries, mainly the USA and China, tend to raise less during their campaigns. As these countries are large investment markets, not operating in them could reduce the probability of success (Momtaz, 2020).

H_{10}: *A positive relationship exists between USD restriction, and the volume of funding startups raise through ICOs.*

Accepting fiat currency (dollar, Euro, Real, etc.) may suggest that the ICO is connected to the traditional banking system, which can increase the venture's reliability and potentially attract more investors, according to Amsden and Schweizer (2018). However, Wu *et al.* (2019) concluded that accepting fiat currency to exchange tokens is uncommon, and due to the lack of available research, its influence on an ICO's fundraising cannot be statistically analyzed. Nonetheless, accepting fiat as a form of payment is statistically essential in achieving a successful ICO, especially regarding the total amount of funds raised. On the other hand, Momtaz (2019) stated that using cryptocurrencies speeds up verifiable transactions and involves lower costs than payments with fiat currency. This could discourage investors and reduce the venture's chances of success.

H_{11}: *A positive relationship exists between FIAT Currency and the volume of funding startups raise through ICOs*

3. Methodology and Data Analysis

This study aims to verify the hypotheses established in the previous section. The objective is to analyze the relationship between the ESG rating and the volume of financing raised by startups through initial coin offerings. The secondary objective is, to identify other variables that may affect fundraising by startups through ICOs distribution. The ICOmark platform (an independent platform for ICO analysis and research) was used to extract the database for the study. The study seeks to determine whether the ESG classification, token distribution, Rating, Ethereum Platform, KYC, Whitelist, minimum viable product (MVP), team size, campaign duration, USD, and fiat restrictions are positively correlated with the amount of funding obtained by startups through their ICOs.

3.1. Variables and Descriptive Statistics

For this study, we analyzed 6,513 ICOs from 2017 to 2021. The data was collected from the ICOmark platform (https://icomarks.com/), and the dependent variable is the financial amount raised through ICOs. The explanatory variables include token distribution, Rating, ETHEREUM platform usage, KYC compliance, whitelist inclusion, Minimum Viable Product (MVP) availability, team size, campaign duration, and USD and fiat currency restrictions. The ESG explanatory variable was calculated based on this research's topic (3.1.1). The "snowball" method was used to select variables with statistical significance.

3.1.1. Quantifying the ESG Properties of Startups

The automated mechanism was deeloped to calculate the ESG ratings of 6,513 startups. This mechanism uses a machine learning strategy that quantifies the ESG characteristics of startups based on their text data, such as

Table 1: Description of Variables

Variable	Acronym	Description	Scale	Source
1. Amount Raised	(Raised)	The variable corresponds to the amount raised by the startup during the campaign.	Dollar	ICOmark
2. ESG (Dependent)	ESG	Criteria for evaluating a company's performance and social and environmental responsibility. "E" stands for environmental, "S" for social, and "G" for governance.	0 - 0.06	Www. SustainableEntrepreneurship.org.
3. Tokens Distributed	(distr_tk)	In ICOs, tokens are distributed to investors as part of the fundraising process for a project.	0 – 100%	ICOmark
4. Rating	(Rating)	Assessment or rating is given to an ICO by specific rating agencies or sector experts. It aims to inform potential investors about the quality, credibility, and potential for success of an ICO.	0 - 5	ICOmark
5. Ethereum Platform	(Ethereum)	Ethereum Platform is a decentralized platform that uses blockchain technology to run smart contracts and decentralized applications (dApps).	0 – 1 (Dummy)	ICOmark
6. Know your customer	(KYC)	KYC refers to a set of mandatory procedures in the financial market that verify a user's true identity. Using KYC in ICOs helps prevent fraud and illegal financial transactions.	0 – 1 (Dummy)	ICOmark
7. Whitelist	(Whitelist)	It consists of a list of authorized participants for a particular event, such as an Initial Coin Offering (ICO), being employed to ensure that only individuals or entities with the required qualifications can participate.	0 – 1 (Dummy)	ICOmark
8. Minimum Viable Product	(MVP)	Developers present An MVP prototype of the product or project to potential investors.	0 – 1 (Dummy)	ICOmark
9. Team Size	(Team Size)	The size of the ICO team refers to its composition and number of members. Evaluating this is essential, as it is critical to the project's success.	Numeric	ICOmark
10. Campaign duration	(Duration)	Time in which an ICO campaign is open for fundraising.	Time	ICOmark
11. USD Retracements	(Restrictions USD)	The variable refers to ICOs with trading restrictions in certain countries, such as China or the USA.	0 – 1 (Dummy)	ICOmark
12. Fiat Currency	(Fiat)	A fiat currency is any official currency backed by the government. The ICO accepts investments made using fiat currencies instead of the exclusive use of cryptocurrencies.	0 – 1 (Dummy)	ICOmark

