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Green Bonds, Digital Finance on Green Finance Performance: The Mediating Role of GCG

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Abstract. This study aims to investigate the impact of green bonds, digital finance and good governance on green finance performance, with good governance also acting as a mediating variable. The study focuses on financial services institutions registered with the OJK in the period 2021-2023. A quantitative approach is used, employing multiple linear regression analysis and the Sobel test. The sample includes eight banks selected through purposive sampling due to the requirement to publish annual reports for the period 2021 to 2023. The results of this study suggests that green bond and Digital Finance have a significant positive impact on Green Financial Performance. In addition, good corporate governance successfully mediates the relationship between green bonds and green financial performance. However, the link between green financial performance and digital finance isn't affected by it.

Keywords: Green bonds, Digital finance, Green Finance Performance, Good Corporate Governance.

1 Introduction

Global awareness of climate change is growing, particularly in light of the pressing need to lower carbon emissions in order to slow down the rate of global warming. Due to the substantial effects on the environment, society, and economy, developing nations—including Indonesia—are the primary focus of numerous mitigation initiatives. Joining the Paris Agreement, an international pact ratified by 195 nations at the 21st UN Climate Conference, is one of the tangible steps to combating climate change. According to [1], the Paris Agreement aims to keep the increase global temperatures to 1.5°C above pre-industrial levels As a response, Indonesia has shown a strong commitment to sustainable development and environmental protection by pledging to reduce carbon emissions by 29% by 2030 using national funds [2]. Accordingly, the Triple Bottom Line approach—profit, people, and planet—makes the sustainable development goals (SDGs) a primary focus [3]. This idea is strongly related to Green Finance, a financing arrangement that considers social welfare (people) and the environment (planet) in combination to business (profit) [4]. To assess the social and environmental impact of their activities, companies are therefore required to incorporate sustainability concepts into their business models.

Green Finance has developed significantly in Indonesia, one of which is through the issuance of green bonds and relevant policy support [5]. However, several obstacles such as people limited awareness, lack of specific regulation, and lack of transparency in reporting are still stand in the way. To illustrate, Bank Mandiri has announced that it will invest IDR 115 trillion in environmental projects by 2023 [6]. This shows how important it is for the banking sector to set the direction of the green finance agenda. Green bonds, which are used for financing environmentally beneficial projects, are a key tool in green finance [7,8]. As of June 2019, Indonesia issued 58% of the green bonds issued in the ASEAN region, followed by the Singapore (18%) and then Malaysia (14%) [9]. This difference in strategy between countries is a reflection of differences in government support and regulations; in Indonesia, the government controls green bond issuance, while the private sector is more involved in Singapore and Malaysia.

Nonetheless, there are still some significant issues facing Indonesia, such as political dynamics, institutional design weaknesses, and inadequate financial institution capabilities [10]. For instance, Bank Mandiri's green bond coupon rate is 5.8% lower than that of its 3-year AAA conventional bond (6.5%), suggesting that overseas investors are still less interested in Indonesia's green bond market. In addition to green bonds, the of the digital era is a significant factor pushing the development of the Green Finance. Digital transformation in Finance sector promotes accountability and transparency, which boosts operational efficacy and investor confidence [11,12]. Innovations like fintech, blockchain-based smart contracts, and artificial intelligence (AI) bolster green finance initiatives [13]. The connection between digital finance and green finance, particularly regarding enhancing the efficacy, security, and transparency of green investments, has not, however, been extensively examined.

Green investment or green finance is inseparable from the role of Good Corporate Governance (GCG), which helps improve transparency, accountability and environmental considerations in corporate strategic decision-making, and is an important tool in the transformation of conventional business practices towards a more sustainable model [14]. The relationship between GCG and green finance is getting stronger, where GCG regulates the system of relationships between management, the board of commissioners, shareholders and stakeholders to strengthen corporate management, while green finance supports investment in environmental projects. Commitment to green innovation and environmental disclosure also strengthens corporate reputation [15–17]. Previous research shows GCG has a positive influence on financial performance through the board of directors [18], boosts investor confidence, which fortifies the connection between environmental reporting, green innovation, and company value. (Iqbal and Brawijaya 2024), and proportional management of environmental costs can improve financial performance [20]. However, there are also findings that board size in GCG negatively affects financial performance [21], and green innovation does not always affect firm value [22,23].

