-RESEARCH ARTICLE-

MODERATING ROLE OF INVESTOR'S SENTIMENTS AND GOVERNMENT SUPPORT BETWEEN FINTECH ADOPTION AND FINANCIAL SUSTAINABILITY

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─Abstract─

The study sought to empirically examine the relationship between Fintech adoption and sustainability, specifically focusing on the mediating role of green innovation and green finance. In addition, this study also examined the impact of government support and investor sentiments on the Saudi Arabia banking sector. In order to analyse the relationship, data was gathered from 330 bank employees who work in financial institutions in Saudi Arabia. The sampling technique used was convenient sampling. The quantitative data was analysed using Smart PLS with PLS-SEM. The empirical research findings indicate that the adoption of Fintech has a favourable and noteworthy effect on sustainability, green innovations, and green finance. Similarly, green finance and green innovation have a positive and significant impact on sustainability. Put simply, the adoption of Fintech and the sustainability of Saudi Arabia's banking sector are influenced by green finance and green innovation. In addition, the results of the moderating effect also indicate a positive and significant influence between green finance, green innovation, and sustainability. This study's findings have made a

valuable contribution to the existing literature. It stands out as the first study to test a mediated and moderated model, as far as the researcher knows. This research highlights the significance of government support and investor sentiments in achieving the sustainability of the banking sector for the overall sustainable development of the country.

Keywords: Fintech, innovations, government support, finance, sustainability, Saudi Arabia.

INTRODUCTION

Sustainability has emerged as a significant concern in multiple sectors, aiming to address environmental degradation and foster socio-economic development (Witesman et al., 2023). In the financial sector, sustainability encompasses the incorporation of environmental, social, and governance (ESG) considerations into investment decisions and business practices, with the aim of promoting environmental stability (Aldowaish et al., 2022). In the pursuit of this importance, financial institutions continue to fall behind in matters of sustainability. Various factors have been identified in literature that contribute to the improvement of sustainability in financial sectors. For instance, the promotion of sustainability acknowledges green finance and green innovation as significant factors. They help direct funding towards environmentally friendly projects and encourage the growth and use of green technologies and practices (Li et al., 2023). By raising funds for renewable energy projects, sustainable infrastructure, and eco-friendly businesses, there is an opportunity to make green finance and green innovative investments that support environmental conservation and climate resilience (Bashir et al., 2023). The financial sector's long-term viability is enhanced (Abdul-Rahim et al., 2022).

Green finance and green innovations play a crucial role in enhancing the sustainability of banks. Research has shown that the adoption of Fintech has had a significant impact on promoting sustainability within financial institutions (Abdul-Rahim et al., 2022). By optimising procedures, improving openness, and expanding availability, green Fintech solutions empower financial institutions to incorporate sustainability factors into their operations and services (Arnone, 2022). Thus, advanced Fintech platforms utilise cutting-edge technological advancements like block chain, artificial intelligence, and big data analytics to support the creation and implementation of environmentally friendly financial products and services (Phukan & Kumar, 2024). The study by Kwong et al. (2023) revealed that as companies focus more on adopting Fintech, they also witness a rise in green financing options. This trend contributes to enhancing the sustainability of the organisation. Similarly, companies are increasingly focusing on green innovations, with Fintech adoption being a significant concern (He et al., 2023). They also made the point that user adoption of Fintech can contribute to greater focus

on green innovations (He et al., 2023), potentially enhancing the sustainability of financial institutions. Through various initiatives like digital platform impact investing platforms, peer-to-peer lending for green projects, and carbon trading platforms, the adoption of green Fintech is expanding access to green finance and fostering innovation in environmentally sustainable financial products. This has the potential to make a significant contribution to the sustainability of financial institutions and the broader financial ecosystem. Thus, the study examined the effects of Fintech adoption on sustainability by enhancing green finance and promoting green innovations.

Major focused on the green finance and green innovation increased when the financial sectors have the government support to increase their sustainability (He et al., 2023; Marqués et al., 2021). Supportive government policies, such as tax incentives, subsidies, and regulatory frameworks create an enabling environment for innovation and investment in sustainable technologies and projects (Zafar et al., 2021). Similarly, there is a growing market demand for improving green financing and innovation decisions that can enhance sustainability. This is driven by positive investor sentiments towards sustainability-driven initiatives (Elkins et al., 2024). Thus, one could make the case that the involvement of the government and the sentiments of investors play crucial roles in driving green innovations and financing, ultimately contributing to the overall sustainability of the financial sector. As a result, research has utilised both of these indicators as moderating variables.

Several empirical studies have been conducted on the adoption of Fintech, green finance, green innovations, and sustainability. The studies have mainly concentrated on examining the impact of Fintech adoption on sustainability (Elkins et al., 2024; Kashif et al., 2024). In addition, the importance of green finance and green innovation in the financial sector is underscored by their direct positive impact on sustainability. This highlights their role in helping to achieve environmental objectives (Hassani & Bahini, 2022). Previous studies have not given much consideration to the role of green innovation and green finance in connecting Fintech adoption with sustainability outcomes. Moreover, the influence of investor sentiments on the connection between Fintech adoption, green innovation, green finance, and sustainability has not been extensively studied (Yao et al., 2021). In addition, the role of government support in fostering innovation and investment in sustainable finance and technology has not been thoroughly examined in previous studies (Khan et al., 2021). As a result, additional empirical research is required to investigate the mediating and moderating effects in order to address the existing gap in studies. Furthermore, the majority of existing empirical studies have primarily concentrated on other countries, with the banking sector of Saudi Arabia receiving minimal attention. Thus, the aim of this study is to examine how the adoption of Fintech affects sustainability by considering the role of green innovation and green finance as mediators. The study also examined the impact of government support and investor sentiments on the Saudi Arabia banking sector.

