

Impact of blockchain technology on firm value: international evidence ESG firms

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Abstract

Purpose – This paper aims to examine the impact of blockchain technology on firm value.

Design/methodology/approach – The sample for this study extends from 2010 to 2022 and includes data from 197 companies. The study uses a regression approach, using feasible generalised least squares (FGLS) estimation for linear panel data models. To analyse the robustness of the model, alternative measures of the dependent and independent variables were included. The sample was divided into financial and non-financial sectors, and the method of generalised moments (SYS-GMM) was applied for the dynamic effect.

Findings – The findings indicate that the implementation of blockchain technology exerts a substantial positive influence on firm value. This phenomenon can be attributed primarily to enhanced transparency and a reduction in information asymmetry.

Practical implications – The results of this study highlight the importance of new technology adoption and its impact on firm value. The integration of blockchain technology is examined to advance theoretical and practical understanding of how it can enable long-term market performance. Furthermore, it provides significant insights into navigating all sectors and meeting the challenges of the digital age by highlighting the synergistic relationship between blockchain technology, strategy and organisational success.

Originality/value – To the best of the authors' knowledge, this is the first study that empirically examines the impact of blockchain technology adoption on firm value in the international context of ESG index. This study fills a research gap by extending the existing literature, which generally focuses on the impact of blockchain technology on firm value.

Keywords Blockchain technology, Adoption, Firm value, Financial technology, SYS-GMM

Paper type Research paper

1. Introduction

In the 21st century, the rapid development of information technology has led to a systematic revolution in digital technologies, including the internet, artificial intelligence and blockchain technology (Favreau, 2022). In fact, digital technologies are emerging as a platform for companies to collaborate on a global scale, which has great potential for business performance (Huynh-The *et al.*, 2023). For this reason, blockchain technology also enables the development of a secure and impartial financial system; it is a kind of extraordinarily large computerised ledger.

Furthermore, a study by Varma *et al.* (2022) found that blockchain technology improves the performance of banking services and provides greater stability and resilience to the system. Blockchain technology is now a new revolution in all sectors, from finance to retail to manufacturing, and in virtually all areas where there is mutual distrust between individuals



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and organisations (Werbach, 2018). Explanations have been proposed in the literature that could explain the adoption of blockchain in firm performance, namely Sheel and Nath (2020), who verified that the adoption of blockchain increases the agility and adaptability of the supply chain, thus providing a competitive advantage and improving firm performance. Alexey Mikhaylov's (2023) comprehensive review of forty-three studies conducted between 2019 and 2023 underscores the imperative for national authorities to implement a regulatory framework for digital assets that is congruent with that of traditional finance. The review under discussion places significant emphasis on the crucial importance of international coordination and rigorous risk management by market operators (Stepanova et al., 2024).

In addition, blockchain technology uses a decentralised network for the processing and authentication of data transactions. Bitcoin in the cryptocurrency market (Fosso Wamba et al., 2020a) is one of the first applications of blockchain. Therefore, the adoption of blockchain can lead to greater transparency and improved business processes (Dutta et al., 2020). The adoption of blockchain can be seen as a dynamic capability, as it has the potential to reconfigure capabilities and transform business models to help firms create and capture greater value (Kamble et al., 2021). In their study, Pan et al. (2020) suggest that blockchain adoption leads to a transformation of operational capabilities that can improve business performance. Similarly, others argue that analytics and data skills within an organisation contribute to faster adoption of new technologies, such as blockchain technology, within an organisation (Wamba and Queiroz, 2020).

This study makes a significant contribution to the extant literature on the relationship between blockchain technology and firm value. Therefore, the following research question was posed:

RQ1. Does the integration of blockchain technology exert a positive impact on firm value?

Furthermore, a number of studies have observed an inconclusive relationship between the adoption of blockchain technology and ESG performance, which necessitates further analysis of the effect of blockchain technology on firm value. Moreover, the benefits of implementing blockchain have been proposed in various business contexts, such as banking and finance (Chen and Bellavitis, 2019), biomedical and healthcare applications (Stafford and Treiblmaier, 2020) and supply chain and logistics (Müßigmann et al., 2020). However, according to Sharma and Paul (2021), the adoption of blockchain by selected companies within an industry (Tsolakis et al., 2021). In addition, Mbama and Ezepue (2018) show that banks can improve their financial performance through digital banking, highlighting the importance of employee and customer engagement and improving customer experience. Furthermore, Gunasekaran et al. (2024) argue that blockchains can improve business performance. Therefore, new performance propositions are emerging as relevant when assessing the impact of blockchain adoption.

In addition, it will be expected to improve financial and non-financial disclosures. Consequently, the following research question was posed:

RQ2. Do blockchain technology affect firm value?

Based on these premises, the present study aims to examine the effect of blockchain technology on firm value in an international context. The present study was conducted on 197 international companies (2,651 observations) over a 13-year period, from 2010 to 2022. The results of the study indicate the potential for improving the performance of companies following the adoption of blockchain technology.

