HOW DO FINTECH AND GOOD GOVERNANCE INFLUENCES FINANCIAL SUSTAINABILITY: WHAT IS THE ROLE OF EXCHANGE RATE FLUCTUATION?

How do FinTech and Good Influences Financial Sustainability: What is the Role of Exchange Rate Fluctuation?

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QUEST FOR EXCELLENCE

Letter of Transmittal

Dr. Md. Qamruzzaman

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Dear Sir,

It is with great respect and enthusiasm that I submit my research thesis entitled *"How do FinTech and Good Governance Influence Financial Sustainability: What is the Role of Exchange Rate Fluctuation?"* This submission marks the culmination of several months of rigorous study and analysis to fulfill the requirements for my graduation from United International University.

The interplay of financial technology, governance practices, and fluctuating exchange rates in driving financial sustainability is investigated in this study. Your valued guidance enabled me to work out a detailed analytical framework, integrating quantitative models and empirical analysis for meaningful insight into this critical area. The research direction, methodological soundness, and academic integrity throughout the study owe much to your mentorship.

Let me express my profound gratitude to United International University for creating the academic environment and providing facilities to conduct this research. Also, I am very grateful to all the global data contributors and their respective institutions through which this empirical evaluation became possible.

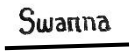
Lastly, I would like to acknowledge the continued support from my family, friends, and peers, whose encouragement has been a source of motivation throughout this journey. I strongly believe that the results of this study will provide useful lessons for policymakers, financial institutions, and researchers. By addressing synergies and challenges of FinTech adoption, governance quality, and macroeconomic volatility, this research aims to contribute to the broader discourse on sustainable financial systems.

I would like to take a moment to thank you all for giving your valuable time to review my thesis. I am really looking forward to discussing its findings and implications under your guidance.

Sincerely,

Sharmin Rahman Swarna

ID: 111 202 032



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Abstract

The present-day financial universe is transforming at record speed due to numerous interrelated developments: technological advances, changes in the regulatory environment, and macroeconomic forces. An emerging focus on Financial Sustainability (FS) referred as the long-term capacity of financial systems to remain stable, efficient, and inclusive has therefore been an increasing priority for both advanced and developing economies. FinTech is taking up a major role in improving (FS), enhancing the efficiency of operations, making financial inclusions & strategic competitiveness of financial institutions a walk in the park. FinTech driven innovations like blockchain, artificial intelligence, and mobile banking make the processes a lot efficient, cost-effective, and inclusive by covering up the unbanked part of society, mainly in developing countries. However, it has also ushered in a plethora of challenges, particularly for traditional banks facing greater competition and potential market share loss. When innovation moves faster than regulation, it creates a more complex environment for compliance and risk management. In addition, practices of financial governance are uneven in their application through institutions, undermining performance and stability. Another area that is especially relevant for financial stability and sustainability of financial systems but faces challenges is exchange rate fluctuations. The nexus between financial and macroeconomic policies necessitates coordination of financial and macroeconomic policies to respond to economic shocks and sustain policy consistency. Trust deficits ensue and adoption of digital finance is further stifled, as the cloud opens new firestorms of data protection and cybersecurity issues. We will explore these dimensions through a combination of research on the effect that FinTech, governance practices, exchange rate management have on financial sustainability, and operationalize the policy recommendation for financial sector resilience.

The primary objective of this research is to examine the multi-faceted effects of FinTech, good governance, and exchange rate fluctuation on FS. In particular, the paper examines the impact of FinTech as a moderator in operational efficiency, market expansion, and financial inclusions on overall financial performance of banks and sustainability. With an attempt to emphasize both short run and long run impacts of FinTech innovations on FS by analyzing their role in reducing transaction times and operational costs in contexts of blockchain and artificial intelligence, this paper seeks to explore this new landscape that is poised to have a far-reaching impact. It also aims at examining the many possibilities that FinTechs bring in terms of customer satisfaction and in generating new possibilities for financial interaction and participation, particularly in developing areas. The second goal is to analyze the effect of FS on good governance practices. The aim of this research is to study the direct and indirect effects of governance structures like board size, audit committee effectiveness, and ownership structure on the stability and growth of financial institutions. In doing so, it aims at highlighting how consistent and strategic governance contributes to enhancing resilience and performance as a whole. Third, it explains how strong governance mechanisms may mitigate financial risk exposures and how these then in turn affect broader economic variables namely FDI and trade openness. The paper also aims to study the impacts

of changing exchange rates on FS with respect to its chances of profit and risk. Here, we will examine the positive and negative response of FS to the impact of the exchange rate shock, as the shock affects the exchange rate, and we will see that financial institutions can strategically respond to this dynamic. Coordination of financial regulations with macroeconomic policies can also generate additional synergy for the strengthening of financial systems, and will also be discussed in the paper. This research is based on the view that sustainable financial systems are essential for facilitating economic growth and resilience. With the digital innovation alongside economic volatility making the financial world a more complex and interconnected place, there is a missing piece in understanding how technology and governance interact and link with the broader economy. The study seeks to furnish pragmatic insights that could serve as a basis for the elaboration of adaptive strategies towards achieving financial sustainability to aid policy formulations by financial institutions and regulatory bodies. The research therefore aims to address these critical areas as part of contributing to the provision of resilient and inclusive financial systems that can circumvent any future crises, for sustainable economic stability and growth.

The secondary data will be collected from the reliable sources like world bank, IMF, etc. and the objectives of this study is to investigate the impact of FinTech, good governance and exchange rate fluctuations on financial sustainability. This analysis includes multiple years to allow for both short-run and long-run effects. They employ sophisticated econometric models to investigate the association of FS with the variables, and make use of cointegration tests to show long-run relationships. As a result, the asymmetric models take into account both negative and positive shocks to better understand how they affect FS differently. The Granger causality tests demonstrate whether causality is one-way or two-way between FS and the other variables. Additional checks conducted on the analysis further validate the integrity of the models themselves, including identifying threats of multicollinearity and autocorrelation. It does note a list of limitations, such as data, inaccuracies and the unfeasibility of accounting for all external factors (like geopolitics, for instance). Despite these limitations, this method provides a holistic approach to grasp the nuanced effects of FinTech, GG and EXf on financial sustainability as well as practical and policy findings that other countries can examine while reinforcing their financial systems.

This study provides significant evidence of a significant impact of FinTech, GG, and EXf on the FS. FinTech is a game-changing lever that enables FS to implement operational efficiency and lower the cost of transactions while improving financial inclusion. To provide evidence of improving banking operations, availability by utilizing digital platforms and enhancing customer experience by utilizing latest technologies such as block chain and artificial intelligence. The empirical evidence shows that FinTech significantly promotes FS in the short and long run and an increase of 1% in FinTech increases FS by 0.0923% in the long run and 0.0534% in the short run. Nevertheless, its benefits can only be maximal if proper strategic adaptation takes place in terms of the competition it creates for traditional banks, the challenges to regulatory frameworks and systemic risks it poses. The second is good governance, which strengthens stability, resilience, and efficiency of financial institutions. Higher corporate governance mechanisms, such as board and audit, positively correlate with

performance. The FS positively reacts to a 1% rise in GG with a long-run response of 0.0212% and a short-run response of 0.0327%. Although the short-run impact of positive governance improvements is benign (i.e., they improve FS), the short-run impact of negative shocks tends to be adverse. Two way impact of FS on exchange rate fluctuation. Although a moderate degree of variability of the exchange rate may provide possibilities for profitability especially via trade and investment, large deviations of the same represent a risk. As can be seen from the results, a long-run growth of 0.0623% in FS boosts an increase of 1% in EXf whilst there reduces -0.0298% of the short-run growth of FS boost when EXf growing 1%. The inherent asymmetry in the EXf shock indicates caution in both positive and negative shocks in order to avoid risk. Policy integration is crucial, the study highlights, because of the need to balance FinTech development against strengthening governance frameworks and the need to better manage exchange rate volatility in this rapidly shifting dynamic. Bringing these pieces together, will play an important role in inducing a sustainable financial growth along with long-term stability.

This paper is revolving around the idea of FinTech, good governance and swing exchange rate as leading the financial sustainability at the same time as this paper do therefore we hope our finding expand the literature. It showed the high positive coefficients of FinTech on operational efficiency and financial inclusions, sound governance as a critical success factor on financial stability, and the two nature of exchange rate fluctuation on financial performance. And the findings indicate that strategic policy adaptation is crucial to exploit these factors while avoiding their risks. Once a foundational understanding of this interrelation is developed through this study, utilizing the findings positively influences policymakers and financial institutions alike by advocating a composite and cohesive system that facilitates sustainable national finance.