Source: Own authorship

press releases, whitepapers, GitHub documentation, website content, and other sources like Crunchbase. The method proposed by Monsouri and Momtaz (2022) was used for the calculation. This method aims to reduce subjectivity in ESG measurement in the literature and relies on word counts using specific dictionaries (corpus) of topics. The ESG classification method developed in Python (ESG_Calculator) was used to evaluate each startup individually. The list of startups was compiled using the union of two listings from two classification and statistics platforms related to cryptocurrency ICOs, ICOMark and Foundico. The chosen indicators are described in Table 1, describing the variables below.

3.2. Descriptive Statistics

Table 2 presents some basic descriptive statistics on the variables used. The data makes us highlight some relevant aspects.

Table 2: Descriptive Statistics of the Results					
Variable	**Average**	**Median**	**DP**	**Min**	**Max**
ESG	0.000898	0.00	0.00295	0.00	0.06
Raised	4,097,054.06	0.000	21,863,886.22	0.00	1,000,000,000
Distr_Tk	0.39	0.45	0.30	0.00	1.00
Rating	2.52	2.70	1.23	0.00	5.00
Ethereum	0.51	1.00	0.50	0.000	1.00
Kyc	0.40	0.00	0.49	0.000	1.00
Whitelist	0.25	0.00	0.43	0.000	1.00
MVP	0.22	0.00	0.41	0.000	1.00
Team size	7.52	6.00	7.80	0.000	66.0
Duration	56.66	31.00	93.94	0.000	3722
Restrictions USD	0.25	0.00	0.44	0.000	1.00
Fiat	0.15	0.00	0.35	0.000	1.00

The following text summarizes the findings of a study on startups that conducted Initial Coin Offerings (ICOs). The first variable analyzed is the amount raised by each start-up, referred to as the dependent variable. The start-up that raised the most money was BITFINEX, with a total value of USD 1 -13824. The minimum value is zero, as some companies did not raise funds. The average value among the start-ups surveyed was USD 4,097,054.06, with a standard deviation of USD 21,863,886.22.

Next, the study evaluated the Environmental, Social, and Governance (ESG) variable, which measures a company's performance and social and environmental responsibility. The start-up that performed best in the Social criterion was Green Coin, with a value of 0.06. Some start-ups did not adopt ESG values and scored zero. The average value of the ESG variable was 0.000898, with a standard deviation of 0.00295. The distributed tokens variable (distr_tk) refers to the tokens given to investors contributing to the project's financing. The average value among start-ups was 0.391, with a standard deviation of 0.298 and a median of 0.450. Some companies awarded investors 100% of their tokens, while 26.31% gave none.

The Rating variable evaluates the quality, credibility, and potential for success of an ICO. Only one start-up, DogData, received a maximum rating, while 13.78% of companies had a zero rating. The average rating was 2.52, with a standard deviation of 1.23 and a median of 2.70, indicating that most start-ups did not receive positive reviews.

The Ethereum platform dummy variable recommends that start-ups use a decentralized platform capable of running smart contracts and decentralized applications (dApps) using blockchain technology. The mean,

median, and standard deviation values were 0.51, 1, and 0.5, respectively, suggesting that many start-ups use this platform. The Know Your Customer (KYC) dummy variable measures whether a start-up has procedures in place to verify the identity of its users. The average value of this variable was 0.40, with a standard deviation of 0.49, indicating that most companies do not adopt this procedure.