To the best of our knowledge, our study is the first to examine the impact of the adoption of blockchain technology on firm value. Consequently, the present study contributes to the extant empirical literature by examining the effect of the impact of blockchain technology adoption on firm value. This examination of the impact of blockchain technology adoption on firm value is further informed by the works of [Abu Afifa et al. \(2025\)](#); [Pancić et al. \(2023\)](#) and [Deng et al. \(2024\)](#).

In this paper, we mobilised transaction cost theory (TCT) to explain the impact of blockchain technology on firm value. We also mobilised diffusion of innovation (DOI) and technology acceptance model (TAM) to explain the theoretical relationships between blockchain technology adoption and firm value. The empirical results indicate the critical role of blockchain technology in improving firm performance.

The structure of the remainder of the paper is as follows: Section 2 presents the theoretical framework and literature review used to identify the hypotheses of the study. Section 3 discusses the data, variables and methodology. Sections 4 and 5 summarise the empirical results, include robustness analyses with alternative measures of the dependent and independent variables, divide the sample into financial and non-financial sectors and apply the two-stage SYS-GMM model for dynamic effect testing. Finally, the paper ends with discussion and conclusion in Section 6.

2. Development of hypotheses

The literature review revealed a limited number of quantitative studies aimed at understanding the impact of technological innovation on firm performance. In fact, [Klößner et al. \(2022\)](#) conducted an international event study to estimate the impact of blockchain initiatives on firm market value. Their results show that blockchain announcements have a significant positive effect on the stock market. Using data from the Chinese A-share market, [Chen et al. \(2022\)](#) investigated the impact of blockchain announcements on firm market value. They showed that blockchain announcements led to positive market reactions.

Meanwhile, [Liu et al. \(2022\)](#) found that Chinese firms' stock returns, return on assets (ROA) and volatility decreased after digital activities. Focusing on the sustainability of blockchain patents and firm value, [Kim et al. \(2020\)](#) examined the relationship between firms' blockchain patents and firm value by observing 153 panels from the US Patent and Trademark Office from 2014 to 2018. The results showed that firms can sustainably increase their value, but according to the TAM, this depends on the user's perceived ease of use and usefulness of the application, as new technologies can have a positive impact on firm value. For example, [Aketch et al. \(2021\)](#) investigated the impact of blockchain technology on financial market performance in Kenya. Based on a structured questionnaire of 84 bank managers, they found that government policies and internet infrastructure in Kenya encouraged firms to adopt blockchain technology.

In addition, [Pan et al. \(2020\)](#) examined the impact of blockchain technology on operational capabilities by collecting data from 50 listed Chinese firms that had adopted blockchain technology. They found that firms with larger assets were more likely to adopt blockchain technology, and that this adoption led to higher asset turnover and lower selling costs. [Rehman Khan et al. \(2022\)](#) applied a closed-ended questionnaire to manufacturing firms in China and Pakistan, collecting cross-sectional data from 290 respondents to examine the relationship between investment in blockchain technology and organisational performance. They found that blockchain characteristics such as visibility, transparency, relationship management and smart contracts had a positive and substantial impact on business outcomes.

Furthermore, blockchain technology has been touted as the next big disruption in financial services. In their paper, [Schuetz and Venkatesh \(2020\)](#) discuss how blockchain could alleviate the problem of financial exclusion in rural India. The authors review the literature of financial inclusion, adoption and blockchain in India and argue that four challenges need to be overcome to solve financial exclusion: geographical access, high costs, inappropriate banking products and financial illiteracy. The emergence of blockchain technology illustrates the disruptive impact of digital innovation while posing challenges for organisations, according to [Holotiuk and Moormann \(2018\)](#). This new technology is having a fundamental impact on a number of industries.

Indeed, [Mai et al. \(2019\)](#) investigate the impact of innovation on firm profitability using a data set collected in Vietnam for the period 2005–2015. Their results suggest that firms with innovative activities may have higher profits compared to non-innovative firms. According to [Khayer et al. \(2020\)](#), cloud computing enables companies to access networks, servers, technology and services, thereby enhancing their core competencies and improving their performance. [Martín-Peña et al. \(2019\)](#) found that increasing the synergy between service-based and digital approaches can improve firm performance. [Hautala-Kankaanpää \(2022\)](#) found that digitisation can improve firm performance by enhancing the firm's supply chain capabilities, especially the ability to integrate digital resources with business operations.

In their 2025 study, [Mikhaylov and Bhatti \(2025\)](#) used statistical methodologies and fuzzy logic to ascertain optimal portfolios within a highly volatile environment. These findings emphasised the uncertainty surrounding these assets and the value of artificial intelligence tools for long-term financial management. In another study, [Cheng et al. \(2019\)](#) examine 82 companies that mention 'blockchain' in their 8-K disclosures. For 56 companies with no significant involvement or track record in blockchain technology, the authors conclude that investors are overreacting to speculative investments in blockchain due to the bitcoin price bubble. [Ali et al. \(2023\)](#) confirm the positive stock market reaction to blockchain news in the US, especially when cost or time savings are mentioned, with smaller companies benefiting more.