Many research studies show that green finance plays an important role in sustainable development by enhancing firm value and bank performance [24,25]. One of the key variables is green bond issuance, which has been shown to increase the flow of funds for environmental projects and improve green sector performance [26]. While

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helping to reduce carbon emissions and promote economic sustainability [7,27,28]. Issuing green bonds also increases investor confidence [29] and strengthens a company's sustainability reputation by attracting ESG-based investors [30], although most research still focuses on developed countries [31]. On the other hand, digital finance contributes to clean energy and green bonds [32], facilitates financing of urban enterprises [33], promotes green innovation through digital transformation [34,35], and improves financial performance of banks [36–38] with effectiveness reinforced through financial regulation [39]. The implementation of green innovation and environmental disclosure also strengthens corporate reputation [15–17]. According to previous research, green bonds show that green finance plays a crucial role in sustainable development. In addition, digital finance also benefits green innovation and corporate performance has a positive impact on green innovation and improved corporate performance. However, there are still several gaps and challenges. First, there is a lack of literature and studies on the role of green bonds and digital finance in green finance. Second, current literature has not explored the moderating effects of green bonds and digital finance on good corporate governance (GCG) in green finance. The motivation for this research is to explore how green bonds and digital finance influence green finance. GCG is treated as an intervening variable between green bonds, digital finance, and green finance. This study theoretically explores the role of green bonds, digital finance, and GCG in enhancing transparency, efficiency, and security in green investments. Additionally, this study offers a new conceptual framework to complement previous research on the digitalization of green finance. Practically, this study benefits various stakeholders and can provide investors with insights into safer green investment opportunities in the green finance sector by leveraging digital technology and good corporate governance.

2 Literature Review

The definition of Stakeholder theory states that each group or individual that can affect or be affected by the achievement of organizational goals is a stakeholder [40]. This definition is reiterated [41], according to which stakeholder theory includes various groups that influence or are influenced by the company, so that the organization's effectiveness is measured by its ability to meet the needs not only of shareholders but of all stakeholders. Divide this theory into three main perspectives: the descriptive, which describes the real interactions between companies and stakeholders; the instrumental, which examined the relationship with stakeholder management and the achievement of corporate goals; and the normative, which emphasizes the moral obligation of companies to pay attention to all stakeholders [42].

Add that key stakeholders include shareholders, employees, creditors, suppliers, customers, banks, governments, and communities, so companies that pay attention to environmental impacts in their operations will gain trust that impacts reputation, customer loyalty, and financial performance[43]. [44] emphasized that to achieve sustainability, managers need to inform their environmental performance to stakeholders. In line with that, [45] states that stakeholder involvement is very important in green

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innovation to reduce environmental impacts, emphasized that green strategies can increase firm value and attract investors through the perspective of stakeholder theory[46].

The relevance of stakeholder theory in this study stems from the fact that digitalization and sustainability can increase business value and stakeholder welfare. In this context, green bonds serve as a strategic tool to reduce environmental stress and increase trust in business practices that are undergoing change. In addition to this, digital currency also strengthens green currency by providing financial services based on technology that enhances users' access to financial services with a range of features. Digital currency not only increases financial efficiency but also encourages more prudent investment decisions.

Stakeholder theory and good corporate governance (GCG) work in tandem to create morally upright, open, accountable, and sustainable businesses. GCG offers a workable framework for putting these ideas into practice, guaranteeing value creation for all parties involved, not just shareholders. Thus, putting green bonds, digital finance, and green finance principles into practice not only satisfies stakeholders' environmental demands but also raises the company's future value and competitiveness.

2.1 Hypothesis

Role of Green Bonds on Green Finance Performance.

Although the issuance of green bonds provides benefits to companies and stakeholders, it not only functions as a financial instrument, but also as a strategic tool that allows companies to fulfill their environmental responsibilities while strengthening stakeholder confidence in sustainable business practices [47]. Some previous studies have tested that green bonds have a positive effect on green financial performance according to [26], green bonds are proven to provide flow and waste treatment to improve green finance performance. The issuance of green bonds provides positive market recreation [48]. Green bond issuance improves the ESG performance of companies in China [49]. Green Bond are effective in promoting funds to feed green initiatives [50], Investors tend to be more interested in issuing green bonds in China [51]. The use of green bonds has proven to be an effective funding method for sustainable supply ratios [52]. On the Based previous literature, it is concluded that:

H1: The performance of green finance is positively impacted by green bonds.