Finally, the Whitelist variable measures whether a start-up maintains a list of authorized participants. The mean, median, and standard deviation values were 0.25, 0, and 0.43, respectively, suggesting that more companies do not use a whitelist than those that do. The Minimum Viable Product (MVP) variable measures whether a company has a functional prototype of its product or project. The average value was 0.22, with a median of six and a standard deviation of 0.41, indicating that most start-ups did not have an initial and functional version of their product or project to present to investors.

The variable "Team size" is used to evaluate the size of a company's team. Our data shows that Era Swap Token presented the most prominent team, with 66 members. Companies had seven members on average, with a standard deviation of 7.80 and a median of six. However, we found that approximately 30% of companies did not disclose their number of team members. The "Campaign Duration" variable (duration) refers to when an ICO campaign was open for fundraising. Our data showed that the mean duration was 56.66, with a median of 31 and a standard deviation of 93.94. This suggests that most companies need around 55 days to raise the requested amount or abandon the project.

The variable "USD Restrictions" refers to specific restrictions or regulations applied to an ICO in which investments are made in U.S. dollars. On average, we found that these restrictions had a value of 0.25, with a standard deviation of 0.44. This indicates that most companies do not suffer from trading restrictions in certain countries. The "FIAT" variable indicates whether an ICO accepts investments using fiat currencies instead of exclusively using cryptocurrencies. Our data showed that, on average, few companies (mean of 0.15) accept fiat currencies to start their investments, preferring cryptocurrencies.

3.3. Model and Estimation Method

When conducting a linear regression, it is crucial to ensure that linearity assumptions and correct model specifications are met. If hypothesis violations are detected, such as a violation of homoscedasticity, alternative estimation methods, such as the Generalized Least Squares (GLS) or robust errors, must be applied. These methods are more efficient in the occurrence of heteroscedasticity.

We used R-STUDIO, a free integrated development environment software for R (a programming language for creating graphs and statistical calculations), to conduct linear regression. The R programming language offers numerous advantages for those working with data, particularly in statistics, data science, and machine learning. It provides complete data analysis, free and open-source software, easy learning, and a wide range of applications. The program is used in econometric research and offers a variety of libraries based on ordinary least squares, maximum likelihood, and generalized methods of moments. It can analyze various data types, such as time series, cross-section, and panel data.

A log-log model specification was assumed to present better results. In the log-log model (where both the dependent and explanatory variables are logarithmic), the estimated coefficients represent elasticities and show the absolute variation of the dependent variable as a function of an absolute variation in the explanatory variable. Please see the model specifications (1) below.

Model (1):

$$lnRaised_i = \alpha_0 + \alpha_1 lnESG_i + \alpha_2 lnKYC_i + \alpha_3 lnMVP_i + u_i \qquad \qquad ...(1)$$

The equation presented here is a linear regression model that predicts the natural logarithm of the value raised (*lnRaised*) based on the natural logarithms of *ESG*, *KYC*, and *MVP* variables and an error term (u_i). In this model, *lnESG* is the dependent variable (Equation 1) and represents a company's commitment level towards environmental, social, and governance issues. On the other hand, *lnKYC* and *lnMVP* are independent variables that represent mandatory procedures for verifying a user's identity and a prototype of a product/project shown to potential investors, respectively. Finally, *u* represents the residual or the error while trying to understand lnESG in terms of the explanatory variables. According to Equation (1) estimation, we expect a

positive correlation between the amount raised and all the explanatory variables. The following is a report on the regressions conducted with the ESG index as the dependent variable.

4. Results and Analysis

The results, presented in Table 4, indicate a satisfactory level of adjustment and statistical significance of the coefficients. The R-squared value suggests that around 2% of the ESG explanation can be attributed to the explanatory factors. The F-statistic validates the joint significance of the coefficients, and the RESET test confirms that the model has an adequate specification.