However, blockchain technology facilitates the integration of customer and supplier supply chain activities by providing a shared record of information that is exceptionally reliable, secure and accurate ([Treiblmaier and Petrozhitskaya, 2023](#)). The adoption of blockchain technology has a significant impact on business performance ([Magnusson et al., 2022](#)). In fact, by automating processes and using data analytics, companies can identify and eliminate bottlenecks, reduce manual errors and improve workflow processes ([Bhatti et al., 2021](#)). For example, they can use machine learning algorithms to optimise supply chain management, reduce inventory costs and increase order fulfilment rates ([Liu et al., 2022](#)).

It can also contribute significantly to improving overall supply chain performance by fostering collaboration and partnership between suppliers and customers to solve problems between supply chain members, which can improve business efficiency and effectiveness ([Junaid et al., 2023](#)). Also, [De Vass et al. \(2018\)](#) conducted a study on the impact of IoT on supply chain performance and their findings demonstrated the positive impact of IoT capabilities on supply chain integration.

The emergence of blockchain technology is widely regarded as a more dependable and secure means of managing organisational data. A growing body of literature highlights the positive impact of Industry 4.0 integration and its associated technologies on firm performance. For example, [Dalmarco et al. \(2019\)](#) show that the deployment of Industry 4.0 technologies contributes to improved operational efficiency, increased flexibility, reinforced cybersecurity and better product and service quality, while also accelerating decision-making processes. In the same vein, real-time decision-making and high-speed production systems

are increasingly driven by big data analytics (Mikalef *et al.*, 2019). Firms adopting these advanced technologies have been found to achieve stronger financial performance, enhanced productivity and elevated market valuations (Tang *et al.*, 2018).

In addition, the adoption of cloud computing enables organisations to manage costs related to the development, maintenance and depreciation of internal IT infrastructure more effectively, thereby improving both operational and financial outcomes (Khayer *et al.*, 2020). Beyond internal efficiency gains, blockchain also facilitates the seamless exchange of critical information such as demand forecasts, logistics data and inventory levels with business partners. This enhanced information sharing fosters more efficient resource utilisation, supports the development of novel partnerships and encourages experimentation with new transactional models and distribution strategies. Ultimately, it serves as a catalyst for innovation (Guo *et al.*, 2022).

Based on these considerations, this study proposes the following hypothesis:

H1. Investment in blockchain technology has a positive impact on firm value.

3. Research methodology

In this section, we test the hypotheses developed to examine the relationship between blockchain technology adoption and firm value of ESG Index companies. We will describe the sample and the sources of the data.

3.1 Sample selection and data collection

The data for this study is collected from listed companies for 13 years, from 2010 to 2022. Our initial sample consists of 395 international companies included in the ESG Index. Companies with missing data were excluded from the initial sample (125). In addition, after filtering our data from companies with missing data (73), we obtained a final sample of 197 companies using blockchain technology, with a total of 2561 observations over the company year. In this research, we used annual data between 2010 and 2022. In this study we have used annual data between 2010 and 2022. We chose 2010 as the starting year for our dataset for two reasons. First, to ensure a reasonable period after the financial crisis of 2008-2009. Second, it was during this post-global financial crisis, post-recession period that fintechs started to develop significantly.

Panel A of Table 1 summarises this sample. The number of firm-year observations by industry according to the Thomson Reuters industry classification is shown in Panel B of the same table, and the number of firms according to the Industry Classification Benchmark (ICB) classification. The number of observations by firm year and by region is shown in Panel C of Table 1.

3.2 Variables measurement

To examine the relationship between adopting blockchain technology and firm value, all measures of the variable are defined in Table 2.

3.2.1 Dependent variable. Tobin's Q was used as an indicator of firm performance in our study. This ratio is explained by Brainard and Tobin (1968) as the ratio between the market value of a company and the replacement cost of its share capital. According to previous research, Tobin's Q is used as a tool to measure market performance (Jia *et al.*, 2024).

3.2.2 Independent variable. We measure blockchain adoption in the form of a binary variable 'BLOCKCHAIN', which takes a value of 1 if the company implement blockchain technology and 0 otherwise (Chouaibi *et al.*, 2024). We search these reports for any mention

Table 1. Sample selection and distribution

<i>Panel A: Sample selection</i>		firms	observations
Initial sample (ASSET4)		395	5,135
Firms with total missing data		(125)	(1,625)
Firms with missing data		(73)	(949)
Final sample		197	500
<i>Panel B: Number of observations based on industry</i>			
ICB code	ICB name	N	%
10	Technology	33	16.751
15	Telecommunications	10	5.076
20	Health care	24	12.182
30	Financials	48	24.365
40	Consumer discretionary	28	14.213
50	Industrials	37	18.781
60	Energy	17	8.629
Total		197	100
<i>Panel C: Sample distribution across countries</i>			
Country	N	Obs	%
United states	91	1183	46.192
Europe	68	884	34.517
Asia	28	364	14.213
Canada	5	65	2.538
Britain	5	65	2.538
Total	197	2561	100

Source(s): Authors' own work

of the adoption of blockchain technology. We also use other reliable sources, such as the Forbes Blockchain 50 and Blockdata. Forbes published the top 50 companies using blockchain in 2018, 2019 and 2020. Blockdata published the top 100 companies using blockchain from 2016 to 2022. Where possible, we also used companies' annual reports to confirm information on blockchain adoption (Mselmi, 2020).