The study results have numerous significant contributions for the financial sectors. Firstly, previous research primarily concentrated on direct effects. This study explores the mediating effects of green innovation and green finance, along with the moderating effects of government support and investor sentiments, to enhance our understanding of the intricate relationships between Fintech adoption and sustainability. These insights also contribute to theoretical frameworks on sustainable finance, technology adoption, and innovation ecosystems, providing a deeper understanding of the mechanisms driving sustainability within the financial sector. Secondly, the study results are valuable contributions for policy makers, financial institutions, and investors, offering valuable insights into promoting sustainability within the financial sectors. Furthermore, by utilising the identified mediating and moderating factors, stakeholders have the opportunity to create specific interventions, policies, and strategies that can improve the impact of Fintech-driven sustainability initiatives. This can lead to increased innovation in green finance and green innovation, as well as the promotion of responsible investment practices. The study results could also assist in providing practical insights that can guide decision-making and promote positive environmental and societal outcomes within the financial sector. The study is divided into five chapters.

LITERATURE REVIEW

Hypothesis Development

The adoption of Fintech has emerged as a crucial factor in promoting financial inclusion, enabling underserved populations to gain wider access to banking services and capital (Abdul-Rahim et al., 2022). Fintech enables effective resource distribution, promotes openness, and simplifies transactions by utilizing cutting-edge digital platforms, potentially fostering economic growth and enhancing sustainability (Abdul-Rahim et al., 2022). Put simply, adopting Fintech solutions encourages the use of sustainable financial practices, leading to improved efficiency and accountability in resource management, ultimately contributing to long-term sustainability. The empirical literature also highlights the significant impact of Fintech adoption on enhancing sustainability. Furthermore, numerous scholars have made significant contributions to this field of study and have reached similar conclusions. For instance, the research conducted by Chen et al. (2022) is just one of many studies that have found a positive correlation between Fintech adoption and the long-term viability of financial institutions. In addition, Sadiq et al. (2023) emphasised the significance of Fintech in advancing sustainable investing by utilising robo-advisors and automated investment platforms. These studies indicated that the adoption of Fintech can make a significant contribution to sustainability by encouraging financially responsible practices that are environmentally friendly. Therefore, the study presents the following research hypothesis:

H1: *Sustainability significantly influenced by Fintech adoption.*

In addition, the adoption of Fintech also allows organisations to create cutting-edge green financial products such as green bonds and sustainable investment platforms. These tools facilitate investments in environmentally friendly products (Sreelekshmi, 2022). Through the utilisation of digitalized processes and blockchain technology, Fintech significantly improves transparency and accountability in green finance. This, in turn, guarantees the effective allocation of funds towards sustainable initiatives. Through the democratisation of access to green finance options and the facilitation of eco-conscious investment decisions, Fintech enables individuals and organisations to actively contribute to environmental preservation and address the impacts of climate change (Ma et al., 2022; Sreelekshmi, 2022). In a separate study, Reilly et al. (2019) emphasise the significance of Fintech in making green investments more accessible, thereby broadening the pool of investors for sustainable projects. In their research, Huang et al. (2023) highlight the potential of Fintech platforms to improve the liquidity and efficiency of green financial markets, which in turn can support the expansion of green finance. They also made the case that the connection between Fintech adoption and green finance can be examined in various countries. Thus, the study is centred on Saudi Arabia and presents the following research hypothesis:

H2: *Green finance significantly influenced by Fintech adoption.*

Utilising fintech adoption can contribute to expanding funding opportunities for green innovation and accelerating the growth of sustainable projects. Through a streamlined process and innovative financial products, Fintech platforms aim to enhance transparency and risk management to attract more investors and promote environmental sustainability (Tian et al., 2023). They also made the argument that fostering a stronger connection between Fintech and green innovation could facilitate the transition towards a more sustainable future. Marqués et al. (2021) emphasised the contribution of Fintech in supporting sustainable entrepreneurship through the provision of crowd funding and peer-to-peer lending platforms. In addition, Kwong et al. (2023) discovered a positive relationship between Fintech adoption and the adoption of green technologies. They found that Fintech adoption can facilitate the financing and support of green start-ups. The studies offer additional insights into how the adoption of Fintech can promote green innovation. Based on previous discussion, the following hypothesis has been proposed:

H3: *Green innovation significantly influenced by Fintech adoption.*

Green finance refers to the provision of funds for sustainable projects such as renewable energy, green infrastructure, and resource efficiency promotion (Udeagha & Ngepah, 2023). The mentioned finance sources contribute to the promotion of innovation, job creation, global collaboration, and the transition to a low-carbon economy. They also enhance corporate governance and risk management (He et al., 2023). Empirical

evidence suggests that green finance serves as a means of integrating financial resources to enhance sustainability and gain a competitive advantage. KV (2024) contends that green finance is crucial for funding the shift towards a low-carbon economy and attaining sustainable development objectives. Bocken (2020) emphasised the importance of green finance in supporting circular economy initiatives for environmental sustainability. The studies highlighted the significance of green finance in promoting sustainable outcomes. Thus, the study has formulated the following hypothesis:

H4: *Sustainability significantly influenced by green finance.*

Green innovation promotes the advancement of environmentally friendly technologies and practices, which are crucial for addressing climate change and resource depletion (Sarfraz et al., 2022). The promotion of sustainable development and improvement of quality of life contribute to economic growth and global competitiveness (Li et al., 2023). Green innovation promotes progress in clean energy, waste management, and sustainable agriculture, facilitating a shift towards a resilient and sustainable future. Several studies have emphasised the significance of green innovation for promoting sustainable growth. Cui et al. (2020) emphasise the significance of green innovation in fostering sustainable consumption and production patterns. This research provides additional evidence of the beneficial impact of green finance on sustainable outcomes. Therefore, it is hypothesised based on previous discussion that,

H5: *Sustainability significantly influenced by green innovation.*

Previous studies have demonstrated a significant relationship between green innovation and sustainability. However, some authors have argued that the use of green as path variables can amplify the impact of other variables (Yan et al., 2022). According to Siddik et al. (2023), several authors have suggested that Fintech can have a positive and significant impact on sustainability through its mediating effect. Other studies have also proposed that the relationship between Fintech adoption and sustainability can be examined in different contexts (Yan et al., 2022). Hong et al. (2020) discovered that Fintech platforms play a vital role in providing essential funding and resources for green start-ups, resulting in the promotion of innovation in sustainable technologies and business models. Yan et al. (2022) emphasised the contribution of Fintech in promoting collaboration between Fintech start-ups and green innovators, thereby facilitating the advancement and commercialization of green innovations. The studies indicate that the adoption of Fintech could enhance sustainability by fostering an innovative culture in environmentally friendly technologies and practices. Thus, the study has formulated the following research hypothesis:

H6: *Sustainability significantly influenced by Fintech adoption through the mediating effect of green innovation.*

Previous studies have examined the relationship between green finance and sustainability, but little attention has been given to the mediating effect. Some studies have examined the mediating effect, but they have primarily focused on other countries rather than Saudi Arabia. This argument is supported by the study of (Fan et al., 2024). They argue that the adoption of Fintech in organisations can lead to an increase in green finance, thereby enhancing sustainability. Udeagha and Ngepah (2023) proposed that Fintech platforms can improve the accessibility and affordability of green financial products and services for sustainable investments. In addition, Song and Hao (2024) emphasised the impact of Fintech in increasing access to green finance for underserved communities and small businesses. The studies indicate that the adoption of Fintech can enhance sustainability by extending the scope and effectiveness of green finance. Therefore, the following hypothesis is formulated based on previous studies:

H7: *Sustainability significantly influenced by Fintech adoption through the mediating effect of green finance.*

The relationship between green finance and sustainability is closely connected in existing literature. Additionally, the role of government support as a moderating variable in the relationship between green finance and sustainability has received limited attention. Prior studies have suggested that the relationship can be examined by considering the moderating effect of (Al Doghan & Chong, 2023) and (Yan et al., 2022). Wang et al. (2024) proposed that government policies and incentives can facilitate collaboration and innovation between Fintech startups and green finance. Additional research has also confirmed that government backing for green finance can enhance the sustainability of businesses by encouraging investments in environmentally friendly initiatives, providing tax incentives for green bonds, and establishing regulatory frameworks that prioritise sustainability metrics. These measures create a favourable environment for sustainable development (Nugraha et al., 2022). The findings indicate that government support can enhance the positive effects of Fintech adoption on green innovation through the provision of resources, infrastructure, and regulatory frameworks that promote collaboration and innovation. Thus, the study presents the following research hypothesis:

H8: *Sustainability significantly influenced by green finance through the moderating effect of government support.*

In addition, government support has been instrumental in enhancing the influence of green innovation on sustainability. Ullah et al. (2023) have demonstrated that government policies and financial incentives have a substantial impact on the advancement and acceptance of green technologies, leading to enhanced sustainability outcomes. Governments can expedite the shift towards a more sustainable economy by offering financial support, subsidies, and regulatory structures that promote innovation in renewable energy, waste management, and eco-friendly technologies. Nugraha et al.

(2022) emphasised the role of government support in addressing obstacles to green innovation, such as high upfront expenses and market uncertainties. This support can contribute to maximising the societal advantages of sustainable practices. The findings indicate that government support is crucial for promoting sustainability and fostering green innovation in the environment. Therefore, the study presents the following hypothesis:

H9: *Sustainability significantly influenced by green innovation through the moderating effect of government support.*

Existing literature indicates that investor sentiments can impact the connection between green innovation and sustainability (Hong et al., 2020; Lee et al., 2021). Piñeiro-Chousa et al. (2021) assert that favourable investor sentiments towards Fintech and sustainability can attract funding for environmentally friendly startups and innovative initiatives. Other authors have also posited that investor sentiments play a significant role in amplifying the impact of green innovation on sustainability (Witesman et al., 2023). Research conducted by Siregar et al. (2023) indicates that favourable investor sentiment towards environmentally sustainable initiatives can enhance the funding and resources allocated to green innovation projects, thereby expediting their development and adoption. The study also argued that investor sentiments are important factors for improving innovative behaviours in organisations, which can lead to improved sustainability. Thus, the study has formulated the following research hypothesis:

H10: *sustainability significantly influenced by green innovation through the moderating effect of investor sentiments.*

The influence of investor sentiments on the effectiveness of green finance in promoting sustainability has been highlighted (Piñeiro-Chousa et al., 2021). According to Wang et al. (2024), the favourable investor sentiment towards environmentally sustainable projects promotes increased investment in green finance initiatives. Several studies have supported the same conclusions. Kwong et al. (2023) and other studies have also provided insights into this relationship. Piñeiro-Chousa et al. (2021) contend that favourable investor sentiments towards Fintech platforms can enhance the demand for environmentally friendly financial products and services, consequently stimulating the expansion of green finance. Omeragić (2023) emphasised the significance of Fintech-enabled crowdfunding and peer-to-peer lending platforms in attracting capital from environmentally conscious investors for green projects. The findings indicate that investor sentiments significantly influence the relationship between Fintech adoption and green finance. This influence is observed through its impact on market perceptions, investment decisions, and capital allocation towards sustainable investments.