However, heteroscedasticity in the model has resulted in inefficient estimates. The Breusch-Pagan test confirms the presence of heteroscedasticity; therefore, the estimation method known as Generalized Least Squares (GLS) has been used. GLS estimators are more efficient in scenarios with non-constant variance (heteroscedasticity) and have been used to correct the heteroscedasticity in the model. The alternative GLS model shows that over 1.5% of the explanation (R-squared) of ESG is due to the explanatory factors. The F-statistic validates the joint significance of the coefficients. The estimates of both models are described in Table 3. The following is a report on the regressions conducted with the ESG index as the dependent variable. The results, presented in Table 4, indicate a satisfactory level of adjustment and statistical significance of the coefficients. The R-squared value suggests that around 2% of the ESG explanation can be attributed to the explanatory factors. The F-statistic validates the joint significance of the coefficients, and the RESET test confirms that the model has an adequate specification. However, heteroscedasticity in the model has resulted in inefficient estimates. The Breusch-Pagan test confirms the presence of heteroscedasticity; therefore, the estimation method known as Generalized Least Squares (GLS) has been used.

GLS estimators are more efficient in scenarios with non-constant variance (heteroscedasticity) and have been used to correct the heteroscedasticity in the model. The alternative GLS model shows that over 1.5% of the explanation (R-squared) of ESG is due to the explanatory factors. The F-statistic validates the joint significance of the coefficients.

The estimates of both models are described in Table 3.

Table 3: Results of Estimating the Raised ICOs, Equation (1)		
Dependent Variable *lnRaised*	**Model (1)** **(OLS)**	**Model (2)** **(GLS)**
Const	4.53991(***)	4.539910(***)
	< 2e-16	0.0000
lnESG	-0.53602(***)	-0.536020(***)
	< 2e-16	0.0000
lnKYC	0.58433(**)	0.584329(**)
	0.00165	0.0017
lnMVP	-0.56349(*)	-0.563490(*)
	0.01096	0.0110
R-squared (R^2)	0.02038	0.015040
F-Stat Joint Significance	F(45.14 on 3 and 6509) p-value < 2.2e-16	F(3, 6509) 33.12933 p-value 3.04e-21
Heteroscedasticity (Breusch-Pagan Test)	137.43, df = 3 p-value < 2.2e-16	
Observations (#)	6,513	6,513
Notes: ***, **, * indicate that the coefficients are statistically significant at the 1%, 5%, and 10% levels, respectively; p-values of the coefficient significance are underneath the estimates; (#) due to missing data, the initial set of countries reduced significantly.		

The following results indicate an inverse relationship between ESG (*lnESG*) and the KYC variable (*lnKYC*), whereas the MVP variable (*lnMVP*) presents a positive relationship with the dependent variable.

Upon analyzing the ESG variable, according to model 2 (GLS), it is predicted that, on average, with a 1% increase in the ESG index, there will be a decrease of approximately 0.54% in the amount raised, with a p-value of 0.0000, while everything else remains constant. This result contradicts hypothesis H_1, which claims a positive relationship exists between the ESG classification of start-ups and the volume of financing raised through ICOs. Regarding the marginal impacts of the explanatory variables, we found that a 1% increase in the KYC variable, which refers to the process used in ICOs to verify the identity of participants, leads to a 0.58% increase in the amount collected, holding other variables constant, with a p-value of 0.0017. Therefore, the result is consistent with hypothesis H_2, which states a positive relationship between KYC and the volume of funding raised by start-ups through ICOs.

The analysis conducted using the GLS method revealed a negative relationship between the MVP variable and the amount of financing raised by start-ups through ICOs, which contradicts hypothesis H_3. In other words, a 1% increase in the presence of an MVP is associated with a 0.56% decrease in the amount raised. However, the statistical significance of the MVP variable is not as vital as that of other variables in the model, as indicated by the p-value of 0.0110. Regarding the ESG index, no significant relationship was found with token distribution, the Ethereum platform, Whitelist, team size, campaign duration, USD restrictions, and FIAT currency. Therefore, hypotheses H_4 to H_{11} could not be proven.

The study also showed no positive relationship between the ESG classification and the volume of financing raised through ICOs. There is a negative relationship between the two variables. This might be because ESG projects are usually long-term investments and can take years to materialize. ICOs, on the other hand, are high-risk investments that are not suitable for long-term investments. Investors typically look for faster returns and are less likely to invest in projects with long-term environmental, social, or governance benefits.