Role of Digital Finance on Green Finance Performance.

Digitalization is increasingly playing a crucial role in improving the effectiveness and efficiency of green finance performance implementation. Digitalization in the financial sector covers various aspects, such as mobile banking, financial technology, blockchain, artificial intelligence (AI) [13]. These technologies can increase transparency, speed up the transaction process, and enable more efficient monitoring and reporting of green initiatives. Therefore, digitization can encourage the adoption of green finance through ease of access and increased accountability. Financial reporting

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accountability becomes increasingly important in digital technology-enhanced openness to stakeholders [12]. In accordance with the research of [53], shows that digital finance can increase financial transparency and reduce transaction costs, which in turn strengthens relationships with stakeholders. Green Finance and Fintech in BRICS countries have a significant effect on reducing CO2 emissions[54]. Fintech increases the positive impact of green finance in India [55]. Technological innovation plays a role in carbon neutrality [56]. Digital finance has a positive effect on corporate green innovation in China [35]. It was concluded that the more internet financing implementation, the better the performance of green financing.

H2: Digital finance has a positive effect on green finance performance.

Role of Green bonds on Green Finance Performance with GCG as an Intervening Variable.

In this research, GCG is a mediating variable between green bonds and green finance. According to the [14], Good Corporate Governance (GCG) can help improve transparency, accountability, and environmental considerations in corporate strategic decision making. Good GCG implementation in the company is closely correlated with firm value, and improved GCG control can benefit investors [57,58]. Stakeholder theory states that good corporate governance allows companies to be responsible to stakeholders, especially investors, by carrying out company performance with reasonable responsibility to both the environment and obligations to investors. because if good corporate governance is properly implemented, it will increase company value directly and indirectly [19]. Previous research has examined GCG which shows a positive influence of the board of directors on financial performance [18]. This is in line, revealed which by assigned expenses to the financial appropriate proportion [20], it will improve financial performance. Revealed that GCG has an effect on green innovation and firm value [19]. Issuance of green bonds improves the ESG performance of companies in China [49]. So, the proposed hypothesis is:

H3: GCG can mediate the positive relationship between green bonds and the performance of green finance.

Role of Digital Finance on Green Finance Performance with GCG as an Intervening Variable.

Good Corporate Governance (GCG) is a variable that has an influence on green finance. However, this study wants to test GCG as an independent variable and also intervening. In previous studies, in general, the two variables were only related to financial performance or green finance. Revealed that GCG has an effect on green innovation and firm value[19]. Fintech increases the positive impact of Green Finance in India [55]. This study will investigate the role of GCG in financial sector sustainability by looking at it both as an independent variable and as an intervening variable in relation to green finance. This is different from previous studies that usually only relate these two variables to financial performance or green finance directly. Conse-

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quently, the aim of this study is to provide a new view on the role of GCG in financial sector sustainability.

H4: GCG is able to mediate the positive relationship between digital finance and green finance.

2.2 Conceptual Framework

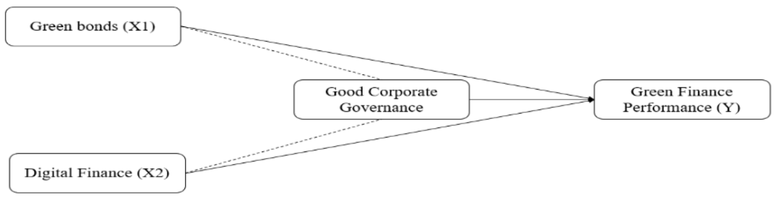

Fig. 1. The Conceptual Framework of this research illustrates the relationship between green bonds, digital finance, GCG, and green finance, with GCG acting as a mediating variable.

3 Method

This study uses purposive sampling, in which samples are selected based on specific characteristics that are relevant to the research objectives [59] The population in this study consists of 238 financial service institutions registered with the Financial Services Authority (OJK) for the period 2021–2023. Given the research focus on green finance, digital finance, and corporate governance, not all institutions in the population are relevant for analysis. Therefore, purposive sampling was applied to ensure that the selected sample effectively represents institutions directly related to the research objectives.