In order to address the gaps include for instance updating the regulatory frameworks to cope up with the rapid growth of FinTech, the need for robust data protection and cybersecurity measures to build trust, and financial literacy level to further increase the financial inclusion. Policymakers need to foster synergies between financial and macroeconomic policies, to manage exchange rate volatility and consistency in sectoral governance. Efforts to develop strategies that enable traditional banks to be competitive against the disrupting force of FinTech, through digital transformation and strategic partnerships, will also need to be prioritized. Moreover, a balance in policies between the short-run conduct of operations and long-run financial viability must be achieved in order for financial institutions to be a sustainable and competitive not only segment of the economy, but a true partner in economic growth.

Keywords: FinTech, Financial Sustainability, Good Governance, Exchange Rate Fluctuation, Bank Performance, Policy Integration.

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List of Abbreviations

FS	Financial Sustainability
FinTech	Financial Technology
GG	Good Governance
EXf	Exchange Rate Fluctuation
ECT	Error Correction Term
CSD	Cross Sectional Dependence
SH	Slope Homogeneity
CADF	Cross-Sectionally Augmented Dickey-Fuller
CIPS	Cross-Sectionally Augmented IPS
MG	Mean Group
AMG	Augmented Mean Group
CS-ARDL	Cross-Sectionally Autoregressive Distributed Lag
NPL	Non-Performing Loans
ROA	Return on Assets
ROE	Return on Equity
GDP	Gross Domestic Product
FDI	Foreign Direct Investment
TO	Trade Openness

Chapter 01: Introduction

1.1 Background of the study

According to, Basha, Reddy, Mubeen, Raju, and Jalaja (2023) the banking sector has a huge impact on economic growth through an indirect and direct channel. To begin with, banks offer loans to households and firms which is essential in order to invest and consume. A study on Indian banks demonstrates a strong relationship between some critical performance factors including domestic credit and return on equity with GDP growth, concluding that an optimal functioning of banks can lead to substantial growth in the economy. The relationship between banking performance and socio-economic development also contributes to reducing income inequality further elaborated by Dourtmes and Andrikopoulos (2021). When banking systems are set up in a way to deliver efficiently, it can help in overcoming inequities by promoting equal access to financial services within diverse socio-economic groups. By being able to avoid oppressive financial requirements, this inclusion allows overlooked communities to engage in economic actions that were once only out of reach. Higher banking Development GDP attracts more communities: Research suggests that higher banking sector development GDP is associated with lower income inequality in countries. The study conducted by Uddin, Chowdhury, and Islam (2017) investigates the effects of socioeconomic drivers on Islamic and conventional banks performance in Bangladesh showing that corruption adversely impacts profitability and cost to income ratio and loan loss provision also affect profitability. A different study by Akbar, Rehman, Bouri, Ijaz, and Arshad (2024) which assesses how socio-economic variables such as corruption, political risk and also financial inclusion affect the stability of banks. The findings indicate that corruption and political risk have an adverse impact on stability, whereas, financial inclusion has a positive effect on stability. Banking competition reduces the negative impact of corruption and increases the positive effect of financial inclusion.

Ruxho and Beha (2024) investigates the role of bank profitability for growth in 16 Central and Eastern European countries between 1999 and 2022. It shows a strong net positive link between bank profitability and economic growth, contrary to theoretical expectations of low profitability as a growth drag and providing new directions for future research. Njoroge (2024) uncovers a strong positive relationship between bank profitability and growth, which does not support the claim that low profitability impedes growth and indicates directions for future research. Specifically, the paper by M. S. Alam, Rabbani, Tausif, and Abey (2021)only examine the relationship between the banking performance and economic growth from long term aspects in India using data the 20 public sector banks (2009-2019) Using different econometric tests, it shows that margin interest and return on asset are strongly associated with growth of GDP. Bank lending capacity and investment activity, on the other hand, are not significantly associated with economic growth. This is what the study recommends to help stimulate the growth rates of these factors.

The study conducted by Tasneem and Ahmad (2024) investigates the functions of private commercial banks (PCBs) and economic growth in Bangladesh: A study with the interaction of the model. Detection of the hypothesis is based on a Granger causality test. It is argued that the advances in PCBs and economic growth provide positive feedback to one another and that eliminating recent deviations and real sector constraints are vital for economic growth. In Bangladesh, a similar study was done Shoaib et al. (2024), Investigating the Role of Islamic Banks in Green Housing Finance towards Sustainable Investment in an Urbanizing Region (Bangladesh) The research, which involves surveys of 400 borrowers and accounts of banks, discovered that Islamic banks play an important role in providing solutions through innovative financing options and eco-friendly housing according to Shariah principles. Implications of the results indicate strategic recommendations for policymakers and financial institutions.

There are numerous factors that influences on Bank Performance (BP) in a generalized way. A study conducted by Sudiyatno, Bagana, Hardiyanti, Puspitasari, and Safitri (2024) is to investigate factors that affect bank performance, one of them is corporate social responsibility (CSR) as a moderating variable. It covers 20 banks in Indonesia and it shows that non-performing loans and bank size do not have an effect to the performance. While loan-to-deposit ratio and CSR positively affected bank performance. Electronic wor d-of-mouth (eWOM) and e-reputation influences bank financial performance as well. The study of Ballouk, Ben Jabeur, Boubaker, and Mefteh-Wali (2024) investigates the influence of eWOM elements (strength, sentiment, passion and reach) on e-reputation and e-reputation influence on bank performance. The results provides positive relationship between e-reputation on Facebook and bank performance is significant and increased fan numbers with positive impact on e-reputation for banks operating in the US. The paper by Neves, Caniaux, Gouveia, and Coelho (2024) studied the effect of both social and environmental variables in performance of Portuguese companies using the Portuguese stock index (PSI) from 2016 to 2020. The findings reveal that while social performance has a negative effect on firm performance environmental performance has a positive effect on firm performance largely driven by institutional pressure, and environmental disclosure. However, environmental performance does play a role in explaining why one firm is more efficient than another, while social performance does not appear to be an efficiency lever. The main result of the another research conducted by Thu (2024) said that overall employees have high perception of all variable "Liquidity Management," "Internal Control Management," and "Employee Development," and it has been found that all these factors have significant effect on overall bank Performance. The paper aims to identify the factors influencing sustainable lending in commercial banks through the value chain concept and to understand the relationship between these factors. A systematic literature review of 1,073 articles and Manurung, Siregar, Fahmi, and Hakim (2024) found that value chain and ESG (environmental, social, and governance) performance are the two dominant factors in sustainable lending. The influence of ESG aspects on sustainability is debated, with some arguing for a positive influence and others arguing for the opposite. The review has not yet explained the causal relationship between these factors and sustainable lending, necessitating further research.

Utilizing unstructured data of 15 banks from 2019 to 2021, this study of P. T. Pham, Tran, Huynh, Popesko, and Hoang (2024) investigates effects of fintech on bank performance in Vietnam. Panel models were estimated using a text mining approach and generalized least squares. Fintech has a statistically significant impact on bank profitability, but there is no statistically relationship between fintech and net interest margin according to the results. The study proposes gradual banking transformation and COVID-19 for sustainability profit.

Sukmana, Fianto, and Abd. Majid (2024) investigates the profitability of Islamic banks in the Organization of Islamic Cooperation Countries using a panel of 41 banks over the period 2010-2020. The findings show that economic freedom has had a significant effect on the profitability of Islamic banks, and that financial and investment freedoms are favorable indicators, while business and monetary freedoms have a negative effect. Some useful implications of the study for policy are conducted for Islamic bank management and economic actors. Another same kind of study conducted by Handajani, Akram, and Sokarina (2024) sources fourty one banks for the period of 2010 to 2020 from the member countries that constitutes the Organization of Islamic Cooperation (OIC) and investigates Islamic banks profitability. The empirical results reveal that economic freedom plays a significant role in determining the profitability of Islamic banks where financial and investment freedoms exhibit positive impacts whereas business and monetary freedoms proved negative impacts. The study has some implications for policy makers particularly for Islamic bank management and economizes actors.