Additionally, investor skepticism towards ICOs, especially toward ESG start-ups, can increase due to concerns about fraud and money laundering, as highlighted by the research of Hornuf *et al.* (2022) Initial Coin Offerings (ICOs) have emerged as an intriguing alternative financing mechanism for innovative ventures since 2017, leveraging blockchain technology to raise capital. However, despite their initial allure, ICOs are characterized by extreme volatility.

Furthermore, regulations implemented to protect investors may have contributed to the slowdown in ICOs, as Bellavitis *et al.* (2020). Regulations designed to protect investors have restricted more speculative and fraudulent ICOs. The study confirmed that start-ups adopting KYC procedures can obtain more financing than those that do not. This contradicts Momtaz (2020). However, Karpenko *et al.* (2021) highlight the importance of KYC procedures and other factors in reducing the risks of an ICO. Investors may consider KYC a sign of greater transparency on the part of start-ups, which increases trust and the amount of financing received.

The study found that start-ups with a product prototype to present to investors do not raise more funds than those without. One possible explanation for the discrepancy between studies is that the effectiveness of an MVP may depend on the specific context of the start-ups studied. The intricate dynamics of Initial Coin Offerings (ICOs) are a testament to the multifaceted nature of start-up financing. This particular study sheds light on the nuanced interplay between a start-up's characteristics and its ability to secure funding through ICOs. The counterintuitive finding that a higher ESG rating correlates with lower capital raised challenges the conventional wisdom that socially responsible practices are always beneficial in attracting investment. It underscores the complexity of investor motivations, where the allure of quick financial returns can overshadow the long-term value of sustainability and ethical governance.

The positive impact of KYC verification on funding success speaks volumes about the critical role of trust in financial transactions. In the digital age, where anonymity can often be a cloak for malfeasance, the assurance that comes with identity verification is a valuable currency. It not only enhances the credibility of the ICO but also fosters a sense of security among potential investors, who are understandably cautious in the volatile realm of cryptocurrency. The study's insights into the MVP's influence—or lack thereof—on investment attraction open up a dialogue about the factors that drive investor decisions in the ICO space. While conventional

logic might suggest that a tangible product would instill confidence in investors, the findings indicate that this is not always the case. This could be attributed to the investors' focus on the potential for rapid growth and scalability, rather than the immediate availability of a product.

Overall, the research emphasizes the importance of a holistic approach to understanding ICO success. It's not just the technological innovation that counts but also how a start-up positions itself in terms of trustworthiness, strategic vision, and adherence to regulatory frameworks. As the ICO landscape continues to evolve, these insights become ever more crucial for start-ups looking to navigate the complex waters of cryptocurrency financing.

In conclusion, the study offers a valuable contribution to the discourse on ICOs, highlighting the delicate balance between various start-up characteristics and their influence on financing outcomes. It serves as a reminder that in the fast-paced world of ICOs, success is not just about having a groundbreaking idea or technology, but also about how a start-up aligns itself with the expectations and apprehensions of its potential investors. The findings on ESG, KYC, and MVP provide a nuanced understanding of the ICO ecosystem, offering a foundation for future research and strategic planning for emerging enterprises.

5. Conclusion

This study aims to analyse the relationship between the ESG classification and the volume of financing raised by start-ups via Initial Coin Offerings (ICOs). The study also aims to identify other variables that may affect fundraising by start-ups through ICOs. To achieve this, the study considered 6,513 ICOs from 2017 to 2021, and the data was collected from the Imparks platform. The ESG explanatory variable was calculated using a machine-learning method proposed by Monsouri and Momtaz (2022).

The study found a negative relationship between the ESG rating and the volume of funding raised through ICOs. This contradicts previous studies that suggested ESG-oriented ICOs would be more successful in raising funds. The study suggests that ICO investors may not be willing to wait for a long time for a return on their investment. The high volatility and risk associated with ICOs can cause investors to seek faster returns, making them less likely to invest in projects that promise long-term environmental, social, or governance benefits. The presence of fraud and money laundering cases can also increase investor skepticism towards this type of investment, especially in the case of ESG start-ups. Regulations to protect investors may also have contributed to the slowdown in ICOs by restricting the most speculative or fraudulent ones. The study also found that start-ups adopting KYC procedures can obtain more financing than those that do not. This result can be attributed to investors' changing perception towards KYC, which is a sign of greater transparency for start-ups. The study brings positive news for start-ups implementing Know Your Customer (KYC) procedures. KYC verification, which confirms participant identities, appears to boost investor trust and consequently, the amount of capital raised. This suggests that transparency is a valuable asset in the ICO landscape.