H11: *sustainability significantly influenced by green finance through the moderating effect of investor sentiments.*

RESEARCH DESIGN

This study aimed to empirically examine the relationship between Fintech adoption and sustainability, specifically investigating the mediating role of green innovation and green finance. This study also examined the moderating impact of government support and investor sentiments on the Saudi Arabian banking sector. The researcher used a quantitative research approach to empirically test the study objective. This approach enables researchers to empirically test study hypotheses based on existing theories and literature (Habib, 2021). The researcher employed an explanatory research approach to explore the factors and mechanisms that drive sustainability outcomes in the financial sector. The study examined the causal relationship among the variables. This approach is considered the most suitable for the current study due to its ability to investigate complex phenomena and understand the underlying reasons for observed relationships. It aligns with the objective of this study, which is to provide explanations for these relationships (Mann, 2003). In addition, researchers utilised cross-sectional research to collect data from a diverse sample of participants representing the financial sector in Saudi Arabia at a single point in time. A cross-sectional design allows for efficient data collection from a diverse group of participants, capturing different perspectives and insights from various stakeholders in the financial sector (Mann, 2003; Milliken et al., 2003). The study hypothesis was tested using the cross-sectional research approach.

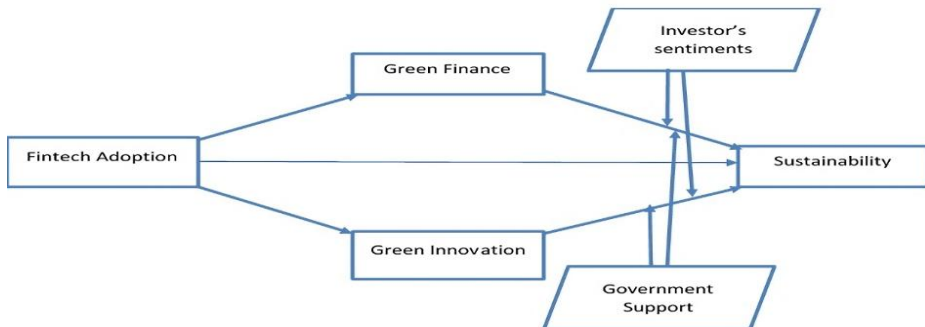### Questionnaire Development

Figure 1: Conceptual Framework

The data from respondents was collected using a structure questionnaire, which was adapted based on previous literature. The study conducted by Balaskas et al. (2024) aimed to assess the perceived level of government support for financial technology initiatives. The support was measured using three items. The study conducted by Balaskas et al. (2024) examined the adoption of Fintech in banking operations using five specific items. The study conducted by Tian et al. (2023) examined the six components of green innovation and explored how banks contribute to environmental sustainability and technological advancement. The concept of green finance includes five key elements which examine financial institutions' efforts in environmentally

responsible investments. The sustainability was assessed using a set of five items derived from study of (Almaqtari, 2024). The assessment of investor sentiments was conducted using four items (Dasgupta & Singh, 2019). These items consist of statements that capture perceptions regarding banks' Fintech adoption and its influence on investment decisions. The items mentioned were assessed using a five-point Likert scale. The adapted questionnaire was distributed to 450 employees in the banking sector using convenient sampling. Out of the total 330, 73 percent were returned, indicating a response rate of 73 percent. The variables mentioned above are predicted in Figure 1.

DATA ANALYSIS

Descriptive Statistics

Table 1: Descriptive and factor loadings

Variables	Mean	SD	VIF
Fintech adoption			
FIA1	3.326	0.289	1.451
FIA2	3.212	0.789	1.544
FIA3	3.915	0.973	1.449
FIA4	3.439	0.795	1.908
Green Finance			
GRF1	3.311	0.856	1.712
GRF2	3.071	0.879	1.715
GRF3	3.068	0.848	1.567
GRF4	3.016	0.853	1.428
GRF5	3.901	0.842	1.892
Green Innovation			
GRI1	3.937	0.885	1.387
GRI2	3.921	0.893	1.452
GRI3	4.006	0.771	1.218
GRI4	4.071	0.815	1.336
Sustainability			
SUS1	4.077	0.76	2.255
SUS2	3.994	0.759	1.773
SUS3	4.02	0.786	2.058
SUS4	4.003	0.808	1.613
SUS5	4.026	0.775	1.568
Investors Sentiments			
INS1	3.812	0.721	1.453
INS2	4.132	0.853	1.252
INS3	3.932	0.843	1.552
INS4	3.892	0.893	1.783
Government support			
GRS1	4.221	0.523	1.852
GRS2	4.431	0.713	1.354
GRS3	3.812	0.642	1.652

Note: Fint-Fintech adoption, SUS-sustainability, GRI-green innovation, GRF-green finance, INS-investor sentiments, GRS-government support.