3.2.3 Control variables. It would be remiss of us not to consider the influence of a number of control variables when analysing the adoption of blockchain technology in firm value. Given the findings of previous studies, we have tried to include a number of control variables relating to the characteristics of the firms in question in our models.

In particular, we have incorporated the following variables:

- Firm size (size), calculated as the natural logarithm of total assets.
- Leverage (LEV), defined as total debt divided by total equity.
- Research and development (R&D), measured as the ratio of R&D expenditures to total asset.
- Firm growth (GROWTH), represented by the change in total firm value in year T.
- Fixed assets (FIXED ASSETS), defined as the net book value of fixed assets divided by total assets.
- Crises (CRISIS) in terms of binary categories of health and financial crises to facilitate analysis.
- Furthermore, we have included dummy variables to allow for the potential influence of year (year), industry (industry) and country (country) on the dependent variables.

Table 2. Definitions and measurements of study variables

Variables	Measures	Source	References
BLOCKCHAIN	BLOCKCHAIN: Binary variable worth 1 if there are adoption of the blockchain technology and 0 otherwise	Annual reports/ website : Forbes/ blok-data	Goli (2023), Hong and Hales (2024)
TOBIN-Q	TOBIN-Q = market value / book value	Thomson Reuters ASSET4 (DataStream)	Brahma <i>et al.</i> (2021), Jia <i>et al.</i> (2024)
SIZE	SIZE = the natural logarithm of total assets	Thomson Reuters ASSET4 (Datastream)	Gregory (2022), Diantimala <i>et al.</i> (2021)
LEVERAGE	LEVERAGE = long-term debt / total assets	Thomson Reuters ASSET4 (Datastream)	Anita <i>et al.</i> (2024), Huynh <i>et al.</i> (2020)
R&D	R&D = R&D expense / total assets	Thomson Reuters ASSET4 (Datastream)	Uyar <i>et al.</i> (2023), Chen and Srinivasan (2024)
GROWTH	GROWTH = rate between previous year's sales and following year's sales	Thomson Reuters ASSET4 (Datastream)	Kaupke <i>et al.</i> (2023)
FIXED ASSETS	FIXED ASSETS = book value of property, plant and equipment / total assets	Thomson Reuters ASSET4 (Datastream)	D'Amato and Falivena (2020)
CRISIS	CRISIS = Binary variable worth 1 if there is a crisis and 0 otherwise	International Monetary Fund 2020	Poretti and Heo (2022)

Note(s): This table reports the definitions of the variables used in our study

Source(s): Authors' own work

3.3 Regression model. The purpose of this study is to investigate whether the use of blockchain technology can increase firm value. More specifically, we want to determine the changes in firm value following the adoption of blockchain technology, controlling for an explanatory variable and some control variables related to firm characteristics. To analyse the study data set econometrically and illustrate how endogeneity bias can lead to incorrect estimates, we examined our study models using feasible generalised least squares regression (FGLS) to estimate the models more accurately. To test our two hypotheses, we estimated a panel regression model with firm value as the dependent variable. We specified two econometric models for estimation.

Based on previous theoretical and empirical studies, we specify the following model:

$$Q - TOBIN_{it} = \beta_0 + \beta_1 BLOCKCHAIN + \beta_2 SIZE + \beta_3 LEVERAGE + \beta_4 R\&D + \beta_5 GROWTH + \beta_6 FIXED_ASSET + \beta_7 CRISIS + \sum_1^{13} Years + \sum_1^7 INDUSTRY + \sum_1^5 COUNTRY + \epsilon_{it}$$

All variables are defined. Year, industry and country denote year, industry and country fixed effects, respectively; ϵ : is the error term and the indices i and t represent firms and years, respectively.

4. Estimation and discussion of results

4.1 Descriptive statistics

The [Table 3](#) present the descriptive statistics (minimum, maximum, mean and standard deviation) for the variables used in the analysis. As can be observed from the presented table, the mean value of the TOBIN-Q score for the companies in the sample is 1.5967, with a standard deviation of 1.7490. This indicates that the variable in question displays a relatively homogeneous dispersion. The minimum value is 0.0175, while the maximum is 17.680. With regard to the blockchain, the mean value is observed to be equal to 0.3908, while the standard deviation is equal to 0.488. The minimum and maximum values are both equal to 0 and 1, respectively. With regard to the control variables, the mean value of firm size, calculated using the natural logarithm of total assets, is 18,514. It can thus be concluded that the sample comprises companies of a relatively large size. Moreover, the companies in the sample demonstrate an average leverage ratio of 24.4%. The mean value of research and development expenditure, as measured by research and development intensity, is 827.3541. In contrast, the mean value of the company's sales growth is 2.4933. Accordingly, the mean value of the fixed active variable is 16.3971. Finally, the mean value of the crisis variable is 0.3076, which is significantly below the mean value of 1 and can be considered relatively low.