This research explores the impact of bank-specific human capital efficiency in affecting the relationship between asset diversification and bank performance between 2008 and 2020. Using fixed effects generalized least squares estimation, the results indicate that as human capital and diversification increases the profitability and efficiency of banks decrease. On the other hand, the beneficial aspect of income diversification in the context of financial stability neutralizes with increased efficiency of human capital Hemrit, Kasraoui, and Feidi (2024). Another paper of Mateev, Sahyouni, and Al Masaeid (2024) assesses the impact of efficiency and market structure on bank performance in the MENA region during the COVID-19 period. Samples consist of 225 banks in 18 countries. It is observed that bank performance is highly responsive to both efficiency and market power, with conventional banks showing more responsiveness compared to Islamic banks. Efficiency played a marginally significant role during COVID-19. While managing high efficiency contributes to financial stability, it also elevates risk-taking behavior. A study of Harsono (2024) analyzed the effect of risk, management quality, company size, and bank liquidity on the financial performance of the banks over the period from 2018 to 2022 using multiple linear regression models based on data from 20 purposively selected banks. Key findings included the following: credit risk had a significant negative effect on financial performance, management quality had a significant positive effect, and firm size and bank liquidity had a positive effect not significant at this time. These results were manifestations of the necessary aspects for the improvement of the financial performance of the banks.

The authors of the study Amin and Jaya (2024) analyze, using annual data from 2015 to 2022, how the basic factors like Capital Adequacy Ratio (CAR), Non-Performing Financing

(NPF), and Operating Expenses and Income (BOPO), along with the macroeconomic variables of inflation, GDP, and interest rates, affect the profitability of Islamic commercial banks. From different multiple linear regression analyses, this paper determined that there are only two factors that really affect profitability significantly, which are CAR and NPF; while others, like BOPO, GDP, inflation, and interest rates, do not. ROA is affected by the summarized version of all these factors. Besides, to realize higher profitability, an Islamic bank should pay great attention to capital efficiency and handle the problem of non-performing financing effectively. Anghel and Lupu (2024) investigates a domain-specific impact of regulatory changes on the European Banking Sector by applying Deep Learning techniques to estimate the relation between the Sustainable Finance guidelines of Action Plan on Finance, Sustainable Growth and Sustainable Growth Packages and the SX7P Index from 2012 to 2023.The research contributes to the literature on deep learning in financial markets while also being a useful source of information for policymakers concerned with sustainability finance regulation.

The selection of factors (FinTech, Good Governance and Exchange Rate) influencing bank performance (BP) is a matter of great importance, taking into consideration the multifaceted nature of banking success. In this respect, such factors have been cautiously selected on the grounds of their theoretical relevance and empirical support, and they correspond to modern challenges that face the banking industry. I will elaborate below how and why these factors have been chosen, drawing from various studies and research papers to highlight their importance and impact on bank performance. Selection of FinTech as a focal point in this thesis would be rooted in its transformative power on the banking industry. Financial technology has, over time, emerged as a force that effectively drives banks in the pursuit of efficiency, innovation, and competitiveness. It enhances operational processes, customer engagement, and risk management-all so crucial to any enhancement in financial performance. For instance, Almubarak and Aljughaiman (2024) established that the integration of FinTech significantly raises the level of profitability while simultaneously reducing the risk-taking behavior of banks. This double effect is rather important, given that banks function within increasingly competitive markets in which traditional practices are becoming increasingly inadequate. Furthermore, the rapid adoption of FinTech solutions has changed customer expectations and behaviors. With increasing awareness, the consumers demand more personalized and time-saving services, which could effectively be delivered with advancements in mobile banking, digital payments, and blockchain technologies. The ability to satisfy such expectations influences retention and acquisition of customers directly, therefore the overall bank performance. It has also been proven that FinTech was not only enhancing the performance of banks but also contributing to financial stability through transparency and inclusion. The application of innovative technologies allows banks to reduce operational costs, thus enabling cost-cutting, which is fundamental to profitability maintenance in a harsh economic environment (Hornuf, Klus, Lohwasser, & Schwienbacher, 2021).

Good governance plays a core role in banks with regard to their functioning and ethical behavior. It describes the structures and procedures from which banks make decisions. The issue of governance within banking becomes very important because it diminishes risks pertaining to bad management practices, while accountability is increased. Inclusion of good governance in this study is informed by its established positive link to better bank performances. Good governance structures ensure that the banks are managed in a manner

which will be compatible with the interests of their stakeholders while the banks remain compliant with regulatory requirements. Indeed, research has established that good governance dampens the adverse effects of riskiness linked with FinTech innovations (Arena, Catuogno, & Naciti, 2023a). This again brings into focus the importance of banks adopting appropriate and effective governance frameworks as they implement new technologies.

Studies show that it is those banks that have superior governance frameworks that are better placed to benefit the most from FinTech innovations. For example, (Arena et al., 2023a) explored how financial technology innovation in banks drives performance, focusing on the monitoring role of women independent directors and supporting the notion that more diversified boards may enhance monitoring and enrich decision-making processes. The most important exogenous determinant in bank profitability is exchange-rate fluctuation, as any bank operating international trade or foreign investments would be affected. Exchange rate volatility has an effect on profitability aspects through its impacts on asset valuation, foreign currency liabilities, and financial stability as a whole. The basis for inclusion of the exchange rate fluctuations in this thesis is their potential to create opportunities and challenges for banks. For instance, favorable changes in the exchange rate could improve the value of foreign-based assets while unfavorable movements might result in considerable losses. Understanding how banks manage the fluctuations makes it imperative to assess the performance of the bank.

Existing literature highlights the complex relationship between exchange rates and bank performance. Banks that effectively hedge against currency risks tend to demonstrate greater resilience during periods of volatility (Al-Matari, Mgammal, Alosaimi, Alruwaili, & Al-Bogami, 2022). Furthermore, research indicates that the ability to navigate exchange rate fluctuations can differentiate successful banks from those struggling to maintain profitability in uncertain economic environments.

1.2 Objective of the study

The purpose of this study, therefore, is to investigate how FinTech, together with good governance, influences bank performance, with a focus on the mediation effect of exchange rate fluctuation. FinTech innovations have transformed the financial services sector in terms of improved efficiency in operations, wider reach, and financial inclusions in recent years. The aim of this paper is therefore to assess the impacts of FinTech adoption and integration on bank performance, considering a few key dimensions, among them profitability, cost efficiency, and customer satisfaction.

Objective 1: To Analyze the Influence of FinTech on Performance of Banks

The purpose of this study is to explore the impact of financial technology (FinTech) innovations on the operational performance, financial performance, and market performance of banks. In particular, it will focus on the most important areas of FinTech dimensions including mobile banking, digital payment systems, and blockchain technology to analyze their

contribution toward increased profitability, efficiency, and customer service. The goal is to see how far FinTech adoption can push the needle towards positive changes in the banking space that promote long-term growth and competitiveness.

Objective 2: To Investigate the Effects of Governance Quality to Bank Performance

This study aims to investigate the effect of corporate governance mechanisms such as transparency, accountability and the structure of boards on bank performance. It is argued that good governance could facilitate an effective infrastructure for sound decision-making, risk management and behaviour, which could potentially improve bank resilience and enhance trust of stakeholders. It will also eliminate various aspects of the governance quality and innovative FinTech practices adopted by banking institutions and how they interact.

Objective 3: The Mediating Influence of Exchange Rate Movements on Bank Performance

The aim here is evaluate how exchange rate changes reduce the influence of FinTech, good governance on bank performance. Since currency markets are among the most volatile of all, this paper explores the nature of that transmission mechanism and assesses how exchange rate dynamics (which in many cases are a significant source of uncertainty) affect operating costs, the international alignment of expense items, and overall financial stability in a broad range of countries with high exposure to foreign currency. It will inform on the potential trade-offs involved in managing exchange rate risks in conjunction with FinTech adoption and governance reforms.

Overall, the three objectives hope to elucidate the interlinked nature between FinTech, good governance, and exchange rate changes in bank performance.

Chapter 02: Literature review, Hypothesis development, and Research Gap

2.1 Literature Review

2.1.1 FinTech and Financial Sustainability

FinTech's impact on bank performance is quite complex as it holds both positive and negative aspects. On the positive side, Fintech improves efficiencies, brings in new customers and offers better avenues for revenue generation and risk management. On the downside, it raises competition and disrupts the traditional business model that creates cybersecurity vulnerabilities and other regulatory complexities and challenges. A couple of key research finding indicates that FinTech has overall negative effect on bank's profitability and competitiveness of banks. As digitization is necessary, it would be better for banks to adapt financial technologies in order to compete. According to the results of a study conducted by Haoliang, Yahya, Rahim, and Ashhari (2024), conclude that FinTech has a lot more negative impacts on banks' profitability and gives pragmatic reasons for banks to adapt and innovate the changes of FinTech. The practical implications of this study will be revolving around that the banks should not only invest in FinTech research and development but also customize strategic action in accordance with bank types as proposed by the research findings of Haoliang et al. (2024).