The sample selection criteria are as follows:

1. Financial services institutions that published sustainability reports during the 2021–2023 period.
2. Financial services institutions that published sustainability reports during the 2021–2023 period.
3. Financial services institutions whose annual reports and sustainability reports are publicly accessible during the same period.
4. Financial services institutions whose annual reports and sustainability reports are publicly accessible during the same period.

The rationale for these criteria is as follows:

1. Institutions that publish sustainability reports demonstrate a clear commitment to environmental responsibility and green finance practices, making them relevant to this study.

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2. Publicly accessible reports ensure transparency and allow the researcher to obtain valid, complete, and verifiable data for analysis.
3. Focusing on banks actively involved in green finance aligns with the research objective of examining the role of green bonds, digital finance, and GCG in supporting sustainable finance. Moreover, banks play a crucial role in financial distribution and economic transformation, making them strategic actors in promoting Indonesia’s transition towards a greener economy.

Based on these criteria, eight banks were selected as the final research sample. These banks have been identified through OJK's official reports as significant contributors to green finance development in Indonesia. the government appointed the following eight banks:

Table 1. Sample Bank

No.	Bank Name
1	Mandiri Bank
2	BNI Bank
3	BRI Bank
4	BCA Bank
5	Bank Artha Graha Internasional
6	Bank Muamalat Indonesia
7	BJB Bank
8	BSI Bank

The dependent variable in this study is green finance (Y) which describes funding to ensure that business profitability (profit) continues without sacrificing social welfare (people) and environmental sustainability (planet) [4]. The indicators used to measure green finance use the indicators of [60], calculated from the costs incurred for life protection to reduce emissions. The independent variable in this study is the green bond variable, which is a debt instrument that offers sustainability projects [61]. Measurements are used according to the instruments that have been used [48], calculated using dummy variables. The GCG variable is an intervening variable. The indicators used to measure GCG that have been used in research are: board of directors, board of committees, audit committee, overall indicators[62].

Table 2. Operational Variable

No.	Assessment Aspect
Green Finance	Environmental Cost
Green Bonds	Green bonds
Digital Finance	Instrument Digital
	Ecommerce
	Data administration
	Details on digitalization and related initiatives

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	Investments in digitalisation and relevant activities
GCG	Size of the board
	External of the board
	Meetings of the board
	Separate chair dummy
	Committee compensation
	A nomination committee
	The nomination committee's meetings
	The committee nominations do not include the CEO.
	The presence of an audit committee
	Size of the audit committee
	Meetings of the audit committee
	An auditor from the Big Four
	the Member's knowledge of finance

This study uses multiple linear regression analysis by first conducting a classical assumption test as a prerequisite to see the effect of green bonds and digital finance on green finance with GCG as mediation. The classic assumption test is carried out by testing for multicollinearity, heteroscedasticity, and normality [63]. The results of the normality test with Kologorov-Smirno show that the significance value is <0.05 so that the data is not normally distributed [64]. To overcome this, a logarithmic transformation was carried out due to positive skewness in the data [65]. The data became normal and satisfied the normalcy standards following the transformation. The findings from additional traditional assumption tests, such as heteroscedasticity andmulticollinearity, have also been carried out and have met the requirements so that they can proceed to regression analysis. In this study, in addition to using regression, the Sobel test was also conducted to test the role of mediating variables in the relationship between X and Y. The Sobel test calculates the significance of the indirect effect between variables by looking at the Sobel statistical value.

4 Results And Discussion

According to Table 3, the average Green Finance score of 51,947.98 (in millions of rupiah) indicates that overall, banks allocate considerable environmental costs. The maximum value was achieved by Bank Artha Graha in 2022, which indicates that the bank has a progressive and innovative strategy in meeting market demands and supporting sustainable initiatives, especially in the post-Covid-19 pandemic period. This achievement not only demonstrates the bank's leadership in the responsible finance sector but can also serve as an example for other institutions to strengthen their commitment to environmentally friendly investment practices. Meanwhile, the minimum value of 0.00 was obtained from Bank Artha Graha which indicates that Bank Artha Graha in 2021, has not allocated significant costs to the environment. While the average green bond is 0.62 which reflects that despite the increasing commitment to green

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financing, there is still ample room for growth and development of sustainable financial instruments in the banking sector.