However, the study revealed that having a prototype of their product to present to investors does not guarantee that start-ups will raise more funds than those without one, indicating that the MVP factor is not directly linked to more excellent fundraising. To expand knowledge on the topic, it would be interesting to carry out future research that replicates the study using alternative methodologies, such as cluster methodology, to obtain a more comprehensive and in-depth understanding of the results. The effectiveness of having a Minimum Viable Product (MVP) remains unclear. The study found no direct link between an MVP and increased fundraising success. This opens doors for further research. Perhaps the impact of an MVP depends on the specific industry or technology involved in the ICO. A deeper understanding of this factor could be crucial for start-up strategies.

We propose replicating the study with alternative methodologies like cluster analysis. This could provide a more nuanced picture of how various factors interact and influence ICO success. The intersection of ESG principles and ICOs presents a fertile ground for research and innovation. Effective communication strategies are essential in aligning investor expectations with the long-term benefits of ESG-focused ICOs, potentially bridging the gap between immediate returns and sustainable impact. Exploring alternative fundraising models, such as tokenized impact investing, could offer a dual appeal of financial returns and positive contributions to society and the environment. Additionally, the liquidity of secondary markets may serve as an incentive for

investment in ESG projects, despite longer maturation periods for returns, suggesting a nuanced relationship between liquidity and long-term investment success. These avenues offer a broader understanding of the dynamics at play in ESG ICO financing and its broader implications in the investment landscape.

References

Adhami, S. *et al.* (2018). Why Do Businesses Go Crypto? An Empirical Analysis of Initial Coin Offerings. *SSRN Electron. J.*, 100, 1-28, Nov. doi: 10.2139/ssrn.3046209

Alshater, M.M. *et al.* (2023). Initial Coin Offerings: A Hybrid Empirical Review. *Small Bus. Econ.*, 1-18, Jan. doi: 10.1007/S11187-022-00726-2

Amsden, R. and Schweizer, D. (2018). Are Blockchain Crowdsales the New 'Gold Rush'? Success Determinants of Initial Coin Offerings. *SSRN Electron. J.*, Apr. doi: 10.2139/ssrn.3163849.

Aslan, A., Sensoy, A. and Akdeniz, L. (2023). Determinants of ICO Success and Post-ICO Performance. *Borsa Istanbul Rev.*, 23(1), 217-239, Jan. doi: 10.1016/j.bir.2022.10.005

Bashatweh, A.D., Abutaber, T.A., AlZu'bi, M.J., Abu KHader, L.F., Al-Jaghbir, S.A. and AlZoubi, I.J. (2023). Does Environmental, Social, and Governance (ESG) Disclosure Add Firm Value? Evidence from Sharia-Compliant Banks in Jordan. in *Sustainable Finance, Digitalization and the Role of Technology, ICBT 2021*, 487, 585-595. doi: 10.1007/978-3-031-08084-5_42

Bellavitis, C., Fisch, C. and Wiklund, J. (2020). A Comprehensive Review of the Global Development of Initial Coin Offerings (ICOs) and their Regulation. *J. Bus. Ventur. Insights*, 15, November, e00213. doi: 10.1016/j.jbvi.2020.e00213

Bellavitis, C., Cumming, D. and Vanacker, T. (2020). Ban, Boom, and Echo! Entrepreneurship and Initial Coin Offerings. available: https://www.pwc.ch/en/publications/2020/Strategy&_ICO_STO_Study_Version_Spring_2020.pdf

Bitetto, A. and Cerchiello, P. (2023). The Nexus Between ESG and Initial Coin Offerings: Evidence from Text Analysis.