In the study of Navaretti, Calzolari, Mansilla-Fernandez, and Pozzolo (2018) and Moran (2020) where they suggest that FinTech is likely to accelerate competition around the market, eventually threatening both the profitability risk and the loss of traditional banks in terms of market share. The rapid evaluation of FinTech also makes it difficult for regulators to keep up with the services which is highlighted by Vives (2017) and Nguyen (2019) in their study. According to (Chauhan), the negative impact of FinTech has been challenging the traditional bank's business models and forces the banks to adapt to new technologies and customer expectations. As per Nair and Menon (2017) where he examines two key policy approaches to FinTech regulation in Europe. The first one is crowdfunding and the second one is payment regulation under PSD 1 and PSD 2. Crowdfunding can often be managed by adapting existing financial regulations without many changes. On the other side, EU payment regulation required significant restructuring because of technology advancements. Regulators should balance reducing transaction costs through technology with protecting investors and service users via regulation. Shu and Hong (2023) claims that there is a negative impact of FinTech on the profitability of commercial banks in china. The similar line of findings can be found in the study of Qi, Yang, and Wang (2022) where he found negative, *U-shaped* relationship between FinTech development and the market power of traditional banks in china. Sajid, Ayub, Malik, and Ellahi (2023) conducted research on the risk taking behavior of banks that determines FinTech product development adversely affects bank risk-taking behavior due to increased operating efficiency.

The effects of FinTech on traditional banking are diverse in different areas or regions. During the year of 2024, Haoliang et al. (2024) propose that the influence has been negatively consequential to the profitability of banks in China, while in other countries such as Indonesia and Nepal, which was considered respectively by Hidayat (2024), Melati (2024) and Bhujel (2024) FinTech raises efficiency and performance. Y. Fang and Wen (2024) also examined the collaborating aspect of banks with FinTech firms, this can be productive if knowledge sharing, synergy and perceived risks are taken into careful consideration. Collaboration between banks and FinTech firms as explored by, can be beneficial but requires careful consideration of factors like knowledge sharing, synergy, and perceived risks. Kharrat, Trichilli, and Abbes (2024) studied the influence of FinTech development on the performance of banks in the Middle East and the North Africa (MENA) region. According to the study, bank performance is positively correlated with the FinTech index. This implies FinTech implementation improves the performance of conventional and Islamic bank's performance in that region. Similarity is observed in the study of Melati (2024) which examined how FinTech adoption affected Indonesian bank's performance in a positive manner. Naser, Sultanova, and Nahar (2024) and Ajouz et al. (2024) also found a favorable association between FinTech innovation and all four dimensions of bank performance which are marketing efficacy, financial robustness, operational efficiency and the strategic competitiveness. According to the study of Safiullah and Paramati (2024), demonstrated a positive relationship between the development of FinTech companies and bank financial stability. It indicates that the growth of FinTech firms can contribute to enhance the financial health of banks. Later in the same year, Ullah et al. (2024) figured out a combined effect amongst the various factors he employed, such as ATMs having a positive effect on ROA and ROE, which shows that a better result is achieved by banks that have more numbers of ATMs. Capital influence ROA positively whereas negatively influences ROE. Size influence ROE negatively while it has an insignificant influence on ROA. Credit risk does not affect ROE but affects ROA negatively. However, Liquidity positively influences ROA but has insignificant influences on the rest of ROE.

Back in the year of 2023, Haddad and Hornuf (2023), Batchu (2023), Shi and Wang (2023), Kipkoech (2023), L. Fang, Li, Subrahmanyam, and Zhang (2023), Baker, Kaddumi, Nassar, and Muqattash (2023), Zheng, Rahman, Hossain, and Moudud-Ul-Huq (2023), Singhvi and Dadhich (2023) suggested that FinTech has the ability to enhance overall bank performance in multiple ways including improved efficiency, profitability, customer experiences and financial inclusion. On the contrary, Sajid et al. (2023) and Shu and Hong (2023) found a negative impact of Fintech on commercial bank profitability.

In the year of 2022, da Silva (2022), Wang and Nor (2022), Lv, Du, and Liu (2022), Horváth, Kerényi, and Szabó (2022) found a mixed impact between FinTech and bank performance in various manners. Qi et al. (2022) found a negative and U-shaped relationship and others Hughes, Jagtiani, and Moon (2022), Untoro and Trinugroho (2022), Grassi, Figini, and Fedeli (2022), Varma, Nijjer, Sood, Grima, and Rupeika-Apoga (2022), Karthika, Neethu, and Lakshmi (2022) found a positive relationship. In the year 2021, Legowo, Subanidja, and Sorongan (2021), Haddad and Hornuf (2021), X. Chen, You, and Chang (2021), Le, Mai, Phan, Nguyen, and Le (2021) highlighted the potential of FinTech in order to improve bank

performance, efficiency, and at the same time customer experience. However, they also point out the mixed nature or potential drawbacks of FinTech's impact considering both positive and negative consequences.

2.1.2 Corporate/Good Governance and Financial Sustainability

The study of Fanta, Kemal, and Waka (2013) tried to determine the effect of internal and external corporate governance mechanisms on the financial performance of commercial banks in Ethiopia. The study applied panel data econometric analysis and found that bank performance was negatively associated with board size and the presence of an audit committee, whilst positively associated with bank size and capital adequacy ratio. But, there was a non-linear relationship between capital adequacy ratio and performance, implying a certain optimal capital adequacy. The results also make it clear that ownership type, loan loss provision, and loan to deposit ratio did not show significant effect on performance. The objective of this research by Athar, Chughtai, and Rashid (2023), was to explore the effect of corporate governance devices on the financial performance of commercial banks in Pakistan. The study with the use of panel data analysis reveals that a larger board and audit committee led to higher profitability and productivity gains but an inefficient one. Findings were also that CEO duality did not have a significant effect on bank performance. Yet when the same study applied measures of performance, gender diversity had a negative impact on all the performance measures. EPS and Technical Efficiency (TE) benefited from foreign ownership.

Another study of Molla, Islam, and Rahaman (2023) aimed to examine the relationship between corporate governance mechanisms with performance of listed banks in Bangladesh. Utilizing dynamic panel data analysis based on the two-step System Generalized Method of Moments (SGMM) estimator, the study reveals that board size positively contributes to accounting performance, while outside independent directors, managerial ownership, and female director have an insignificant effect on banks performance. The purpose of this study which is conducted by Tashkandi (2023), is to examine the relationship of Shariah supervision and other corporate governance variables on the performance of the case of Islamic banks in GCC (Gulf cooperation council) countries. To conduct the study, a dynamic panel data regression model was used based on the GMM estimator and a positive association between Shariah board size and bank performance has been found. On the other hand, larger board size and greater number of independent directors were related with lower performance. In addition, it was found that performance was positively influenced by bank size, capital adequacy ratio and GDP growth and negatively by investment deposits and inflation. The study of Rarmizi, Nasaruddin, and Hidayah (2023) was to forecast the influence of Islamic Corporate Governance on the financial performance of Indonesian Islamic Commercial Banks The study employed a descriptive quantitative research design by employing a secondary data from annual reports of 7 Islamic Commercial Banks for 2016–2021. The results demonstrate that the ICG has a positive and significant effect on financial performance, in terms of Return on Assets (ROA).

