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Blockchain; a new accounting paradigm to anticipate bankruptcy

La Blockchain; un nouveau paradigme comptable pour anticiper la faillite

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Abstract

Blockchain technology and its many applications have become a major catalyst for new ideas and solutions for the financial sector. But the theoretical framework of Blockchain, even for the financial sector, remains rough and empirical evidence is lacking.

The objective of our paper is to show how Blockchain based accounting could anticipate the bankruptcy of a company to do this we will model the quarterly fluctuations of the 2 famous bankruptcy prediction models; ZScore and Merton's DD of general accounting and compare them to the daily fluctuations of Blockchain's real time accounting.

A case study was chosen as a research strategy to add a realistic touch. There are two main outcomes of our research. The first is that the technology will therefore have greater implications for companies with high volatility. The second finding is that the implications will not only be positive in the form of earlier identification of difficulties but may also negatively affect the company by exacerbating the short-term economic problem, the problem that has not been discussed in the context of Blockchain accounting before.

Keywords: Blockchain; Accounting; Audit; Bankruptcy prediction; financial data.

Résumé

La technologie Blockchain et ses nombreuses applications sont devenues un catalyseur majeur de nouvelles idées et solutions pour le secteur financier. Mais le cadre théorique de la Blockchain, même pour le secteur financier, reste brut et les preuves empiriques sont insuffisantes.

L'objectif de notre article est de montrer comment la comptabilté basée à la Blockchain pourrait anticiper la faillite d'une entreprise pour ce faire nous allons modéliser les fluctuations trimestrielles des 2 modèles célèbres de prédiction de faillite ; ZScore et DD de Merton de la comptabilité générale et les comparer aux fluctuations quotidiennes de la comptabilité en temps réel de la Blockchain.

Une étude de cas a été choisie comme stratégie de recherche pour ajouter une touche réaliste. Il y a deux principaux résultats de notre recherche. Le premier est que la technologie aura donc des implications plus importantes pour les entreprises ayant une forte volatilité. La deuxième constatation est que les implications ne seront pas seulement positives sous la forme d'une identification plus précoce des difficultés mais peuvent également affecter négativement l'entreprise en exacerbant le problème économique à court terme, le problème qui n'a pas été discuté dans le cadre de la comptabilité Blockchain avant.

Mots clés : Blockchain ; Comptabilité ; Audit ; Prédiction de faillite ; Données Financières.

Introduction :

The world is constantly evolving due to technological advancements that impact our daily routines and the way we conduct business. Despite the fact that information and communication technologies have significantly transformed production, they have not yet digitized business operations. Attempts to digitalize trade have been hindered by security concerns and the difficulty of coordinating data across borders and among the various parties involved in an international trade transaction. However, a new technology called the Blockchain is believed by many to have the potential to revolutionize the way trade is conducted. The Blockchain is a technology that creates a trusted and distributed ledger that each participant can access and verify, but that no single party can control. It is referred to as a "trust machine" due to its use of cryptographic and algorithmic techniques and its decentralized and distributed nature, which makes it very resilient. Originally developed as the underlying technology for the cryptocurrency bitcoin, the Blockchain's applications have quickly expanded to various fields beyond cryptocurrencies. Due to its transparent, secure, and immutable nature, the Blockchain has gained attention from both the private sector and public authorities. The number of proof-of-concepts and pilot projects is rapidly increasing, and applications of the technology touch almost every sector of the economy and society, including finance, e-commerce, food safety, supply chain management, and even voting. Many of these applications are "permission-based," meaning permission is required to make transactions on the ledger. Billions of euros are being invested in Blockchain companies, and the number of patents related to the technology is growing. In 2017, venture capital funding for Blockchain start-ups steadily reached $1 billion, and the number of Blockchain-related patent applications tripled. The Blockchain has received a lot of attention and has been described with a range of hyperbolic adjectives, including "game-changing," "revolutionary," and a "miracle cure." No other technology has received as much notoriety since the emergence of the Internet, and none has sparked as much controversy outside the world of information technology specialists. In recent years, the Blockchain has transformed the financial world by creating a transparent, reliable, and immutable record of transactions through the innovative combination of pre-existing technologies in computer networks and cryptography.