The predicted data in Table 1 displays the descriptive statistics for the study variables: Fintech adoption, green finance, green innovation, sustainability, investor's sentiments, and government support. The descriptive statistics reveal that the mean values across these categories range from 3.016 to 4.421, with standard deviations ranging from 0.289 to 0.973, indicating variability in the responses. The loadings, which represent the correlation between observed variables and underlying constructs, indicate the strength of association. The values range from 0.633 to 0.91. Variance Inflation Factors (VIF) are used to evaluate multicollinearity, typically with values below 2 indicating low collinearity. The predicted results are presented in Table 1 Above.

Measurement Model

The measurement model is assessed for convergent and discriminant validity using Partial Least Squares (PLS) Structural Equation Model (SEM) implemented in Smart PLS-4. These assessments are discussed in the following two sections.

Convergent validity

Convergent validity refers to the extent to which multiple measures of the same instrument converge or are related to each other. The convergent validity includes factor loadings, Cronbach's alpha, composite reliability, and average variance extracted (AVE). Factor loadings indicate the degree of association between observed variables and their latent constructs. Values above 0.7 are generally deemed satisfactory. Cronbach's alpha and composite reliability evaluate the internal consistency of a set of items, with values above 0.7 indicating acceptable reliability. The AVE (Average Variance Extracted) quantifies the proportion of variance explained by the latent construct compared to measurement error. A value greater than 0.5 is generally considered satisfactory. The recommended values are provided by multiple authors. (Edeh et al., 2023; Hair Jr et al., 2017). The results are presented in Table 2.

Table 2: Convergent Validity Results

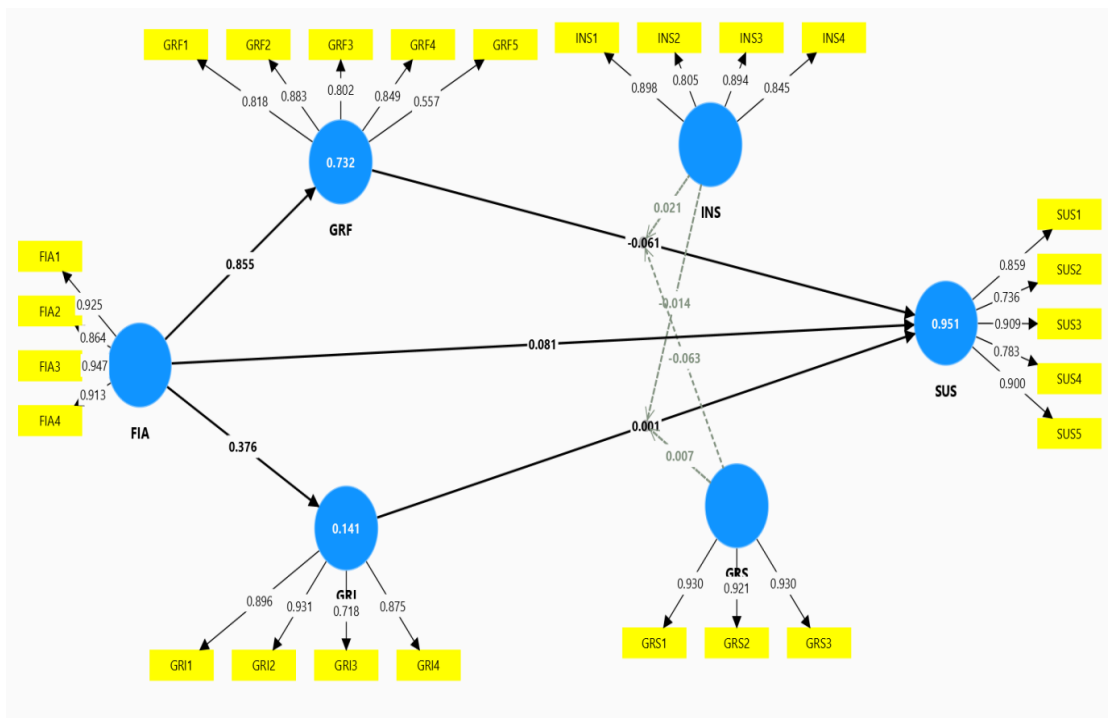| Variable	Alpha	Composite Reliability	Average Variance Extracted
FIA	0.851	0.870	0.652
GRI	0.782	0.821	0.613
GRF	0.821	0.852	0.723
GRS	0.753	0.781	0.551
INS	0.794	0.822	0.623
SUS	0.873	0.891	0.752

Figure 2: Factor Loadings

Discriminant Validity

The discriminant is a fundamental factor that ensures differentiation between various constructs in a study model. Various methods, such as Fornell and Larcker's criterion, cross-loadings, and the Heterotrait-Monotrait (HTMT) ratio, can be used to assess this. Fornell and Larcker's criterion states that the square root of the Average Variance Extracted (AVE) for each construct must be greater than the correlation coefficients between that construct and other constructs in the model (Hair et al., 2017). It is ideal for AVE values to exceed inter-construct correlations (Hair et al., 2017). Cross-loadings assess the degree to which items demonstrate a stronger association with their intended construct in comparison to other constructs. According to Hair Jr et al. (2017), items should demonstrate higher loadings on their intended construct to establish discriminant validity. The HTMT ratio compares the correlations between constructs to the correlations within constructs. Henseler et al. (2015) found that values below 0.85 are considered acceptable, indicating that constructs have stronger correlations with their own items than with items from other constructs. This demonstrates the discriminant validity of the construct. The results of discriminant validity are presented in Table 3 below.