The purpose of the study was to assess the impact of corporate governance mechanisms on the financial performance of listed banking companies in Bangladesh by Hoque, Islam, and Ahmed (2013). It applies the dynamic panel regression model estimated with the GMM estimator to examine the impact of various corporate governance variables, such as board characteristics, ownership structure, and audit committee activity, on bank performance measures represented by ROA, ROE, and Tobin's Q. Given the fact that the specific outcomes are not provided regarding the significance and direction of such a variable's relations to bank performance, the usage of the GMM estimator gives evidence of a harder approach to potentially emerging econometric challenges in order to give reliable estimates. Another study conducted in Bangladesh by Islam, Sathye, and Hu (2015) where the purpose of the study is to create a unique corporate governance index and evaluate its impact on bank performance in Bangladesh. Based on the Wilcoxon signed rank test, the findings indicate that the introduction of the Code of Corporate Governance resulted in significant enhancements in corporate governance practices. However, in terms of the comprehensive corporate governance index against bank performance, no significant relationship was observed through regression analysis. M. A. Rahman and Islam (2018) analyzed how different aspects of corporate governance practices affect the performance of listed commercial banks in Bangladesh . Conducting a pooled OLS regression analysis on a dataset of 17 publicly traded Bangladeshi banks for the period 2013-2017, the paper finds that larger board size, a greater proportion of independent directors, and separation of CEOs positively influences bank performance measured by ROA, ROE, and EPS. Also, bank size was positively associated with higher bank size corresponding to higher ROA and ROE.

This research of S. U. Ahmed, Ullah, Ahmed, and Rahman (2016) is aimed to investigate the relationship between corporate governance mechanisms and financial performances of Islamic banks in Bangladesh. Based on panel data of six years on six listed Islamic banks, for the purpose of estimation, OLS regression was used to analyze the impact of different variables of corporate governance on bank profitability measured through ROA. These results suggest that although some corporate governance mechanisms, such as director fees and ownership control, relate positively to bank performance, others do not exhibit a significant relationship; these include board size, CEO duality, and institutional shareholding. This can be interpreted to convey the limitation of the present study and perhaps the need for further research into specific dynamics surrounding corporate governance in Islamic banking and effective mechanisms necessary to enhance bank performance.

Whereas, Rashid, Zobair, Chowdhury, and Islam (2020) tried to explore the impact of corporate governance on bank productivity in Bangladesh. The contribution of bank productivity, in a two-step approach, first measured it through the Malmquist Productivity Index, followed by regression analysis to identify the underlying factors that contribute to bank productivity. The results show that ownership structure and some other board characteristics under corporate governance are the strong predictive variables that influence bank productivity. Precisely, these facts have important implications for policymakers and bank managers while devising policies to improve bank productivity and overall economic growth. What impact corporate governance has on the performance of commercial banks in Bangladesh explored by

S. Ahmed, Jannat, and Ahmed (2017). From panel data regression analysis on 29 listed commercial banks for the period 2011-2014, the result indicated there is a positive relationship between the corporate governance score and bank performance as measured by ROA. However, the influence of other variables describing bank size, risk, efficiency, and macroeconomic variables on bank performance showed mixed results. The results actually suggest that better practices of corporate governance do positively relate to bank performance in Bangladesh. The influence of corporate governance on the performance of commercial banks in Bangladesh has observed by Morshed, Kabir, Muhibbullah, Afroz, and Asuhaimi (2020) as well. The results from panel data analysis of nine public and private commercial banks during 2009-2017 have shown that the capital adequacy ratio is the most significant factor affecting bank performance measured in terms of ROA, ROE, and EPS. While the size of the board and audit committee were not discussed in relation to bank performance, as stated in the abstract of the paper, such variables could likely have been considered in the study.

In the year 2024, Saha and Uddin (2024) was to find out the extent to which the corporate governance practices have been impacting the performance of the listed commercial banks in Bangladesh. Based on this, through multiple linear regressions, using a sample of 33 listed banks on the Dhaka Stock Exchange over the period 2017-2021, this present study finds that the size of the board and audit committee features, such as size and independence, explain bank performance positively. However, board independence and the skills of board members did not emerge as significant determinants of performance. The findings therefore indicate that board size and audit committee strength can be used to enhance the performance of banks in Bangladesh. M. Alam, Akhtar, and Al-Faryan (2024) comparatively tries to discuss the impact of corporate governance on the profitability of Indian banks with their counterparts for the SAARC nations. Using a two-stage analysis, panel regression, and GMM, the derived conclusions of the study were that board accountability has a positive influence on bank profitability, while transparency and disclosure have a negative influence. The study also gathered that Indian banks are far ahead of SAARC banks in terms of corporate governance and profitability. The finding suggests that higher bank profitability in the SAARC region may be achieved through increased accountability and transparency of the board and better disclosure practices. On the other hand, Hassan, Mohd Hanafiah, Abu Hassan, and Shaharudin (2024) study the Corporate Governance mechanisms' impact on bank performance in emerging Asian markets. The research on panel data for 109 listed banks from 2011 to 2015 concludes that effective corporate governance mechanisms, such as practices of efficient risk management, board composition, and transparency, have a positive relation with bank performance. However, restructuring measures in banks have an insignificant influence on performance. This brings back into focus the relevance of good corporate governance as an impetus for bank performance in emerging markets.

2.1.3 Exchange Rate Fluctuation and Financial Sustainability

The impact of the exchange rate, interest rates, and global risk on the return for every bank is covered under the scope of this study by Çiçek and Yıldırım (2024). Using the

multivariate diagonal BEKK-GARCH(1,1) model, it is derived that relatively great interest rate fluctuations prevail for private banks, while public banks are insensitive to shocks. Another finding of the study is that the spillovers are significant, especially from the global factors of volatility. The findings indicate that the Turkish banking sector was more sensitive to domestic interest rate shocks compared to exchange rate or global shocks. In this study, evidence was found showing structural breaks existing in the interest rate covariance equations, which signifies that any model on financial volatility cannot neglect these breaks. Yemi and Nakawooya (2024) analyzed the impact of foreign exchange rates on the profitability of Nigerian banks. The descriptive study design was used with a Pearson correlation analysis, hence, data from 23 First Bank branches in Lagos and Ondo States were analyzed. From this, it was found that a higher foreign exchange rate positively influences bank profitability. This means that through currency fluctuations, especially the devaluation of the home currency, banks stand to gain.

The study of Kush (2022) sought to ascertain how exchange rate fluctuations affect the performance of Centenary Bank Uganda Limited, head office. This was a correlation descriptive survey research design, collected from interviews and questionnaires. The results show that the financial performance of the bank is largely affected by its economic stability, monetary policies, and competitiveness in the international trade. It indicates that FED termed the bank on stable economic environment can be good earnings effective monetary policies and competitive international trade environment. Whereas Keshtgar, Pahlavani, and Mirjalili (2020) examined the effect of exchange rate fluctuations on the performance of Iranian banks. Panel data regression with random effects was employed to investigate data of 14 Iranian banks during a period starting from 2007 to 2017. In other words, it results that the exchange rate volatility has a negative effect on bank profitability (return on investment) but positive effect on the loan deposit ratio. This means that exchange rate fluctuations can increase credit risk and reduce banks profitability. In addition, omitting bank-specific characteristics, including liquidity, equity and efficiency, can hinder the ability of exchange rate volatility to exert adverse impacts.

Another study by Lagat and Nyandema (2016) set out to establish the relationship and impact of foreign exchange liberalization on the financial performance of listed commercial banks in Nairobi Securities Exchange Kenya. Methods of data set consisting of 2006 to 2013 observations was analyzed using time series correlation research design. A positive correlation was detected between the foreign exchange rates and bank performance proxies (return on equity, return on capital employed and earnings per share) in the research. The implication is that, this exchange rate depreciation (higher exchange rates) of the Kenyan shilling could partly have enhanced bank profitability via profits from trading in foreign exchange. The purpose of the study is to explain the determinants of banking crises in developing countries, with an emphasis on external liabilities and the stability of the exchange rate which is conducted by Gaies, Goutte, and Guesmi (2019). The authors examined data from 67 developing countries between 1972 and 2011 using a logit panel model and various econometric techniques. The evidence points to the fact that if the external liabilities are in the form of debt, the more charge of banking crises occur, while if they are in the FDI form, the more avoid of banking crises.

Moreover, macroeconomic indicators like the stability of the exchange rate, economic growth and institutional quality are arguably very important determinants in decreasing the probability of banking crises. In an environment of deeper globalization and greater financial integration whether international reserves have the buffer effect on the real exchange rate was the object of analysis of the study by Aizenman, Ho, Huynh, Saadaoui, and Uddin (2024). The study used a panel of 110 countries over a period of 20 years (2001–2020), employing nonlinear panel regression and panel threshold regression methodologies. Results indicate that international reserves could alleviate the negative effects of positive terms-of-trade shocks on the real exchange rate but only in nations with underdeveloped financial systems. A stronger buffer effect was also observed for countries that are somewhat open to international capital flows (i.e., neither too open, nor too closed.