Several studies have analyzed the current or future application of the Blockchain in different business sectors, including its potential use in accounting. The application of the Blockchain in accounting is a particularly debated topic because it could disrupt the field of accounting and its related professions, such as auditing.

In order to determine the extent to which a Blockchain-based accounting system could predict the failure of a company, this study will collect financial data from a listed company, model the quarterly fluctuations of two bankruptcy prediction models (the Merton model and the Altman model), and compare them to the daily fluctuations of a Blockchain-based accounting system. The results will be analyzed to reach a final conclusion.

1. Literature review :

The Accounting Blockchain is a type of Blockchain that is used to record and validate financial transactions. It allows users to verify and record transactions securely and transparently, without the need for trust in a third party (Nakamoto, 2008).

Several studies have been carried out on the use of the Accounting Blockchain in the field of accounting. For example, a recent study by Ibouh M et al (2022) presented the use of Blockchain and its effects on accounting functions in companies according to numerous studies published over the last decade in order to establish a conceptual model explaining the sequential effect of the wave of global digitalization and how it arrived at business models, then its impact on the accounting function based on many factors and characterized by the quality of information, ease of use, reduction costs and time.

A study by SADJO. K & al. (2021) studied the contribution of different Blockchain technology transactions to improving the perceived quality of accounting information.

A study by Lai et al. (2019) examined the use of the Accounting Blockchain for auditing financial statements. The study concluded that the use of blockchain accounting could improve the reliability and transparency of financial statements, but that challenges such as technical complexity and regulation remain to be overcome.

Another study by Wang et al. (2018) explored the use of blockchain accounting for transaction auditing. The study suggested that the use of Blockchain accounting could make auditing more efficient and less costly, by allowing better traceability and a reduction in errors.

Byström (2016) examined the role of blockchain in real-time accounting and credit risk modeling. According to the author, blockchain technology can be used to automate and improve real-time accounting processes, allowing transactions to be tracked and validated faster and more accurately. Additionally, blockchain could be used to develop new credit risk models, providing more accurate and real-time financial information. This could lead to better credit decision-making and reduced risk of default."

Finally, a study by Zhang et al. (2017) reviewed the benefits and challenges of using Accounting Blockchain in accounting processes. Identified benefits included reduced costs, improved transparency and security, and reduced risk of fraud. Challenges identified included technical complexity, regulatory issues and the need to change existing processes.

Blockchain accounting is a promising area that could bring many benefits to the accounting industry, but there are still challenges to overcome before its use becomes widespread (Lai et al., 2019; Wang et al., 2018; Zhang et al., 2017).

2. Research methodology :

In this article, we hold the epistemological aspect of positivism using the case study method as it will allow us to explore a wide range of questions about Blockchain , including why, how and what, and to draw conclusions from it, and it is therefore ideal for explanatory and exploratory research.

The nature of our research is such that real-life context is the best way to illustrate the potential impact of Blockchain systems. Also, using the financial statements of an actual company allows conclusions to be drawn in the context of publicly traded companies, although it cannot be considered a gold standard.

In this article we attempt to model the quarterly fluctuations implied by the practical design to reflect on them within the established theoretical framework.

The practical design we described above was developed by Byström (2016) where it uses for the same purposes as ours.

H1: Hypothesis 1 is that future actual daily scores are likely to fluctuate more than is implied by volatility assessed from actual quarterly scores.

H2: Hypothesis 2 is that future actual daily scores are likely to fluctuate less than implied by volatility assessed from actual quarterly scores.

3. Quantitative data collection :

In our case study, we use data from the financial reports of company X, for confidentiality reasons we have not displayed the name of the company studied.

We use financial data for the 4 quarters of 2020 to facilitate modeling. The whole financial report we have used is reviewed by an auditor. We used moreover the daily stock prices of the enterprises as a data.

The period of 1 year seems adequate to demonstrate the conceptual quarterly fluctuations of the scores therefore to model it with reasonable accuracy.

To illustrate the graphics, we gathered the financial data in order to determine Z-scores of Altman and distances to default of Merton.

We estimate the standard deviations of the actual quarterly metrics over the year 2020 and use the square root of time (√63 assuming 21 trading days per month) to plate the potential daily volatilities of the measures, assuming that the movements are independent, in order to replicate the daily fluctuations of each risk of bankruptcy.