Bourveau, T., De George, E.T., Ellahie, A. and Macciocchi, D. (2022). The Role of Disclosure and Information Intermediaries in an Unregulated Capital Market: Evidence from Initial Coin Offerings. *J. Account. Res.*, 60(1), 129-167. doi: 10.1111/1475-679X.12404

Burns, L. and Moro, A. (2018). What Makes an ICO Successful? An Investigation of the Role of ICO Characteristics, Team Quality and Market Sentiment. *An Investig. Role ICO Charact. Team Qual. Mark. Sentim,* September 27, 2018.

Campino, J., Brochado, A. and Rosa, Á. (2022). Initial Coin Offerings (ICOs): Why Do they Succeed?. *Financ. Innov.*, 8(1), 1-35. doi: 10.1186/s40854-021-00317-2

Casarella, P. and Manfrè, C. (2019). Capital Raises, Initial Coin Offerings, and Token Sales. 22(1). available: https://gbr.pepperdine.edu/2019/03/capital-raises-initial-coin-offerings-and-token-sales/

Chen, Z. and Xie, G. (2022). ESG Disclosure and Financial Performance: Moderating Role of ESG Investors. *Int. Rev. Financ. Anal.*, 83, Oct. doi: 10.1016/j.irfa.2022.102291

Chod, J., Trichakis, N., Tsoukalas, G., Aspegren, H. and Weber, M. (2019). On the Financing Benefits of Supply Chain Transparency and Blockchain Adoption Management Science-Forthcoming. *Oper. Res. Cent. Sloan Sch. Manag.*, 1-35. available: https://ssrn.com/abstract=3078945

Cornell, B. (2021). ESG Preferences, Risk and Return. *Eur. Financ. Manag.*, 27(1), 12-19. doi: 10.1111/eufm.12295

Czaja, D. and Röder, F. (2022). Signalling in Initial Coin Offerings: The Key Role of Entrepreneurs' Self-Efficacy and Media Presence. *Abacus*, 58(1), 24-61. doi: 10.1111/abac.12223

Fahlenbrach, R. and Frattaroli, M. (2021). ICO Investors. *Financ. Mark. Portf. Manag.*, 35(1), Mar. doi: 10.1007/s11408-020-00366-0

Feng, C., Li, N., Wong, M.H. and Zhang, M. (2018). Initial Coin Offerings, Blockchain Technology, and White Paper Disclosures. available: https://papers.ssrn.com/sol3/papers.cfm? abstract_id=3256289

Fenu, G., Marchesi, L., Marchesi, M. and Tonelli, R. (2017). *O Fenômeno ICO e suas relações com Ethereum inteligente Contrato Ambiente.*

Fisch, C. (2019). Initial Coin Offerings (ICOs) to Finance New Ventures: An Exploratory Study. *J. Bus. Ventur.*, 34(1), 1-22. doi: 10.13140/RG.2.2.17731.91683

Fisch, C. and Momtaz, P.P. (2020). Institutional Investors and Post-ICO Performance: An Empirical Analysis of Investor Returns in Initial Coin Offerings (ICOs). *J. Corp. Financ.*, 64, 101679, Oct. doi: 10.1016/j.jcorpfin.2020.101679

Fisch, C., Meoli, M. and Vismara, S. (2022). Does Blockchain Technology Democratize Entrepreneurial Finance? An Empirical Comparison of ICOs, Venture Capital, and REITs. *Econ. Innov. New Technol.*, 31(1-2), 70-89. doi: 10.1080/10438599.2020.1843991

Fuchs, J. and Momtaz, P.P. (2023). Token Governance in Initial Coin Offerings: Implications of Token Retention and Resale Restrictions for ICO Success. available: https://ssrn.com/abstract=4619262

Hornuf, L., Kück, T. and Schwienbacher, A. (2022). Initial Coin Offerings, Information Disclosure, and Fraud. *Small Bus. Econ.*, 58(4), 1741-1759. doi: 10.1007/s11187-021-00471-y

Jacobs, B.I. and Levy, K.N. (2022). The Challenge of Disparities in ESG Ratings. available: https://mitsloan.mit.edu/sustainability-initiative/aggregate-confusion-project