Table 1: Summary of Literature Review

Author	Country	Methodology	Dependent Variable	Independent Variable	Findings
Haoliang et al. (2024)	China	GMM	Profitability of Chinese commercial banks, measured by Return on Assets (ROA)	Fintech development index, Bank-specific control variables: Asset size, Cost-to-income ratio, Capital adequacy ratio Loan-to-deposit ratio, Macroeconomic control variable: GDP growth rate	-ve
Haddad and Hornuf (2023)	The study analyzed financial institutions from 87 countries. over a period (likely 2005-2018)	Panel Data Analysis with a Two-Step System GMM estimator.	Net Interest Margin, ROA, ROE, Tobin's Q, Annual Stock Return, Z-score, Stock Return Volatility, and Marginal Expected Shortfall.	Fintech start-up formations.	+ve
Kiilu (2018)	Kenya	Correlation Analysis and Multiple Linear Regression Equation with the technique of estimation being Ordinary Least Squares.	Financial performance of commercial banks in Kenya (measured by Return on Assets (ROA))	The number of registered mobile payment account users, Number of mobile transactions, Value of money transacted.	+ve
Batchu (2023)	Global	Mixed-Methods Approach.	The financial performance of traditional banking institutions. This can be measured through various metrics like return on assets (ROA), return on equity (ROE),	Fintech integration. This can be measured by factors like the number of Fintech startups, the adoption of Fintech services by banks, and the level of digital transformation in the banking sector.	+ve

			profit margin, and market capitalization.		
Navaretti et al. (2018)	Europe	Mixed-Methods Approach.	The performance and competitiveness of traditional banks	The level of FinTech integration and innovation	-ve
Iman (2019)	Indonesia	Descriptive-Exploratory Research.	The ability of traditional banks (specifically STB) to innovate and compete with fintech startups.	The level of fintech adoption and the competitive landscape created by fintech startups.	+ve
K.-C. Chen (2020)	China	DEA methodology, two-stage network systems	Bank efficiency (overall, productivity, and profitability) and Financial performance indicators (ROA, ROE, Z-score)	Internet-only bank entry Financial indicators (income diversification, loan-to-asset ratio, profit margin ratio, asset turnover ratio, size, revenue per employee)	+ve
da Silva (2022)	Portugal	Single-factor model, the Market Model (MM).	Stock prices of traditional banks	FinTech funding events	Mixed Digital Lending: Negative impact, suggesting a substitution effect. Digital Payments: Positive impact, suggesting a complementary effect. Digital Capital Raising: Initial negative impact, followed by a positive effect, suggesting a complex relationship.

Nair and Menon (2017)	India	Systematic literature review	The performance and market share of traditional banks	The emergence and growth of FinTech firms	-ve
Vives (2017)	US, China, and the European Union (EU).	Survey-based literature review	The impact of FinTech on Banking (This refers to the outcome being measured)	Development and application of digital technologies in financial services (e.g., big data, AI, mobile payments), Emergence of FinTech firms, Regulatory landscape for FinTech vs Traditional Banks	mixed
Nguyen (2019)	Finland (implied by the affiliation with Tampere University of Applied Sciences)	Researching and analyzing public articles and researches	The competitive landscape of the financial industry	The rise of FinTech, Technological advancements, Regulatory changes	mixed Positive Impact: FinTech can drive innovation, improve efficiency, and enhance customer experience. Negative Impact: FinTech can erode traditional banks' market share, particularly in areas like payments and lending.
Moran (2020)	UK or US	Research Onion framework	The competitive landscape of the banking industry, specifically the impact on traditional banks.	The rise of FinTech, Technological advancements, Regulatory changes, Consumer preferences	-ve
Shi and Wang (2023)	Singapore	Theoretical and analytical modeling approach, supported by numerical analysis.	The transformation of the global financial landscape	Rise of FinTech, Technological advancements, Regulatory changes, Changing consumer behavior	+ve

Qi et al. (2022)	China	Lerner index, the Boone index, Monti-Klein model	interest rate spread of commercial banks, expressed as ΔR.	FinTech development, Technological innovation, Business innovation Ownership structure, Preloan, Marketsize, $GDP_{grow,}$ $\text{Cost}_{rate,}$ Shibor, Finance, Regulations.	-ve, U-shaped relationship between FinTech development and the market power of traditional banks.
Legowo et al. (2021)	Indonesia	descriptive analysis research method with a qualitative approach.	The impact of FinTech on the banking industry	Technological advancements, Regulatory environment, Consumer behavior, Competitive landscape	mixed
Vasiljeva and Lukanova (2016)	Latvia and the Baltics	mixed methods — integrating both qualitative and quantitative approaches	The impact of FinTech on the competitive landscape of the traditional banking industry.	Technological advancements, Regulatory changes, Consumer behavior, Market dynamics	mixed
Hidayat (2024)	Indonesia	PRISMA method	Operational efficiency and profitability of traditional banks	Fintech adoption	+ve [The research results show that fintech improves operational efficiency and profitability of traditional banks, but also poses challenges in terms of technology adoption and changes in consumer behavior]
Haddad and Hornuf (2021)	Multiple countries (87 countries)	(GMM) system dynamic panel estimator	Performance of traditional financial institutions, Default risk of traditional financial institutions	Fintech startup formations	+ve [However, the paper also highlights potential risks associated with the rise of fintech, such

					as increased systemic risk and the need for enhanced regulation to mitigate these risks]
Hughes et al. (2022)	United States	stochastic frontier analysis (SFA) combined with market value regression	Non-Performing Loan (NPL) ratio	Lender type (large banks, small banks, LendingClub), Lending efficiency,Inherent credit risk	The study found a positive relationship between the NPL ratio and the market value of large banks, indicating that the market rewards risk-taking behavior. However, it also found a negative relationship between lending inefficiency and market value, suggesting that the market penalizes inefficient lending practices.
Wang and Nor (2022)	China	quantitative analysis, using random model	Return on Equity (ROE) of traditional banks	FinTech index (composite measure of e-banking replacement rate, self-service machine growth rate, and technology employee growth rate), Capital adequacy ratio (CAR), Non-performing loan ratio (NPL) Cost-to-income ratio (CIR), Non-interest income ratio (NIRR), M2 money supply growth rate	FinTech index: Positive, CAR: Negative, NPL: Negative, CIR: Negative, NIRR: Negative, M2: Positive.
Kipkoech (2023)	Kenya	Descriptive research methods	Financial Performance (measured by Return on	Fintech adoption (measured by mobile banking users, mobile payments, risk and financial inclusion, amount invested)	+ve [A positive relationship was found between

			Equity (ROE) and Return on Assets (ROA))		fintech adoption and financial performance]
Melati (2024)	Indonesia	literature review method	Financial Performance (measured by Return on Equity (ROE) and Return on Assets (ROA))	Fintech adoption (measured by various factors like COVID-19 cases, lockdown policies, national characteristics, application features, and seasonal variations, mobile banking apps, blockchain, AI, and machine learning)	+ve
L. Fang et al. (2023)	China	machine learning combined with econometric techniques	Bank Efficiency (measured by profit, cost, interest income, and noninterest income), Bank Risk (measured by Z-score, capital asset ratio, liquidity ratio, and non-performing loan ratio)	FinTech Innovation	+ve
Ky, Rugemintwari, and Sauviat (2019)	East African Community (Burundi, Kenya, Rwanda, Tanzania, Uganda)	panel data fixed effects regression approach	Bank performance (measured by profitability, efficiency, and stability)	Bank involvement in mobile money	+ve
Untoro and Trinugroho (2022)	Indonesia	panel data regression model	Bank Performance (NIM, ROA, ROE), Bank Risk (NPL, SD_ROE)	P2P Lending, Fintech Adoption	P2P Lending: Negative effect on NPL (decreased credit risk, No significant effect on other performance and risk measures, Fintech Adoption:

					No significant effect on performance or risk
Sajid et al. (2023)	Emerging Countries (China, India, Pakistan, Bangladesh)	Z-score proxy	Bank Risk-Taking Behavior	Fintech Product Development	-ve [Fintech product development negatively affects bank risk-taking behavior through improved operating efficiency]
Sedera	Indonesia	Regression analysis	Bank Performance (Market Share)	Growth of Fintech Lending, Growth of Fintech Borrowing	+ve [The study suggests a positive correlation between the growth of Fintech lending and the performance of traditional banks, particularly rural banks. This indicates that Fintech lending can potentially benefit traditional banks by expanding their market reach and improving their performance.]
Baker et al. (2023)	Jordan and the United Arab Emirates (UAE)	Multiple linear regression analysis	Financial Performance (measured by total deposit and net profit)	Financial Technology (FinTech), specifically: Financial Inclusion, Alternative Payment Methods (APMs), Automation	+ve [FinTech has a positive impact on both total deposit and net profit]