We apply the square root rule for temporal scaling to generate the volatility deviation for periods other than those utilized in the actual estimations.

We generate normally distributed random numbers around the actual scores after calculating all the fluctuations.

For guaranteeing a genuine estimation of measurement we used normal distribution.

4. Presentation of results :

4.1 Modeling Quarterly Altman Z-score Fluctuations :

In table 1 below, we calculated the quarterly Z-scores for 2020.

Table 1: Calculation of Z SCORE

Date	**03/31/2020**	**06/30/2020**	**09/30/2020**	**31/12/2020**
Total assets	56,065,000	55,477,400	55,143,600	56,669,400
Total liabilities	26,936,200	28,139,200	28,341,200	28,571,000
Working capital	20,729,800	17,765,800	17,673,000	16 201 200
Reservations	0	0	0	0
Current result	637,000	552,600	68,200	-56,000
Sales	10,441,800	10,821,600	10,215,200	13,043,000
Market capitalization	52,975,000	41,838,600	40,440,800	34,967,600
Z-SCORE	**1.84**	**1.50**	**1.43**	**1.30**

Source: Established by our own care

Here we show how the Z-score for March 31, 2020 was calculated:

The financial ratios needed for the Z-scores according to the formula:

$Z = 1.2\ A + 1.4\ B + 3.3\ C + 0.6\ D + 0.99\ E$

Rationale:

A = 20,729,800/ 56,065,000= 0.36

Where working capital is calculated as current assets less current debts = 38,147,800-17,418,000 = 20,729,800

B = 0 / 56,065,000= 0

C = 637,000/ 56,065,000= 0.01136

Where the current result was calculated as operating income – operating expenses = 3820400 – 3,183,400 = 637,000

D = 52,975,000/ 26,936,200= 1.966

Where the market capitalization is the share price multiplied by the number of shares outstanding = 200 * 264875 = 52,975,000

E = 10,441,800/ 56,065,000= 0.1862

Putting these numbers into the Z-score formula:

Z = 1.2*0.36 + 1.4*0 + 3.3*0.01136+ 0.6*1.966 + 0.99*0.1862= 1.8334

In the same way, the four Z-scores were calculated with the quarterly data of the 3 remaining quarters of the year 2020.

In order produce the standard deviation and the mean of the Z-scores for the year 2020, we use the following formula:

$$\sigma = \sqrt{\frac{1}{N}} \quad \sum_{i=1}^{N}(x_i - \bar{x})^2$$

Where:

σ - Standard Deviation

N - The number of samples

xi - individual values x

$\bar{x}$ - the average of the individual values

In our case:

$\bar{x}$ = 1.84 + 1.5 + 1.42 + 1.3 = 8.04 / 5 = 1.515

By subtracting the mean of the individual values and bringing them to degree 2

$(1.84 - 1.515)^2 = 0.1056$

$(1.50 - 1.515)^2 = 0.000225$

$(1.43 - 1.515)^2 = 0.007225$

$(1.30 - 1515)^2 = 0.046225$

Add the results and divide by N to get the mean of the squared differences (variance):

$\sigma^2 = 0.1056+0.000225+0.007225+0.046225/4 = 0.03981$

$\sigma = \sqrt{0.03981} = 0.19952$ which is the standard deviation of quarterly Z-Scores.

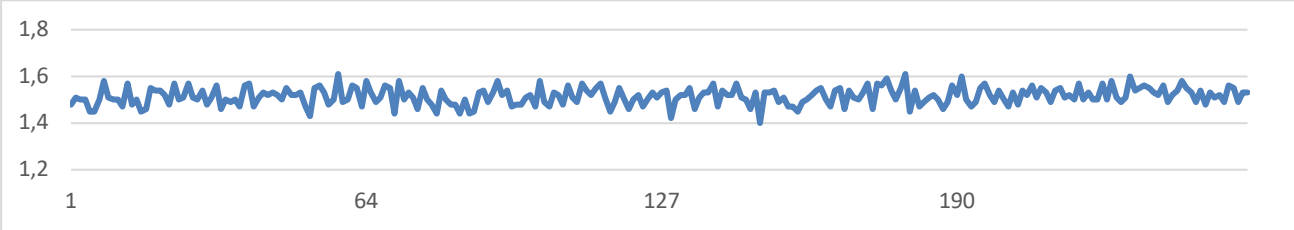
To convert the quarterly standard deviation to the daily deviation, we divide it by the square root of 63 (number of trading days per quarter):

σ daily $= 0.19952/\sqrt{63} = 0.025$

Now, to present the fluctuations of the 4 quarters, we generate 252 normally distributed random numbers separately for each respective quarter, taking into account their means and their standard deviation = 0.025.