Table 3: Discriminant validity

	FIA	GRI	GRF	GRS	INS	SUS
FIA						
GRI	0.415					
GRF	0.514	0.532				
GRS	0.535	0.631	0.583			
INS	0.438	0.553	0.531	0.651		
SUS	0.315	0.4512	0.423	0.531	0.474	

Empirical Results

Table 4: Hypothesis Results

Hypothesis	Beta Coefficient	Standard Error	T-value	p-value
FINT->SUS	0.348	0.079	4.412	Accepted
FINT->GRI	0.254	0.065	3.908	Accepted
FINT->GRF	0.312	0.067	4.657	Accepted
GRI->SUS	0.287	0.062	4.63	Accepted
GRI->SUS	0.183	0.054	3.389	Accepted
FINT->GRI->SUS	0.215	0.061	3.525	Accepted
FINT->GRI->SUS	0.197	0.049	4.024	Accepted
GI*INS->SUS	0.209	0.052	4.019	Accepted
GRF*INS->SUS	0.136	0.038	3.579	Accepted
GRI*GRS->SUS	0.149	0.042	3.548	Accepted
GRF*GRS->SUS	0.143	0.041	3.488	Accepted

The next step after assessing the measurement model is to test the hypothesis using the bootstrap resampling technique with 5000 iterations. The results of the direct hypothesis indicate that the adoption of Fintech has a positive and significant impact on sustainability, green innovation, and green finance. The findings highlight the transformative potential of Fintech platforms in reshaping traditional financial services towards sustainability-driven models. Moreover, the findings indicate that there is a significant and positive mediating effect of green innovation and green finance on the relationship between Fintech adoption and sustainability. The significance of green innovation and green finance in promoting sustainability agendas within the context of Fintech adoption is underscored by these mediating pathways. The results of the further moderating analysis showed that government support and investor sentiments have a positive and significant moderating effect on the relationship between green innovation, green finance, and sustainability. The results indicate that investor sentiments play a significant role in enhancing the relationship between Fintech adoption and environmental outcomes. Government support has a positive and significant impact on green innovation, green finance, and sustainability. The results indicate that government support enhances the influence of Fintech adoption in promoting green innovation and

finance, highlighting the crucial role of regulatory frameworks in fostering environmental innovation. The results mentioned above are presented in the table.
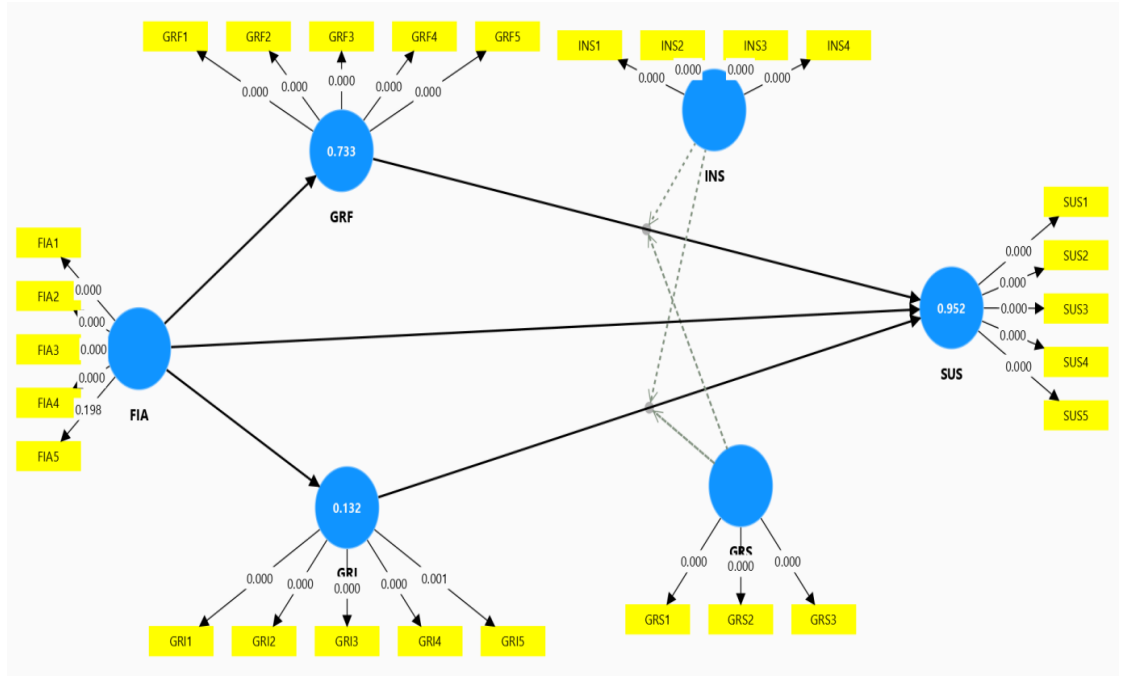

Figure 3: Path Model

FINDINGS AND DISCUSSION

This study aimed to examine the relationship between Fintech adoption and sustainability in Saudi Arabia banks, while considering the mediating effects of green innovation and green finance. The study also examined the moderating effect of investor sentiments and government support. The empirical findings indicate that the adoption of Fintech has a positive and significant impact on the sustainability of financial institutions in Saudi Arabia. The findings suggest that the adoption of Fintech plays a crucial role in enhancing the sustainability of financial institutions in Saudi Arabia. This is achieved through the implementation of environmentally friendly practices such as digital lending, mobile banking, and electronic payments. Fintech platforms also provide innovative tools and services that support sustainable practices. Digital payment solutions and crowdfunding platforms enable access to finance for green projects, supporting environmental conservation efforts (Phukan & Kumar, 2024). The study findings are supported by additional studies that indicate the potential of Fintech solutions to drive sustainable development (Kashif et al., 2024). These findings highlight the significant role of technology in advancing environmental objectives in Saudi Arabia's financial sector.