4.2 Multicollinearity test

According to [Kennedy \(1979\)](#), the presence of multicollinearity may be inferred from a correlation coefficient exceeding 0.70 between two variables. Therefore, on the basis of the correlation matrix in [Table 4](#), given that the value of the correlation coefficient between two variables is less than 0.70, it is not necessary to consider the issue of multicollinearity. Furthermore, the variance inflation factor (VIF) can be used to determine the presence of multicollinearity. In this study, the variance inflation factor (VIF) values are less than 2.0, indicating that multicollinearity is not a significant issue.

4.3 Selection of fixed or random effect

The panel data diagnostic tests suggest that the fixed effects model is the more statistically appropriate of the model. As shown in [Table 5](#), the Hausman test was conducted to compare

Table 3. Descriptive statistics

Variables	Obs.	Min.	Max.	Mean	SD
<i>Panel A: descriptive statistics for metric variables</i>					
TOBIN-Q	2561	0.0175	17.6801	1.5967	1.7490
SIZE	2561	16.0033	20.9992	18.5148	1.4696
LEVERAGE	2561	0.0000	0.9942	0.2443	0.1448
RD	2561	442.6655	1436.334	827.3541	150.6433
GROWTH	2561	-0.9999	1915.82	2.4933	51.7966
FIXED-ASSET	2561	6.9077	25.8475	16.3971	2.4277
<i>Panel B: Frequencies (%) of binary variables</i>					
			Conditions		%
BLOCKCHAIN			0		60.92
			1		39.08
CRISIS			0		69.24
			1		30.76

Source(s): Authors' own work

Table 4. Correlation matrix and VIF test

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Blockchain	1						
Size	0.0948	1					
Leverage	0.1063	-0.1046	1				
R&D	0.0680	0.1164	0.0361	1			
Growth	-0.0371	0.0657	-0.0144	0.1027	1		
Fixed asset	0.0589	0.5823	0.0770	0.3493	0.1168	1	
Crisis	0.1699	0.0309	0.0325	0.0217	-0.0309	0.0300	1
VIF	1.06	1.60	1.06	1.16	1.02	1.78	1.03

Source(s): Authors' own work

Table 5. Results of panel data tests

Tests	Model
Hausman test	82.07 (0.000)***
Breusch-Pagan test	774.77 (0.000)***
Modified wald test	1915540.04 (0.000)***
Wooldridge test	40.573 (0.000)***
White's test	301.76 (0.000)***

Note(s): *, **, *** denote significance at 10, 5, and 1%, respectively

Source(s): Authors' own work

the fixed and random effects estimators. The results revealed a significant p -value ($p < 0.05$), thus confirming the suitability of the fixed effects specification.

Furthermore, the Wooldridge test revealed first-order autocorrelation within the panel structure. Heteroscedasticity was also assessed using the White test, the Breusch-Pagan test and the modified Wald test. In all cases, the chi-squared statistics were highly significant ($p < 0.05$), indicating heteroscedasticity and non-constant variance across observations. To address these econometric issues and improve the reliability of the estimates, the analysis used robust techniques, particularly the FGLS method.

4.4 Multivariate analysis

As demonstrated in [Table 6](#), the findings indicate a positive and statistically significant correlation between blockchain technology and the value of the company at the 1% level. The estimated coefficient of this association is 0.3771, with a p -value of 0.000. In addition, the findings suggest that the integration of blockchain technology has a favourable and substantial impact on the firm value of entities included in the ESG Index, thereby validating hypothesis *H1*. This finding is consistent with the results of numerous previous studies, including those by Prateek [Sharma et al. \(2023\)](#), [Pancić et al. \(2023\)](#), [Chatterjee et al. \(2022\)](#), [Aydiner \(2021\)](#).

With regard to the control variables, as illustrated in [Table 6](#), there is a negative and statistically significant correlation between firm size and firm value (coefficient = -0.5607). The t -statistic used to assess the significance of this coefficient indicates that the relationship is indeed statistically significant ($t = -21.40$, $p = 0.00$). Therefore, this result is consistent with the findings of previous studies that have identified a negative impact of firm size on firm value, as evidenced by the work of [Lim and Mali \(2024\)](#). As demonstrated in the

Table 6. Regression results

Variables	Coef	Z	Sig
BLOCKCHAIN	0.3771	5.88	0.000***
FIRM_SIZE	-0.5607	-21.40	0.000***
FIRM_LEV	0.4515	2.09	0.036**
R&D	0.0017	8.25	0.000***
GROWTH	-0.0003	-0.52	0.601
FIXED-ASSET	0.0260	1.56	0.119
CRISIS	-0.0499	-0.75	0.455
Constant	9.8230	23.19	0.000***
Year fixed effect		Included	
Firm fixed effect		Included	
Country fixed effect		Included	
Wald chi ²		745.97 (0.000)	
Observations		2561	
F (Fisher)		106.23 (0.000)	
R ²		22.35%	

Note(s): *, **, *** denote significance at 10, 5, and 1%, respectively

Source(s): Authors' own work

accompanying table, statistical analysis demonstrates a positive relationship, though not statistically significant, between leverage and firm value (coefficient = 0.4515).