Table 3 shows that digital financial disclosure has an average value of 16.71. This indicates that out of the five indicators, banking companies have disclosed a lot of digital technology through their websites. These disclosures include fixed, unrecognized, as well as recognized intangible assets, financial instruments, and estimated liabilities. The average value recorded reflects the openness of banking companies in communicating important aspects of the digital technologies they use. This disclosure is significant because it allows stakeholders to obtain clear and transparent information about financial position of the company, as well as a result of digital technology on their operations and asset value [66].

Table 3 shows that the average GCG score obtained from various indicators, including the number of directors, audit committee, frequency of meetings, involvement of Big Four auditors, and the number of members with a financial background, reached 98.52. This value indicates that in general, GCG practices in banking institutions are at a very good level. This reflects the company's commitment to transparency, accountability, and management with integrity. The achievement of the maximum score achieved by Bank BNI for two consecutive years in 2021 and 2022 shows that the bank has succeeded in implementing GCG principles consistently and effectively. This success can be interpreted as recognition of the commitment of the management and board of directors in creating a business environment that not only complies with regulations, but also proactive in safeguarding the interests of stakeholders. Thus, Bank BNI is not only a role model in GCG practices, but also strengthens its position and reputation in the national banking industry.

Table 3. Statistics Descriptive

Variable	N	Min	Max	Mean	Std. Deviation
Y *Green Finance*	24	0.00	871660.62	51947.98	183061.71
X_1 *Green Bonds*	24	0.00	1.00	0.62	0.49
X_2 *Digital Finance*	24	15.00	17.00	16.71	0.62
Z GCG	24	42.33	134.40	98.52	25.69
Valid N (listwise)	24				

The regression results for testing H1 and H2 are displayed in Table 4., where simultaneously green bonds, digital finance and GCG variables have a positive effect on green finance. The coefficient of determination shows 0.848, indicating that the independent factors in this study are able to explain 84.8% of the variation in digital finance.

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Table 4. Direct Effects

Direct Effect	***Coeff.***	***P-Value***	**Description**	
X_1 *Green Bonds*	3.588	0,003**	Positively Significant	H_1 Accepted
X_2 *Digital Finance*	0.852	0,003**	Positively Significant	H_2 Accepted
Z *Good Corporate Governance*	0.045	0,003**	Positively Significant	-
F-Stat	14.876	-	-	-
P-Value	0.001**	Positively Significant	-	-
R-Square	0.848	-	-	-

***p-value < 0.05*

Table 5, Shows the results of the Sobel test which aims to test whether GCG can mediate the relationship between green bonds (X1) and Digital Finance (X2) on Green Finance (Y). The analysis results show that GCG has a positive effect in mediating the relationship between green bonds (X1) and green finance (Y), so H4 is accepted. However, this study shows that GCG is unable to mediate the relationship between digital finance (X2) on green finance (Y), so H4 is rejected.

Table 5. Indirect Effects

Indirect Effect	***Coeff.***	***P-Value***	**Description**	
X_1 *Green Bonds*	2.794	0,005**	Positively Significant	H_3 Accepted
X_2 *Digital Finance*	0.636	0,535	Not significant	H_4 Rejected

***p-value < 0.05*

4.1 A Green Bond has a positive impact on Green Finance

The results of this study show that green bonds have a positive effect on green finance, which means that the increase in the number of green bonds issued by banks is directly proportional to the increasing allocation of green funding. Therefore, to achieve broader sustainability goals, banks, government, and society must work together to create an ecosystem that supports the growing of the green bond industry and sustainable funding. This finding is in line with the research of [26], which state that Green financing and market response are positively impacted by the issuance of green bonds[48,52]. Therefore, efforts to optimize the potential of green bonds should be a priority for all stakeholders to achieve the expected sustainability goals.

The increasing issuance of Green Bonds indicates a growing awareness among investors and financial institutions of the importance of supporting sustainable projects. The results of this study confirm that as more green bonds are issued by Banks, the

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allocation of green funding increases. This suggests that In addition to being a source of funding, green bonds also act as a strategic instrument that can drive the overall expansion of green finance [67]. The importance of the positive relationship between green bonds and green finance also reflects a strong synergy between the urgent need to address climate change and the financial capacity available for sustainable projects. With increased allocation of funds to green projects, banks can play a central role in the transition to a low-carbon economy.