We presented the results as 2 graphs in Figure 1 and 2 showing both daily and quarterly Z-scores;

Figure 1: Blockchain-Based Real-Time Accounting Daily Z-Score



Source: Established by our own care

The Horizontal axis in Figure 1 shows the 4 quarters of 2020, i.e. 21 days per trading month, and the vertical axis in Figure 1 shows the daily Z score estimates.

Figure 2: Quarterly Z-Score based on classic accounting

Source: Established by our own care

The Horizontal axis in Figure 2 shows the 4 quarters of 2020, i.e. 21 trading days per month, and the vertical axis in Figure 2 shows the quarterly Z score estimates.

4.2 Modeling Quarterly Fluctuations in Merton's Probability of Default :

Table 2 below shows all the elements needed to calculate Merton's probability of default versus default using the simplified formula.

A score below 1.8 means the company is likely to be heading for bankruptcy, while companies with a score above 3 are not likely to go bankrupt.

We notice that the scores of the company are below the threshold and therefore the latter has a high probability of going bankrupt, but the main purpose of this research is to study the comparison between real-time accounting and traditional accounting.

Table 2: Calculation of Merton DDs

Elements	**03/31/2020**	**06/30/2020**	**09/30/2020**	**31/12/2020**
Total debts	26,936,200	28,139,200	28,341,200	28,571,000
Market capitalization	52,975,000	41,838,600	40,440,800	34,967,600
Quarterly volatility of stock returns (σE)	0.173	0.225	0.118	0.255
Probability of bankruptcy	9.473	6.762	12,761	5,685

Source: Established by our own care

The company has already estimated the daily volatility of stock market returns, which are shown in Table 2, using logarithmic returns to account for the compound impact, which is often taken into consideration in the Black&Scholes model.

It was then converted to quarterly volatility using the square root of time rule.

Here is how the probability of default was calculated for period 1 according to the following formula:

$$\mathbf{DD} = \frac{\mathbf{Ln(l)}}{\mathbf{(L-1)}} \frac{\mathbf{1}}{\mathbf{\sigma E}} = \frac{\mathbf{Ln(0,337)}}{\mathbf{(0,337-1)}} \frac{\mathbf{1}}{\mathbf{0,173}} = \mathbf{9,437}$$

With DD= Distance Default (Probability of Failure)

Where L is the leverage calculated as follows:

$$\frac{\mathbf{D}}{\mathbf{V_E + D}} = \frac{\mathbf{26\,936\,200}}{\mathbf{52\,975\,000 + 26\,936\,200}} = \mathbf{0,337}$$

DD= Distance Default (Probability of Failure)

Likewise, we calculated the probabilities for each quarter of 2020. To model the quarterly fluctuations of the DDs, we use the same method of the Z-scores.

$$\boldsymbol{\sigma} = \sqrt{\frac{1}{N}} \quad \sum_{i=1}^{N}(x_i - \bar{x})^2$$

Where:

σ - Standard Deviation

N - The number of samples

xi - individual values x

$\bar{x}$ - the average of the individual values

In our case:

$\bar{x}$ = (9.473 + 6.763 + 12.761 + 5.685) / 4 = 8.67025

By subtracting the mean of the individual values and bringing them to degree 2

$(9.473 \_ 8.67025)^2 = 0.6444$

$(6.763 \_ 8.67025)^2 = 3.6414$

$(12.761 \_ 8.67025)^2 = 16.7342$

$(5.685 \_ 8.67025)^2 = 8.9117$

$\sigma^2 = (0.6444 + 3.6414 + 16.7342 + 8.9117) / 4 = 7.482925$

$\sigma_{\text{Quarterly}} = 2.73549$

2.73549 Which is the standard deviation of the quarterly DDs.

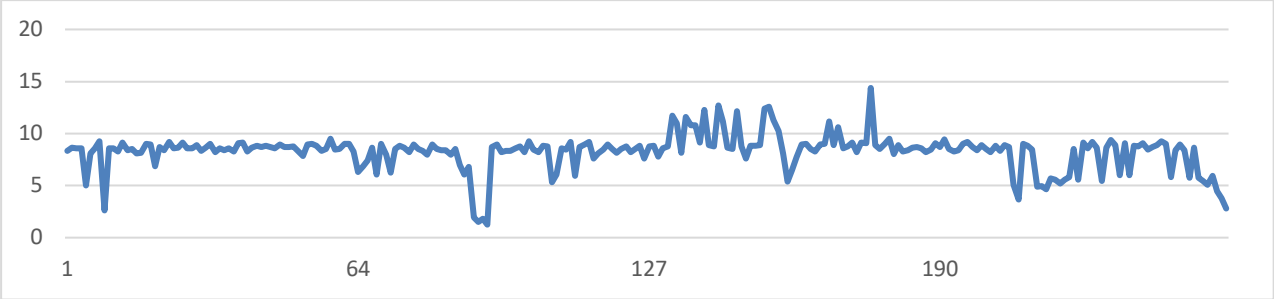
To convert the quarterly standard deviation to the daily deviation, we divide it by the square root of 63, which is the number of trading days per quarter:

$\sigma_{\text{daily}} = 2.73549 / \sqrt{63} = 0.3446$

Now, to model the fluctuations of the 4 quarters, we generate 252 normally distributed random numbers separately for each respective quarter, considering their standard deviation = 0.3446

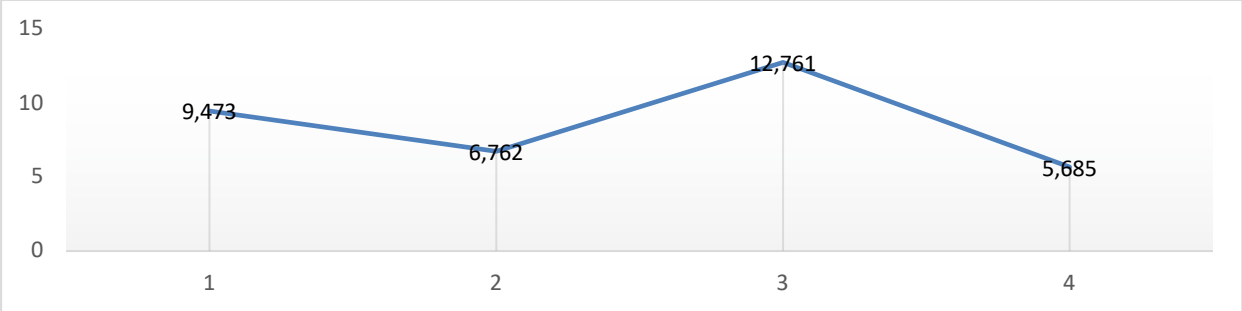
We have presented the results in the form of graphs in Figure 3 and 4 showing both daily and quarterly DDs.

Figure 3: Daily Merton DD of Blockchain-Based Real-Time Accounting



Source: Established by our own care

Figure 4: Quarterly Merton DD based on classical accounting



Source: Established by our own care

5. Analysis and results :

We remark that the model of Z-score is more affected by real time accounting because it's calculated with more financial ratios basis. The ratios we already provide has added an extra dynamic dimension to the model thanks to the stock quotes which are calculated daily.

Misunderstood financial ratios could affect significantly Z-score results, which is particularly relevant when unaudited quarterly reports are used for analysis.

Additionally, the average 18% increase in audit costs has little to no discernible impact on the quality of interim reports or on the benefits that follow. As a result, regulators are unlikely to start requiring the auditing of interim financial reports, and management has almost no incentive to do so. (Bedard, Courteau, 2013).

Altman's Zscore model is most likely to be affected by real-time accounting. This observation is in accordance with the studies of Byström (2016) and Lai et al. (2019) who showed that to upgrade the accuracy and speed of real-time accounting processes Blockchain is highly recommended. By utilizing daily updated financial ratios, Zscore's model could undoubtedly benefit from an extra-dynamic dimension that could lead to a good decision-making.