Fintech adoption has a positive and significant impact on green innovation. The study by Mori (2021) indicates that Saudi Arabia is focusing on adopting Fintech to promote a green innovative environment and emphasises the importance of technology-driven financial solutions in fostering sustainability. Empirical evidence confirms that Fintech platforms utilise technologies like block-chain, artificial intelligence, and big data analytics to create and implement innovative solutions for environmental issues (Mhlanga, 2023). The findings emphasise the significance of the relationship between Fintech adoption and green innovation in driving sustainable progress of financial institutions in Saudi Arabia. The relationship between Fintech adoption and green finance is positive and significant. It has been observed that as the adoption of Fintech increases, there is also a corresponding increase in green finance. This can be attributed to the fact that Fintech solutions play a crucial role in enabling the development of green financial products like green bonds and carbon trading platforms. These tools help in mobilising capital for companies to promote sustainability (Addy et al., 2024). Fintech platforms play a crucial role in improving transparency, efficiency, and accessibility in the green finance market. This, in turn, attracts a wider range of investors to sustainable investment opportunities.

Furthermore, green innovation has a positive and significant impact on sustainability. The findings indicate that green innovation plays a crucial role in enhancing the sustainability of financial institutions in Saudi Arabia. This is achieved through the adoption of renewable energy technologies, eco-friendly materials, and resource-efficient processes, all of which contribute to sustainability (Rui & Lu, 2021). Given the growing importance of technological advancements and environmentally friendly practices, green innovation is crucial for achieving sustainability objectives both in Saudi Arabia and worldwide (Sarfraz et al., 2022). The study findings are further supported by a recent study conducted by (Iqbal et al., 2022). These findings suggest that the financial sector in Saudi Arabia should prioritise green innovation in order to enhance their institutions.

In addition, the results also indicate that green innovation plays a positive and significant role in mediating the relationship between Fintech adoption and sustainability. The research findings highlight the crucial role of green innovation in connecting Fintech adoption and sustainability, leading to a significant increase in the sustainability of financial institutions (Abdul-Rahim et al., 2022). Fintech platforms facilitate the advancement and acceptance of environmentally friendly technologies by offering financial support, knowledge, and opportunities in the market to visionaries and business owners (Addy et al., 2024). These growing innovations contribute to the improvement of sustainability outcomes by reducing environmental impacts, improving resource efficiency, and encouraging eco-friendly practices (Qin et al., 2024). Therefore, by focusing on the adoption of Fintech in financial institutions of Saudi

Arabia, we can enhance innovation behaviour and promote sustainability. This will lead to an increased emphasis on Fintech adoption by financial institutions.

The green finance plays a crucial role in bridging the gap between Fintech adoptions and the sustainability of financial institutions in Saudi Arabia. The findings indicate that the adoption of Fintech by banks has a significant impact on promoting green finance and sustainability. Fintech platforms play a crucial role in enabling the creation and utilisation of green financial products and services, including impact investing platforms, peer-to-peer lending for green projects, and carbon trading platforms (Song & Hao, 2024). This, in turn, allows businesses to secure funding for initiatives that support sustainability (Volz, 2018). Additional support for the empirical mediating effect results can be found in the following studies (Tian et al., 2023; Yan et al., 2022). These findings emphasise the significance of Saudi Arabia banks prioritising Fintech adoption to enhance their intention to increase financing sources, ultimately promoting sustainability.

Additional findings indicate that government support plays a crucial role in moderating the relationship between green innovation and sustainability. The study highlights the crucial role of government support in shaping the relationship between Fintech adoption and green innovation. It underscores the significance of regulatory frameworks in driving technological innovation for sustainability (Kashif et al., 2024). Government policies play a crucial role in creating an environment that promotes Fintech adoption and green innovation. This is achieved through the provision of funding, infrastructure, and regulatory support (Kwong et al., 2023). For example, tax incentives for green investments and grants for research and development encourage innovation in environmentally sustainable technologies (Song et al., 2020). Based on empirical evidence, it is important for government institutions to take initiatives in promoting Fintech adoption. This can lead to improvements in green innovations and enhance the sustainability of financial institutions. Additional government support plays a crucial role in bridging the gap between green finance and sustainability. The validity of these findings is reinforced by additional studies that utilised a moderating variable and discovered a substantial impact (Alkahtani et al., 2020).

Simply stated, investment sentiments play a crucial role in moderating the relationship between green innovations and sustainability, with a positive and significant impact. The findings presented in this study highlight the impact of market dynamics on technological innovation for sustainability. The research suggests that positive investor sentiments towards green innovation initiatives indicate a strong belief in the potential of sustainable technology solutions. As a result, the growing interest from investors in green innovation is leading to increased investment in environmentally sustainable projects, which in turn is fueling innovation and driving market growth (Saunila et al., 2018). Similarly, the sentiments of investors play a crucial role in moderating the

relationship between green finance and sustainability, with a positive and significant impact.