The outcome of this study are in line with the principles of stakeholder theory, where the influence of green bonds on green finance can be seen through several aspects. First, with clear ratings and transparent reporting, green bonds can help attract capital from investors who want to contribute to sustainability. This creates a greater flow of funds for environmentally friendly and sustainable projects. In the view of stakeholder theory, this reflects the realization that stakeholder interests can be aligned with corporate goals to achieve sustainability. Second, green bonds can encourage innovation in the development of green technologies and sustainable business practices. These innovations not only benefit the company issuing the green bond, but also provide benefits to society and the environment, which are part of the core stakeholders. Third, by tying the source of funding to the outcome of a positive impact on the environment, green bonds help set expectations for companies to pay more attention to the interests of broader stakeholders.

Overall, the relationship between green bonds and green finance can be understood within the framework of stakeholder theory, where both complement each other to encourage more sustainable and inclusive financial practices. Through green bonds, companies not only fulfill their financial responsibilities but play an important role in protecting and safeguarding the environment. Therefore, collaboration between companies, investors, governments and communities is essential to create an ecosystem that supports sustainability and maximizes benefits for all stakeholders.

4.2 Digital Finance has a positive effect on green finance

This study shows that digital finance has a positive effect on green finance in the banking sector. This shows that the higher the adoption of digital technology in banking finance, the higher the sustainability financing. Digital finance, which includes the use of information and communication technology in financial transactions and services, provides ease of access and significant efficiency. With digital platforms in place, banking institutions are able to reach out to a wider segment, including small and medium-sized enterprises as well as sustainable projects that were previously difficult to get the attention of traditional investors. This not only increases financial inclusion but also creates opportunities for investments that support environmental sustainability.

This finding is in line that both Green finance benefits from digital finance and financial technologies [54–56,68].In the context of global financial development, Digital finance simply use of digital technology to provide financial related services, while fintech includes innovations that facilitate financial transactions. One of the significant contributions of digital finance lies in its ability to increase financial accessibility

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and inclusion. By reducing costs and speeding up processes, digital technologies enable more individuals and companies to engage in sustainable financial activities. This is particularly important in the context of green finance, where financial support is needed for projects focused on environmental sustainability. In addition, fintech also plays a critical role in facilitating investment in environmentally friendly sectors. The various applications and platforms created by fintech provide opportunities for investors to fund initiatives that are aligned with sustainability principles.

Overall, the integration of digital finance in the banking sector, while taking into account the principles of stakeholder theory, has a significant positive effect on the development of green finance. Through this approach, banks can not only reap economic benefits but also take an active role in addressing the environmental challenges facing the world today. This effort is important so that the banking sector not only functions as a driver of economic expansion, but also as an agent of change that supports sustainability.

4.3 GCG is able to mediate the positive relationship between green bonds and green finance

The results show that good GCG implementation can strengthen the relationship between spending on green bonds and the achievement of green finance objectives. Effective GCG serves as a framework that ensures transparency, accountability and responsibility in the utilizing of funds derived from green bonds. With solid GCG in place, investors are more likely to provide financial support to sustainable projects, given better risk management and certainty about positive environmental impacts. The results of this study are also in line with the findings of [19] and who say that GCG has a positive effect on green innovation and green finance[55]. Emphasize that companies that implement effective GCG are able to allocate resources for research and development of green innovation, which in turn increases the competitiveness and reputation of the company in the global market[19].

On the other hand [55], highlighted the link between GCG and green finance, where good governance principles can increase the confidence of investors and other stakeholders in financing green projects. In this context, GCG serves as an important element that ensures that every investment is directed towards initiatives that are sustainable and not detrimental to the environment. This not only provides economic benefits, but also encourages positive social growth. A good GCG approach can reduce uncertainty among stakeholders and increase trust in the market. When investors feel confident that deviations from GCG principles will not occur, they are more willing to invest in green bonds. This in turn will encourage the growth of green finance, which is essential to meet sustainable development goals [69].

Overall, this study confirms the importance of GCG in supporting and mediating the relationship between green bonds and green finance. By integrating GCG principles in green financing strategies, companies and financial institutions can not only strengthen their reputation but also contribute significantly to a greener and more sustainable future. Therefore, effective GCG implementation should be a priority for all parties involved in the green finance ecosystem. The results of this study are in

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line with the principles of stakeholder theory where with the support of good GCG, it is able to mediate and enrich the positive relationship between green bonds and green finance. This not only helps facilitate sustainable funding but also reinforces a sense of shared responsibility in the face of global environmental challenges. Collective commitment from all stakeholders is key to ensuring the success and sustainability of future green finance initiatives.