Ji, L., Sun, Y., Liu, J. and Chiu, Y.-H. (2023). Environmental, Social, and Governance (ESG) and Market Efficiency of China's Commercial Banks Under Market Competition. *Environ. Sci. Pollut. Res.* doi: 10.1007/s11356-022-23742-x

Karpenko, O.A., Blokhina, T.K. and Chebukhanova, L.V. (2021). The Initial Coin Offering (ICO) Process: Regulation and Risks. 14(12), 599. doi: 10.3390/JRFM14120599

Kim, J.W. and Park, C.K. (2023). Can ESG Performance Mitigate Information Asymmetry? Moderating Effect of Assurance Services. *Appl. Econ.*, 55(26), 2993-3007. doi: 10.1080/00036846.2022.2107991

Lyandres, E., Palazzo, B. and Rabetti, D. (2022). Initial Coin Offering (ICO) Success and Post-ICO Performance. *https://doi.org/10.1287/mnsc.2022.4312*, Feb. doi: 10.1287/MNSC.2022.4312

Mansouri, S. and Momtaz, P.P. (2022). Financing Sustainable Entrepreneurship: ESG Measurement, Valuation, and Performance. *SSRN Electron. J.*, 37(6), 106258. doi: 10.2139/ssrn.3997723

Momtaz, P.P. (2019). Entrepreneurial Finance and Moral Hazard: Evidence from Token Offerings. *available SSRN.*

Momtaz, P.P. (2020). *Initial Coin Offerings*, 15(5). doi: 10.1371/journal.pone.0233018

Moxoto, A.C., Soukiazis, E. and Melo, P. (2024). The Determinants of the Initial Coin Offering (ICOs): A Cross-Country Study. available: https://ssrn.com/abstract=4783615

Moxotó, A.C., Melo, P. and Soukiazis, E. (2021). Initial Coin Offering (ICO): A Systematic Review of the Literature. *Proc. Annu. Hawaii Int. Conf. Syst. Sci.*, 2020-Janua, 4177-4186. doi: 10.24251/hicss.2021.507

Ren, X., Zeng, G. and Zhao, Y. (2023). Digital Finance and Corporate ESG Performance: Empirical Evidence from Listed Companies in China. *Pacific Basin Financ. J.*, 79, Jun. doi: 10.1016/j.pacfin.2023.102019

Roosenboom, P., van der Kolk, T., de Jong, A., Roosenboom, P., van der Kolk, T. and de Jong, A. (2018). What Determines Success in Initial Coin Offerings?. *available SSRN ...*, 22(2), 161-183, Apr. doi: 10.1080/13691066.2020.1741127

Roosenboom, P., van der Kolk, T. and de Jong, A. (2020). What Determines Success in Initial Coin Offerings?. *Ventur. Cap.*, 22(2), 161-183. doi: 10.1080/13691066.2020.1741127

Samieifar, S. and Baur, D.G. (2021). Read Me if You Can ! An Analysis of ICO White Papers. *Financ. Res. Lett.*, 38, September 2019, 101427, Jan. doi: 10.1016/j.frl.2020.101427

Sheehan, N.T., Vaidyanathan, G., Fox, K.A. and Klassen, M. (2023). Making the Invisible, Visible: Overcoming Barriers to ESG Performance with an ESG Mindset. *Bus. Horiz.*, 66(2), 265-276. doi: 10.1016/j.bushor.2022.07.003

Wang, D., Luo, Y., Hu, S. and Yang, Q. (2022). Executives' ESG Cognition and Enterprise Green Innovation: Evidence Based on Executives' Personal Microblogs. *Front. Psychol.*, 13. doi: 10.3389/fpsyg.2022.1053105

Wu, S.H., Sung, H.C. and Cheng, T.C. (2019). Measuring ICO Performance Indicators: An Empirical Study Via White Papers. *2019 IEEE Int. ….* available: https://ieeexplore.ieee.org/abstract/document/8751390/

Zhou, G., Liu, L. and Luo, S. (2022). Sustainable Development, ESG Performance and Company Market Value: Mediating Effect of Financial Performance. *Bus. Strateg. Environ.*, 31(7), 3371-3387. doi: 10.1002/bse.3089