The *t*-statistic used to assess the significance of this coefficient indicates that the relationship is not statistically significant ($t = 2.09$, $p = 0.036$). The findings of the statistical analysis suggest the existence of a positive yet insignificant relationship between R&D intensity and firm value, as evidenced by a coefficient of 0.0017. The *t*-statistic used to assess the significance of this coefficient indicates that the relationship is indeed statistically significant ($t = 8.25$, $p = 0.000$).

This result is therefore consistent with those of previous studies, including those conducted by [Leung and Sharma \(2021\)](#) and [Guo et al. \(2024\)](#). As proposed by [Sheng and Montgomery \(2022\)](#), investors assess the value of R&D investment based on its potential to improve a company's performance. As illustrated in the table, there is a negative correlation between sales growth and firm value, with a coefficient value of -0.0003. The *t*-statistic indicates that the relationship is not statistically significant ($t = -1.47$, $p = 0.142$).

This result is therefore consistent with those of previous studies, such as those conducted by [Combes et al. \(2024\)](#) and [Chen et al. \(2024\)](#). Finally, the results presented in the table indicate a negative and statistically significant relationship between crisis and firm value, with a regression coefficient of -0.5607. The *t*-statistic used to assess the significance of this coefficient indicates that the relationship is indeed significant ($t = -21.40$, $p = 0.00$). Moreover, this result is in accordance with the findings of prior research, including studies conducted by [Noone et al. \(2024\)](#), [Ahmad et al. \(2022\)](#) and [Ahmad et al. \(2023\)](#).

5. Robustness test

To examine the robustness of our results, we conducted an additional analysis. The additional analyses relate to:

- Alternative measures;
- Heterogeneity analysis
- Dynamic effect: SYS-GMM two stage

5.1 Alternative measures

The dependent variable « TOBIN-Q » was replaced with « MTBV ». The independent variable (blockchain technology) has been replaced by a « FINTECH-INDEX » obtained from the World Bank.

5.1.1 *The dependent variable: MTBV.* The regression results are presented in column (1) of Table 7. The coefficient for blockchain is statistically significant and positive effect on MTBV at the 1% level, indicating that the development of blockchain have a positive effect on the value of firm.

5.1.2 *The independent variable: FINTECHINDEX.* The regression results are presented in column (2) of the Table 7. The coefficient of 'FINTECH-INDEX' is significantly positive at the 1% level, indicating that the development of financial technology have a positive effect on the value of firm.

5.1.3 *The dependent and independent variables: MTBV and FINTECHINDEX.* The empirical results are presented in column (3) of the Table 7. The results demonstrate that the coefficient of 'FINTECH-INDEX' is significantly positive on MTBV at the 1% level, indicating that the development of financial technology can have a positive effect on the value of firms.

5.2 Heterogeneity analysis

A second robustness test was performed to enhance the reliability of the results obtained and to verify the validity of the empirical analyses. In accordance with the objectives of the present study, the sample was divided into two distinct subgroups: companies in the financial sector (comprising 47 companies and 611 observations) and those in the non-financial sector (comprising 150 companies and 1,950 observations), covering the period 2010–2022.

The findings of the regression for the financial sector, as illustrated in column 1 of Table 8, demonstrate that the implementation of blockchain technology exerts a favourable and statistically significant influence on firm value (coefficient = 0.128; $z = 3.50$; $p < 0.001$). Furthermore, the control variables, namely company size, financial leverage, R&D intensity, growth and fixed assets, also demonstrate significant relationships with firm value.

For the non-financial sector, the results presented in column 2 of the above table also confirm a positive and significant impact of blockchain on company value, with an even higher coefficient (0.492; $z = 5.93$; $p < 0.001$), suggesting a more pronounced influence in this sector. Furthermore, it is imperative to recognise that company size and the intensity of R&D activities remain pivotal in elucidating value creation.

5.3 Dynamic effect: SYS-GMM two stage

We used robustness testing and endogeneity analysis. Specifically, GMM estimation of the system was introduced to address the inverse causal relationship between blockchain technology and firm value.

The GMM estimator allows us to control for endogeneity between variables and unobservable heterogeneity over time. Therefore, the estimated dynamic model consists in establishing a relationship between firm value at period t , denoted by Y and its 1-year lagged value (Lag TOBIN-Q), in the presence of the independent variable of blockchain technology and the set of control variables. The results show that our applied research model:

$$\begin{aligned} TOBIN - Q_{it} = & \beta_0 + \beta_1 Q - TOBIN_{t-1} + \beta_2 BLOCKCHAIN + \beta_3 SIZE + \beta_4 LEVERAGE \\ & + \beta_5 R\&D + \beta_6 GROWTH + \beta_7 FIXED - ASSETS + \beta_8 CRISIS + \varepsilon_{it} \\ & + \sum_1^{13} Years + \sum_1^7 INDUSTRY + \sum_1^5 COUNTRY + \varepsilon_{it} \end{aligned}$$