In this study, we looked at the impact of real-time accounting on a model called Altman's Zscore, which is used to predict a company's risk of bankruptcy. We found that the model is

particularly sensitive to daily updated financial data, as it is based on various financial ratios calculated from accounting reports. Adding daily updated data could improve the accuracy of bankruptcy risk assessment. We also discovered that daily fluctuation results can be affected by misunderstandings of financial ratios, especially when unaudited quarterly reports are used. It is important to note that using unaudited accounting reports can lead to errors in financial ratio calculations and impact the results of the Z score.

Bedard and Courteau (2013), suggest that it would be interesting to further examine the benefits and costs of auditing interim financial reports using blockchain technology. This highlights the importance of having accurate and up-to-date financial data to improve the quality of bankrupycy analysis. By comparing these findings to research on blockchain technology and real-time accounting, we conclude that their study provides new insights into the role of blockchain technology in improving risk assessment for bankruptcy. For example, Byström (2016) found that blockchain technology can be used to automate and improve accounting processes in real time, which aligns with our findings on the importance of daily updated financial data for credit risk analysis. However, with blockchain accounting systems, daily fluctuations in default prediction scores will be valuable because they are timely, potentially volatile, and contain automatically verified financial information at no extra cost. Additionally, the cost of human audits may decrease dramatically, leading to a reconsideration of the cost/benefit ratio of audits, even if the automatic valuation of intangible assets may not be satisfactory.

Considering that the significance of the daily variations in the scores is determined by the standard deviation of the quarterly measurements of the risk of failure prediction, the new blockchain accounting systems will have more implications for riskier companies that present a high volatility of the components used in one or more other bankruptcy prediction models than other systems.

When the data are compared, it becomes clear that daily variances rise according to the quarterly score's standard deviation.

However, depending on the source of the risk taking, these ramifications could be either beneficial or bad. Stakeholders will gain from greater power to control management's actions and greater involvement in management processes if the source is management's reckless and unreasonable behavior.

Otherwise, managers may feel more pressure than necessary as a result of the enhanced transparency. According to the data, the company appears to be relatively risky because its

Altman model score is below 1.8 and its Merton model default probability ranges between 5% and 12%. Leaders can now make strategic decisions before it's too late thanks to this research. Blockchain-based accounting is therefore a crucial tool for the early detection of financial issues that can result in a more effective process of managing businesses during their financial storms for both the businesses themselves and their creditors, allowing to reduce losses and/or steer them away from troubled waters.

The ability to incorporate specifically created Balance Sheets is another noteworthy advantage of these daily updated financial statements that is useful in assessing a business for an investment or loan.

Restating financial accounts is the name of the procedure that is now in use. Rephrasing is done to put more emphasis on various elements of the company's financial condition and to eliminate "noise" from financial statements prepared in accordance with GAAP and IFRS, such as by separating operating and financial operations investment. (Penman, 2013).

It seems that one potential benefit is the ability to have more transparent and up-to-date financial information, which can be useful for stakeholders such as creditors and investors in evaluating a company's financial health and making strategic decisions. The use of blockchain can also make the process of restating financial statements more efficient and cost-effective. However, it is important to consider that the increased transparency can also bring additional pressure on management, as investors and lenders may be more closely monitoring the company's financial performance. It is also important to note that the adoption of blockchain technology is not a panacea and will not solve all financial reporting issues, but it can be one tool among others that can be considered to improve the accuracy and transparency of financial information.

This characteristic can significantly exacerbate the short-termism issue, which has not received much attention in the context of blockchain technology. Economic short-termism is the pursuit of goals that are ideal in the short term but insufficient in the long term through decisions and actions. (Laverty, 1996).

Pressure from capital markets and management systems that prioritize short-term aims over long-term ones are factors that contribute to short-termism issues.

According to studies, market pressure does in fact play a significant part in increasing issues with short-termism, and reducing market pressure enables businesses to value long-term investments. (Laverty 2004).

The frequency of financial reporting is also seen as contributing to the problem. To meet public expectations of quarterly results, management may reduce R&D and marketing expenditures, which make numbers short term and hurt future development (Herz, 2016).

Despite all the advantages of transparency and accurate reporting, it seems logical to predict that things could get worse with transparent blockchain accounting.