The moderating effect demonstrates the potential of green finance to amplify the impact of sustainability initiatives. This research aligns with previous studies that have identified the significant influence of investor sentiment, along with its moderating effect (Majid et al., 2021). The empirical studies also suggest that investor sentiments play a significant role in promoting investment in green financial products and projects, thereby enhancing their impact on sustainable development (Liu et al., 2024). Thus, these studies indicate that when investor sentiment towards sustainability is strong, the advantages of green finance in promoting sustainable objectives are amplified, underscoring the importance for companies to prioritise this in order to enhance the sustainability of financial institutions in Saudi Arabia.

Implications and Future Directions

The study results contributed from both a theoretical and practical standpoint. Research in academia has made various contributions. Initially, existing academic literature primarily focused on the direct impact of Fintech on sustainability, green innovation, and green finance. Despite the lack of focus on the mediating effect, it is worth noting. This study made significant contributions by identifying the mediating effects of green innovation and green finance. Explores the ways in which Fintech adoption impacts sustainability outcomes, offering theoretical insights into the driving forces behind environmental progress in the financial sector. In addition, past research on investor sentiment and government support has primarily focused on different contexts, with little attention given to the moderating effect. This study presents significant findings regarding the identification of moderating effects of government support and investor sentiments. It expands our understanding of the contextual factors that shape the impact of Fintech adoption on environmental progress. Additionally, it contributes to theoretical frameworks on sustainable finance and technology adoption. Additionally, academic research has made valuable contributions to the understanding of Saudi Arabia, as previous studies primarily concentrated on different nations. These findings could be valuable for researchers in Saudi Arabia looking to expand their study framework.

There is also a practical contribution with the extended framework and significant findings. Firstly, the identification of the mediating effect between Fintech adoption and sustainability highlights the significance of innovations and financial mechanisms in attaining sustainability goals. These findings could assist policymakers in developing policies and initiatives that promote the integration of Fintech solutions with green innovation and finance, thus expediting the transition towards a more sustainable economy in Saudi Arabia. Secondly, the substantial influence of government support and investor sentiments underscores the crucial role of regulatory frameworks and

market dynamics in shaping the impact of Fintech adoption on environmental progress. Based on research findings, policymakers have the opportunity to take a proactive approach in fostering an environment that supports sustainability initiatives driven by Fintech. This can be achieved through the implementation of favourable policies, offering incentives, and promoting collaboration among stakeholders.

The study's significant findings have several limitations that could be addressed in future research. The study primarily focuses on employees of banks, while neglecting banking and non-banking users, thus limiting the scope of the study. Hence, future research should involve non-banking users to enhance the generalizability of the study. Currently, research is limited to cross-sectional research design. However, future research could explore the use of longitudinal design to understand variations in results. The current study only examined two mediating effects. Future research should consider expanding the framework to include additional mediating effects in order to enhance the generalizability of the findings. Finally, it is worth noting that the current study is limited to one country, which restricts the generalizability of the findings. Future research should consider conducting comparative analyses to enhance the generalizability of the research.

The study's findings suggest that Fintech adoption, green finance, and green innovation are significant factors in enhancing sustainability. The study findings suggest that investment sentiments and government support play a significant moderating role in the relationship between green innovation, green finance, and sustainability. Hence, it can be contended that the banking sector of Saudi Arabia should prioritise the aforementioned indicators in order to enhance the sustainability of banking. The study may inform policy makers and regulators about the significance of Fintech adoption in enhancing the sustainability of banks. Future studies should address the limitations of this study in order to enhance the generalizability of other research.

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Appendix: Survey instrument

Government support	1. The government supports and improves the use of FinTech services. 2. The government has introduced favourable legislation and regulations for FinTech services. 3. The government is active in setting up all kinds of infrastructure, such as a telecom network, which has a positive role in promoting FinTech services.
Fintech Adoption	1. I intend to continue using FinTech services in the future. 2. I will always try to use FinTech services in my daily life. 3. I plan to continue to use FinTech services frequently. 4. If I had access to Greek FinTech services, I would have the intention of using them. 5. I think it will be worth it for me to adopt Greek FinTech when it is available.
Green Innovation	1. Our bank prioritizes implementing measures that reduce pollution in our operational processes. 2. Our bank focuses on optimizing energy and resource consumption in our day-to-day operations. 3. Our bank emphasizes the use of environmentally friendly materials and practices in our operational procedures. 4. Our bank effectively manages and reduces hazardous substances or waste generated from our operations. 5. Our bank actively works to minimize our consumption of coal, oil, electricity, and water in our day-to-day operations. 6. Our bank is committed to reducing the use of raw materials in our operational processes.
Green finance	1. Green financing significantly improves the revenue and market share of our bank 2. Green financing significantly decreases the operational expenditure of our bank. 3. Green financing significantly reduces paper usage and energy consumption in our bank. 4. Green financing improves banks' compliance with environmental standards. Green financing improves the reputation and image of the bank. 5. Green financing improves the relationship between the community and stakeholders
Investors sentiments	1. Fintech adoption by banks positively influences my sentiment towards investing in the banking sector. 2. I am more likely to invest in banks that actively embrace fintech solutions to enhance their services and operations. 3. The implementation of fintech solutions by banks increases my trust in their ability to adapt to changing market dynamics. 4. I believe that banks investing in fintech solutions are more likely to provide innovative and customer-centric services, which positively influences my investment decisions.