Table 7. Regression results for alternative measures

Variables	Dependent variable			Independent variable			Dependent and independent variable		
	Coef	Z	Sig	Coef	Z	Sig	Coef	Z	Sig
BLOCKCHAIN	0.866	3.85	0.000***	0.377	5.61	0.000***	1.129	4.79	0.000***
FIRM_SIZE	-1.062	-11.55	0.000***	-0.558	-21.31	0.000***	-1.065	-11.61	0.000***
FIRM_LEV	11.489	15.17	0.000***	0.426	1.97	0.049**	11.313	14.91	0.000***
R&D	0.004	5.45	0.000***	0.108	8.29	0.000***	0.248	5.43	0.000***
GROWTH	-0.001	-0.51	0.609	-0.0001	-0.33	0.740	-0.0006	-0.30	0.763
FIXED-ASSET	-0.043	-0.75	0.454	0.024	1.47	0.142	-0.046	-0.79	0.430
CRISIS	0.144	0.62	0.538	-0.013	-0.20	0.843	0.210	0.91	0.3364
Constant	18.003	12.11	0.000***	9.675	22.90	0.000***	17.704	11.96	0.000***
Wald χ^2 (7)		560.57			741.94			570.39	
Prob > χ^2		0.000			0.000			0.000	

Note(s): *, **, *** denote significance at 10, 5, and 1%, respectively
Source(s): Authors' own work

Table 8. Regression results for sector effect

Variables	Financial sector			Non-financial sector		
	Coef	Z	p-value	Coef	Z	p-value
BLOCKCHAIN	0.128	3.50	0.000***	0.492	5.93	0.000***
SIZE	-0.410	-24.96	0.000***	-0.490	-8.63	0.000***
LEVERAGE	2.682	18.25	0.000***	-0.258	-0.95	0.342
R&D	0.413	4.51	0.000***	0.119	6.42	0.000***
GROWTH	-0.001	-1.05	0.296	-0.0002	-0.32	0.748
FIXED-ASSET	0.051	5.30	0.000***	-0.039	-1.43	0.153
CRISIS	0.007	0.18	0.854***	-0.059	-0.70	0.484
Constant	6.783	20.74	0.000***	9.664	14.63	0.000***
Wald chi ²		1,341.40			262.58	
(p-value)		0.000***			0.000***	
No. of groups		47			150	
Observations		611			1,950	

Note(s): *, **, *** denote significance at 10, 5, and 1%, respectively

Source(s): Authors' own work

Table 9 present the regression results of the impact of blockchain adoption on firm value using the SYS-GMM approach. The Sys-GMM moment conditions are correctly specified when the p -value of AR (1) is 0.003, which is less than 0.05, and the p -value of AR(2) is 0.167, which is greater than 0.05. Moreover, the J statistic, as proposed by Hansen (1982), is used to test the null hypothesis of the overall validity of the instrument used.

The resulting value must be less than the number of groups (Ullah *et al.*, 2021b). Accordingly, the value of N is 197, while T is 11. Consequently, this study offers an ideal opportunity to use the dynamic Sys-GMM approach developed by Arellano and Bond (1991).

The estimates presented in the two-stage GMM model, called SYS-GMM, are confirmed in terms of statistical significance, signs and estimated coefficients. In fact, the level of significance and the values of the coefficients of the lagged variable of firm value (Lag TOBIN-Q) further justify the dynamic specification of the model and confirm the need to include these effects. Indeed, firm value is highly dependent on its lagged variables.

The estimates presented in the SYS-GMM two-stage GMM model are confirmed in terms of statistical significance, the sign of the coefficients and the estimated coefficients themselves. Indeed, the coefficient for blockchain is 0.162, and the result is statistically significant at the 1% level. This indicates that for each one percent increase in the utilisation of blockchain technology, the value of the company in question increases by 0.1343 percentage points. Furthermore, the coefficient for firm size is -0.443 and is statistically significant at the 0.01 level. The estimated coefficient for debt level is 1.2380, which is statistically significant at the 1% level. This leads to the conclusion that there is a positive relationship between the company's level of debt and its value.

Moreover, the coefficient for the company's research and development expenditure is positive at 0.034 and statistically significant at the 1% level. This suggests that the company's overall expenditure on research and development has no discernible impact on its value. With regard to the variable representing sales growth, the coefficient is negative at -0.00009 and significant at the 1% level. Conversely, the coefficient on fixed assets is negative at -0.0120 and significant at the 1% level, indicating that a company's fixed assets exert a negative effect on its value.

Table 9. Regression results for SYS-GMM

Variables	Coef	TOBIN-Q T	Sig
TOBIN-Q	0.845	1,849.92	0.000***
Blockchain	0.162	2.99	0.003***
Size	-0.443	-7.27	0.000***
Leverage	1.238	2.11	0.000***
R&D	0.034	6.68	0.000***
Growth	-0.00009	-0.83	0.000***
Fixed-Assets	-0.0120	-9.82	0.000***
Crisis	-0.063	-5.51	0.000***
Year dummy		Included	
Industry dummy		Included	
Country dummy		Included	
Constant	7.922943	6.17	0.000
Observation		2,361	
F statistic		73.21	
Number of groups		197	
Number of instruments		11	
Arellano–Bond Test AR (1)		0.003	
Arellano–Bond Test AR (2)		0.167	
Hansen test (p-value)		0.002	

Note(s): *, **, *** denote significance at 10, 5, and 1%, respectively

Source(s): Authors' own work

In conclusion, the occurrence of health and financial crises has been demonstrated to exert a negative impact on company value. The coefficient associated with the crisis variable is -0.063, which is statistically significant at the 1% level. These findings are corroborated by the results of previous studies, including those conducted by [Wang et al. \(2022\)](#), [Yang and Han \(2023\)](#) and [Guo et al. \(2023\)](#).