A greater understanding of how financial outcomes fluctuate will help to mitigate this possible issue. Long-term projects must be valued, and managers must explain to stakeholders why they are making certain decisions.

Instead of trying to falsify the figures and satisfy every unreasonable shareholder demand, they should embrace transparency. The adoption of blockchain accounting techniques can only have a synergistic effect in these situations, when management is responsible and transparent about its actions.

Conclusion :

All counterparties are required to adopt blockchain accounting principles. A blockchain ledger's entire purpose is to update and store all transactions conducted both inside the business and with external counterparties.

But in order to achieve this, it must create all transactions as token transfers inside the blockchain, which is only achievable if all counterparties have adopted the technology.

The blockchain can easily write and preserve intra-company transactions, but when used alone, it loses the majority of its advantages. Naturally, transactions must be started using a cryptocurrency that is easily convertible into the counterparties' preferred fiat currencies and is denominated in those fiat currencies.

These factors provide a significant adoption problem, but it can be handled by introducing the technology gradually through the most popular middleman—financial institutions.

Since banks and other financial intermediaries are leaders in this field, there is reason for optimism that other companies will be able to quickly and uniformly embrace the technology.

Moreover using two of the most widely used bankruptcy prediction models—Z-scores Altman's and Merton's DD model—we demonstrated the theoretical daily swings of failure anticipation scores.

In other words, we can say that the material impact is comprised by the fluctuations themselves, but that their magnitude is defined by the daily volatility of the measures, which, in the absence of a true blockchain accounting system, can only be inferred from the quarterly volatility. After

performing the analysis, we can say that the material impact is largely confined within the limits set by the standard deviation of the quarterly measurements.

The societal impact is explored a little bit too extensively when the technological difficulties of deploying blockchain are taken into account.

Future study should cover a wide range of these topics. The first is due to the fact that no model for predicting bankruptcy has been created to deal with continuously updated ledgers, and the daily volatility of their measures that results from this lacks a clear interpretation.

Second, updated failure prediction score models must be created in order to take into account daily developments and offer useful interpretation. Direct integration into blockchain accounting systems, most likely in the form of smart contracts monitoring the company's financial health, should be one of the major prerequisites for these models.

While blockchain technology seems like a great solution to problems that have long haunted auditing, accounting and corporate governance, including poor quality financial statements, the astronomical costs of auditing in terms of money and time, lack of shareholder control over their business, and insufficient security of financial data, a company wishing to implement it should proceed with caution.

As a first step in introducing technology into business practices, we suggest using it for internal accounting and gradually extending it to external transaction processing.

However, the danger of overlooking issues, not doing enough research, or being too positive about societal impact can come from the property of being revolutionary and the "new computing paradigm".

Although implementing blockchain technology may seem like a great way to address issues that have long plagued auditing, accounting, and corporate governance, such as unreliable financial statements, exorbitant auditing costs in terms of both money and time, a lack of shareholder control over their business, and inadequate financial data security, a company should exercise caution.

We advise employing technology for internal accounting as a starting point before gradually expanding it to include external transaction processing.

However, the trait of being revolutionary and the "new computer paradigm" also come with the risk of ignoring problems, not completing enough research, or being overly optimistic about societal influence.

Under these circumstances, it is very simple to overlook the safeguards and engage in overesti mating the blockchain's potential.

Further study is required to examine the effects of blockchain accounting on additional failure anticipation models given the nature of the research's constraints.

The ideal approach to combine regularly updated, technically audited financial data and ultimately support the creation of unique smart-contract models.

In terms of perspectives, our study paves the way for further research on the use of real-time accounting and blockchain technology in bankruptcy risk analysis. For example, it might be worth exploring other credit risk models and comparing their performance when based on daily updated financial data. It would also be interesting to better understand the factors that can influence the effectiveness of Altman's Zscore model when used with daily updated financial data.

In sum, our study makes an important contribution to research on the impact of real-time accounting on the analysis of bankruptcy risk and underlines the importance of having accurate and updated real-time financial data to improve the quality of the credit risk assessment. We hope that our results and insights will pave the way for future research in this exciting area.

Moreover, from now on, more in-depth research can be carried out taking into account all the possible repercussions - technological, environmental, societal and economic.

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