Lv et al. (2022)	China	e Error Correction Model (ECM)	Bank Profitability (measured by Return on Equity - ROE)	Fintech Development Index (FTI), Bank Size (Total Assets), Net Interest Margin (NIM), Non-Performing Loan Ratio (NPL) , Cost-to-Income Ratio (CTI)	mixed [Fintech has a U-shaped impact on bank profitability. Initially, it might decrease profitability, but in the long run, it can positively impact it. Bank size (total assets) and net interest margin (NIM) have a positive impact on bank profitability. Non-performing loan ratio (NPL) and cost-to-income ratio (CTI) have a negative impact on bank profitability.]
X. Chen et al. (2021)	China	structural equation modeling technique	Customer Satisfaction, Expectation of Bank Employee, Assistance Bank Service Quality, Employee Work Efficiency	Perceived Usefulness (PU) of FinTech Products (FTPs)	+ve [Perceived Usefulness (PU) of FTPs has a positive impact on: • Customer satisfaction • Low expectation of bank employee assistance • Bank service quality

					• Employee work efficiency]
Horváth et al. (2022)	Hungary	qualitative research method (in-depth interviews with open-ended questions)	Success of cooperation between banks and FinTechs	Organizational Ambidexterity, Exploitation focus, Internal champions.	mixed [Positive: Ambidextrous internal champions or suppliers of the banks can facilitate successful cooperation between FinTechs and banks. Negative: Excessive exploitation focus by banks can hinder the realization of benefits from cooperation.]
(Yin)	China	a comprehensive analysis(qualitative & quantative)	Success of commercial banks in leveraging Fintech opportunities during COVID-19	Fintech adoption and integration	+ve [The paper suggests that Fintech adoption can positively impact commercial banks' performance and competitiveness, especially during the COVID-19 pandemic.]
Golubić (2019)	Global	qualitative analysis, case studies, surveys and interviews, comparative	The impact of digital technologies on commercial banking	Fintech firms, Digital technologies (e.g., online banking, mobile banking, crowdfunding), Regulatory environment.	mixed [Positive: Fintech firms are challenging traditional banking models by offering

		analysis, and regulatory research			innovative services and lower costs. Positive: Digital technologies are enabling banks to improve efficiency and customer experience. Negative: The lack of a suitable regulatory framework for Fintech can hinder innovation and pose risks to consumers.]
Bhujel (2024)	Nepal (Kathmandu)	Multiple regression model	Adoption of Fintech Services	Customer Trust, Data Security, Perceived Usefulness, Perceived Ease of Use, Fintech Promotion.	mixed [Positive: Data security, perceived usefulness, and fintech promotion have a significant positive impact on the adoption of fintech services. Negative: Customer trust and perceived ease of use were found to have insignificant effects on fintech service adoption.]
Lien, Doan, and Bui (2020)	Vietnam	multivariate regression	Intention to use fintech services	Perceived usefulness, Perceived ease of use, Customer trust, Social influence.	+ve [All independent variables (perceived usefulness,

					perceived ease of use, customer trust, and social influence) have a positive impact on the intention to use fintech services.]
Shu and Hong (2023)	China	empirical research	Commercial Bank Profitability (measured by Return on Assets - ROA)	Fintech Index	-ve [The study found a negative impact of fintech on the profitability of commercial banks in China.]
Y. Fang and Wen (2024)	China	evolutionary game theory and prospect theory	Stability of innovation collaboration between commercial banks and fintech companies	Benefits and costs of innovation collaboration, Fairness of income distribution, Complementarity of knowledge and technology, Synergy of collaboration, Perceived value of gains and losses by partners.	mixed [Positive: Complementarity of knowledge and technology, synergy of collaboration, and perceived value of gains by partners positively influence the stability of innovation collaboration. Negative: The perceived value of losses by partners negatively influences the stability of innovation collaboration.]
Le et al. (2021)	Vietnam	Multivariate Panel Regression	Bank performance (measured by various financial indicators like	Mobile banking app adoption (measured by age of the app)	+ve [The study found a positive impact of mobile

			ROA, ROE, fee income, etc.)		banking app adoption on bank performance, particularly for small banks.]
Al-Amin, Mia, and Hasan	Bangladesh	Random Effects Model	Return on Assets (ROA) and Return on Equity (ROE)	Automated Teller Machines (ATMs), Agent Banking, Cash Recycling ,Machines (CRMs), Software Development, Firm Size (Control Variable).	mixed [ATMs, Agent Banking, and CRMs: These FinTech variables have a negative impact on bank profitability, as measured by ROA and ROE. Software Development: This variable has a positive impact on bank profitability. Firm Size: This variable has a negative impact on bank profitability.]
Zheng et al. (2023)	Developing Countries	fixed-effect (FE) and random-effect (RE) models	Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM).	Fintech-driven inclusive finance index	+ve [Fintech-driven inclusive finance has a positive impact on bank profitability.]
Grassi et al. (2022)	Italy	Exploratory multiple case studies	Customer Value	Data Strategy (specifically, the use of data to understand customer needs and preferences)	+ve
(Chauhan)	Global	Descriptive analysis	Traditional Banking Industry	Fintech Innovations (e.g., digital payments, peer-to-peer lending, blockchain)	-ve [The impact of fintech on traditional banking is generally negative, as it challenges

					traditional business models and forces banks to adapt to new technologies and customer expectations.]
Singhvi and Dadhich (2023)	Global	Qualitative and conceptual analysis	Sustainable Banking Practices (including ESG integration, sustainable investments, financial inclusion)	Fintech Revolution (Fintech innovations such as digital banking, green investments, blockchain)	+ve [The impact of Fintech on sustainable banking is positive, with Fintech innovations driving the development of sustainable financial products, promoting financial inclusion, and increasing efficiency in the banking sector.]
Varma et al. (2022)	Global	Qualitative research approach that emphasizes thematic analysis and systematic literature review	The banking industry and its performance, including factors like efficiency, customer satisfaction, and financial stability.	Fintech innovations (e.g., blockchain, AI, machine learning, digital payments)	mixed [The impact of Fintech on the banking industry is both positive and negative. While Fintech can improve efficiency, customer experience, and financial inclusion, it also poses challenges like increased competition, cybersecurity risks, and potential job displacement]

Karthika et al. (2022)	India	Systematic review with a focus on thematic analysis	The performance and efficiency of the banking sector	Fintech innovations (e.g., mobile banking, digital payments, AI, blockchain)	+ve [The impact of Fintech on the banking sector in India is positive. Fintech innovations have improved customer experience, increased efficiency, and promoted financial inclusion.]
Kharrat et al. (2024)	Middle East and North Africa (MENA) region	Simultaneous Equation Model:	Bank performance (measured by various metrics like ROA, ROE, efficiency)	FinTech Index (a newly developed index measuring FinTech development in the MENA region)	+ve [The study found a positive relationship between the FinTech Index and bank performance. This suggests that increased adoption of FinTech technologies leads to improved performance for both conventional and Islamic banks in the MENA region.]
Melati (2024)	Indonesia	literature review approach	Financial Performance (measured by metrics like operational efficiency, liquidity, profitability, and growth)	Fintech Adoption	+ve [The literature review suggests a positive relationship between Fintech adoption and financial performance. Fintech adoption can improve operational

					efficiency, liquidity, and profitability of banks.]
Naser et al. (2024)	Kingdom of Bahrain	Panel Data Estimation Methods	Bank Performance (measured by Return on Assets, ROA)	FinTech Index (FTI, FTII, FTOI)	+ve [The study found a positive relationship between Fintech innovation and bank performance. This means that banks with higher levels of Fintech adoption tend to have better performance, as measured by ROA.]
Ajouz et al. (2024)	Palestine	Quantitative methods, Partial Least Squares Structural Equation Modeling (PLS-SEM), Smart-PLS software	Marketing Efficacy, Financial Robustness, Operational Efficiency, Strategic Competitiveness.	FinTech (Financial Technology) Adoption.	+ve [The study found a positive relationship between FinTech adoption and all four dimensions of bank performance: marketing efficacy, financial robustness, operational efficiency, and strategic competitiveness. This suggests that FinTech adoption can significantly enhance the overall performance of Palestinian banks.]