4.4 GCG is unable to mediate the positive relationship between digital finance and green finance.

These findings prove that GCG is unable to act as an effective mediator in the relationship between digital finance and green finance in the banking sector studied. Although the development of financial digitalization shows a positive trend, the Sobel test results indicate that the increase in digital finance does not significantly encourage green finance through the GCG mechanism, with a p-value of 0.535. This finding suggests that digitalization in the banking industry is more likely to have a direct impact on financial sustainability, without having to go through strict governance.

This study contradicts the findings of [19] regarding the impact of GCG on green finance. One reason is that companies, despite applying GCG principles, are often more concerned with short-term profits than investing in projects that support environmental sustainability. This indicates that despite the commitment to GCG, external factors such as market pressure and lack of incentives from the government also play an important role in corporate an emphasis on investment decisions [70]. One factor that may explain this result is the proven characteristics of digital technologies that enhance transparency and operational efficiency. Innovations in digital finance, such as fintech, blockchain and artificial intelligence (AI), are generally equipped with systems that enforce transaction accountability. Thus, the role of GCG as a mediator in this context becomes less relevant. When banking institutions adopt these technologies, they not only improve the accessibility and efficiency of financial services, but also support broader sustainability initiatives, without reliance on the strict oversight of corporate governance structures [71]

The outcomes of this research shows the importance of policies and regulations that support digital transformation in improving green finance performance. This suggests that greater focus should be placed on strengthening digital finance regulations, developing technological infrastructure, and improving digital finance literacy among the public. Thus, efforts to improve green finance in the banking sector need to be done not only through improving GCG practices, but also through measures that proactively encourage innovation and inclusion in the green economy[72]. In addition, the positive relationship between digital finance and green finance cannot be optimally realized if the stakeholder theory is not in line with GCG principles. To create a conducive environment for the growth of both, a harmonious synergy between stakeholder engagement and good governance is required. Only then can we ensure that investments in digital innovation are also in line with environmental sustainability goals.

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5 Conclusion

According to this study, Digital Finance and Green Bonds have a favorable effect on green finance, indicating that financial digitization and green financial instruments are crucial for ensuring the long-term viability of Indonesia's banking industry. Furthermore, the findings indicate that while the GCG can mediate The connection between green finance and green bonds cannot mediate the relationship between digital finance and green bond. According to this finding, the banking industry's adoption of green bonds may enhance corporate governance, which will further support the use of green finance. On the other hand, Digital Finance has a more direct impact on green finance without requiring a corporate governance system.

From an academic perspective, this study contributes to enriching the literature on the relationship between green bonds, digital finance and green finance and clarifying the role of CGG as an intermediary in the context of financial sector sustainability. From a theoretical perspective, the current study's findings support stakeholder theory, which includes the following emphasizes the importance of stakeholder involvement in the decision-making process of companies, especially with regard to green finance. In addition, these findings also strengthen the theory that emphasizes that good governance can increase transparency and accountability in green finance policy, although this is not always relevant in the context of the digitalization of the financial sector.

In practice, this research provides insights for banks and regulators in Indonesia to prioritize policies that support the strengthening of green bonds and digital finance transformation in the green finance sector. Banks and financial institutions are recommended to further expand the make of Green Bonds as a means financing tool and strengthen corporate governance aspects to increase the effectiveness of green finance. On the other hand, regulators need to encourage innovation in digital finance by ensuring a stronger digital infrastructure and more adaptable regulations so that the banking sector can more directly optimize its impact on green finance.

However, this study has several limitations that need to be taken in the account. First, the study sample is limited to the banking sector in Indonesia, so the results may not be

fully transferable to other sectors or countries with different economic characteristics. Second, this study uses a quantitative approach that focuses on the relationship between the variables without examining the specific mechanism of how digital finance affects green finance beyond the GCG channel. Therefore, it is recommended that future research should also investigate other factors that may mediate between digital finance and green finance, such as digital finance regulation or technological innovation in the banking sector. Thus, this study provides an important foundation for academics. Conference participants, practitioners and regulators are invited to understand the dynamics of green finance in the digital age and suggest strategic measures to improve the sustainability of the banking sector in the future.

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