6. Discussion and conclusion

6.1 Discussion

The principal objective of this study was to examine the effect of blockchain technology adoption on firm value, focusing on international companies included in the ESG index between 2010 and 2022. Based on a panel data set of 197 companies, the findings provide robust empirical support for the hypothesis that blockchain implementation positively influences firm value. The overall model reveals statistically significant results, reinforcing the theoretical proposition that blockchain represents a strategic resource capable of enhancing firm performance.

More specifically, the econometric analysis confirms Hypothesis *H1*, which posits a positive relationship between the use of blockchain technology and firm value. This finding is aligned with prior literature ([Sharma et al., 2023](#); [Pancić et al., 2023](#); [Abu Afifa et al., 2025](#)) and reinforces the idea that blockchain, through its core attributes transparency, traceability and immutability can contribute to reducing agency costs, increasing investor trust and improving firm valuation. In addition, control variables such as financial leverage, R&D intensity and fixed assets were found to have significant and positive effects on firm value, underscoring the importance of innovation and capital investment in value creation processes. Conversely, growth and crisis variables do not exhibit a statistically significant

effect, which may reflect the long-term nature of blockchain's value contributions, rather than short-term market fluctuations.

From a theoretical perspective, these findings contribute to the growing body of research on the intersection between emerging technologies and corporate performance. Whilst the majority of extant studies have relied upon TCT and the TAM, this study advocates for the inclusion of broader theoretical frameworks, such as the Unified Theory of Acceptance and Use of Technology (UTAUT) and the DOI theory. These frameworks offer enhanced explanatory power, facilitating not only a comprehensive understanding of the adoption process, but also the organisational conditions necessary for blockchain to generate quantifiable value outcomes.

It is important to note that the present study also highlights a gap in extant research, namely the underexplored impact of blockchain adoption on firm value from a shareholder-oriented perspective. The majority of extant works focus on operational efficiency, supply chains or ESG transparency, without directly linking technological innovation to financial market performance. This study provides a novel contribution by situating blockchain adoption within a financial performance lens, suggesting that blockchain should be viewed not only as a tool for compliance or data management but as a core driver of shareholder value.

6.2 Conclusion

The present study investigated the relationship between the adoption of blockchain technology and firm value. A sample of ESG-indexed international companies was observed over the period 2010–2022. The findings confirm that implementation of blockchain significantly enhances firm value, thus providing empirical support for Hypothesis *H1*. Furthermore, the analysis emphasises the strategic importance of complementary resources, including R&D investment and fixed assets, in optimising the benefits derived from blockchain adoption.

The study makes several important contributions to academic and managerial domains. From a theoretical standpoint, it enriches extant literature by shifting the analytical focus from operational and compliance benefits to value creation mechanisms. It also encourages the use of broader adoption frameworks, such as UTAUT and DOI, which can provide a more comprehensive explanation of how firms internalise blockchain into their strategic trajectories. From a managerial perspective, the findings suggest that firms should not treat blockchain merely as a technical upgrade, but rather as a strategic resource requiring coordinated investment in innovation, governance and infrastructure to realise its full value potential. The study provides investors with a novel perspective on the evaluation of firms' digital maturity and long-term value generation. In conclusion, the research invites regulators to foster environments that incentivise the responsible adoption of emerging technologies, particularly those with performance-enhancing potential.

Nevertheless, it should be noted that the present study is subject to several limitations. Firstly, the model operates under the assumption of rational implementation timing, a premise which may not accurately reflect the heterogeneity of firm-level decision-making processes. Secondly, the utilisation of the ASSET4 database may result in the restriction of the sample to firms with relatively high ESG disclosure quality, thereby limiting the generalisability to the broader market. Thirdly, while the study incorporates control variables, it does not fully account for the potential impact of institutional and cultural differences across countries. Finally, the study does not examine the potential for endogeneity or reverse causality between blockchain adoption and firm value, despite the implementation of robustness checks.

It is recommended that future research address the limitations identified in the present study by expanding the geographical scope, using mixed-method approaches (case studies, interviews) and testing additional moderating or mediating factors. Such factors may include digital maturity, regulatory environment and corporate governance quality. It is suggested that comparative studies between emerging and developed markets have the potential to provide a more comprehensive understanding of the institutional conditions that amplify the impact of blockchain on firm performance.

In conclusion, this study emphasises the transformative potential of blockchain technology in enhancing firm value, particularly when supported by innovation-oriented strategies and capital resources. As the digital transformation of business accelerates, understanding the financial and strategic implications of blockchain adoption remains a critical priority for scholars, practitioners and policymakers alike.

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