Safiullah and Paramati (2024)	Malaysia	Dynamic panel GMM model, regression model	Bank Financial Stability (measured by Z-score and RZ-score)	FinTech Firm Development (measured by the number of FinTech firms)	+ve [The study found a positive relationship between the development of FinTech firms and bank financial stability. This suggests that the growth of FinTech firms can contribute to improving the financial health of banks.]
Ullah et al. (2024)	China	Descriptive statistics and multiple linear regressions	Return on Assets (ROA), Return on Equity (ROE).	Number of ATMs (ATM), Capital adequacy (Capital), Bank size (Size), Credit risk (Credit risk), Liquidity (Liquidity).	Mixed [**ATM**: Positive and significant impact on both ROA and ROE. This suggests that banks with more ATMs tend to perform better financially. **Capital:** Positive and significant impact on ROA, but a negative and significant impact on ROE. **Size:** No significant impact on ROA, but a negative and significant impact on ROE.

					Credit risk: Negative and significant impact on ROA, but no significant impact on ROE. **Liquidity:** Positive and significant impact on ROA, but no significant impact on ROE.]
Fanta et al. (2013)	Ethiopia	Descriptive and inferential statistical analysis and multivariate regression analysis, Classical Linear Regression Model (CLRM)	Bank Performance: Measured by Return on Equity (ROE) and Return on Assets (ROA)	Internal Governance: Board Size Existence of Audit Committee External Governance: Capital Adequacy Ratio (CAR) Capital Ratio (CR) Loan Loss Provision (LLP) Loan to Deposit Ratio (LDR) Control Variables: Bank Size Ownership Type	Mixed Negative: Board size, existence of an audit committee Positive: Bank size, capital adequacy ratio (non-linear relationship) No significant impact: Ownership type, loan loss provision, loan to deposit ratio
Athar et al. (2023)	Pakistan	Panel data analysis using a pooled effects regression model. Data was collected from annual reports of 19 Pakistani commercial banks from 2013 to 2020.	Return on Assets (ROA) Earnings per Share (EPS) Technical Efficiency (TE) Total Factor Productivity (TFP)	Board size CEO duality Audit Committee size Gender diversity Foreign ownership	Mixed. Board size: Positive impact on ROA and TFP, negative impact on TE. CEO duality: No significant impact on any performance measure. Audit Committee size: Positive impact

					on ROA and TFP, negative impact on TE. Gender diversity: Negative impact on all performance measures. Foreign ownership: Positive impact on EPS and TE.
Molla et al. (2023)	Bangladesh	Dynamic panel data analysis using two-step System Generalized Method of Moments (SGMM) estimators.	Bank performance (measured using accounting and market-based performance indicators)	Board size Outside independent directors Managerial ownership Female directors	Board size has a positive impact on accounting performance. Outside independent directors, managerial ownership, and female directors have no significant impact on bank performance.
Tashkandi (2023)	Gulf Cooperation Council (GCC) countries	Dynamic panel data regression model using the generalized method of moments (GMM) estimator.	Bank performance (measured by ROA)	Shariah Supervisory Board size Board of Directors size Independent Directors Bank size Investment deposits Capital adequacy ratio GDP growth Inflation Global financial crisis dummy	Shariah Supervisory Board size: Positive impact on bank performance. Board of Directors size: Negative impact on bank performance. Independent Directors: Negative impact on bank performance.

					Control Variables: Bank size, capital adequacy ratio, and GDP growth have a positive impact on performance, while investment deposits and inflation have a negative impact.
Rarmizi et al. (2023)	Indonesia	Descriptive quantitative research using secondary data from annual reports of 7 Islamic Commercial Banks in Indonesia from 2016 to 2021. Data analysis involved statistical tests like normality, multicollinearity, and heteroscedasticity, followed by simple linear regression.	Financial performance, measured by Return on Assets (ROA)	Islamic Corporate Governance (ICG)	A positive and significant relationship exists between ICG and financial performance. ICG, as measured by disclosure compliance with regulatory frameworks, positively impacts ROA.
Hoque et al. (2013)	Bangladesh	Dynamic panel regression model using the generalized method of moments (GMM) estimator.	Bank performance (measured by ROA, ROE, and Tobin's Q)	Number of board members (lnBM) Proportion of independent directors (IND) Proportion of non-independent and non-executive directors (NINE) Sponsor/director ownership (SDO) Institutional ownership (INO) General public ownership (GNP)	General public ownership: Positive and significant impact on ROA, ROE, and Tobin's Q. Frequency of audit committee meetings: Positive and significant impact

				Number of audit committee meetings (lnACM) Chief Executive Officer's compensation (lnCEO) Company size (lnTA) Debt-equity ratio (lnDEQ)	on ROA, ROE, and Tobin's Q. Directors' ownership: Positive and significant impact on Tobin's Q. Independent directors: Positive and significant impact on Tobin's Q. Objective: To investigate the influence of corporate governance me.
Islam et al. (2015)	Bangladesh	Wilcoxon signed rank test and regression analysis.	Bank performance (not explicitly specified)	Comprehensive corporate governance index	The introduction of the Code of Corporate Governance in Bangladesh has significantly improved corporate governance practices. There is no significant relationship between the comprehensive corporate governance index and bank performance.

M. A. Rahman and Islam (2018)	Bangladesh	Pooled Ordinary Least Square (OLS) regression analysis	Bank performance (measured by ROA, ROE, and EPS)	Board size (BOD), Number of independent board members (IBM), CEO status (CEO), Bank size (LBSM)	Board size has a positive impact on ROA, ROE, and EPS. Independent board members have a positive impact on ROE and EPS. CEO separation has a positive impact on ROA. Bank size has a positive impact on ROA and ROE.
S. U. Ahmed et al. (2016)	Bangladesh	Panel data regression using Ordinary Least Square (OLS)	Return on Assets (ROA)	Firm size (FS) Number of board meetings (BODM) Board size (BODS) CEO duality (CEODT) Director fees (DIRF) Number of independent directors (IND) Institutional shareholding (ISH) Ownership control (OC)	Firm size has a negative impact on ROA. Director fees and ownership control have a positive impact on ROA. Other variables, including board size, CEO duality, number of board meetings, number of independent directors, and institutional shareholding, do not have a significant impact on ROA.

Rashid et al. (2020)	Bangladesh	Two-step approach: Malmquist Productivity Index (MPI) to measure total factor productivity (TFP) Ordinary Least Square (OLS), Fixed Effect (FE), and Random Effect (RE) regressions to analyze the determinants of bank productivity.	Bank productivity (measured by TFP)	Ownership structure (e.g., foreign ownership, institutional ownership) Board characteristics (e.g., board size, board independence) Financial performance (e.g., return on assets, return on equity)	The average productivity of Bangladeshi banks is 1.03%. Corporate governance factors, including ownership structure and board characteristics, significantly influence bank productivity.
S. Ahmed et al. (2017)	Bangladesh	Panel data regression using Ordinary Least Square (OLS)	Return on Assets (ROA)	Corporate governance score Bank size Risk (measured by provision for bad debt) Efficiency (measured by operating expense/operating income) GDP Inflation rate Real interest rate	The study found a positive relationship between corporate governance score and bank performance (ROA). The impact of bank size on ROA is mixed. Risk and efficiency have a negative impact on ROA. The impact of macroeconomic variables (GDP, inflation rate, and real interest rate) on ROA is mixed and depends on specific

					economic conditions.
Morshed et al. (2020)	Bangladesh	Panel data regression using Generalized Least Squares (GLS)	Return on Assets (ROA) Return on Equity (ROE) Earnings per Share (EPS)	Board size (BDS) Size of the audit committee (AC) Capital adequacy ratio (CAR)	Capital adequacy ratio (CAR) has the greatest impact on bank performance.
Saha and Uddin (2024)	Bangladesh	Multiple linear regression analysis	Return on Assets (ROA) Return on Equity (ROE)	Board size Board independence Size of audit committee Independence of audit committee Board skills Management skills of board members	Board size has a positive and significant impact on both ROA and ROE. Board independence and board skills have no significant impact on firm performance. Audit committee size and independence have a positive and significant impact on ROE.
M. Alam et al. (2024)	India and SAARC nations	Two-stage analysis: Panel regression Generalized method of moments (GMM)	Return on Assets (ROA) Return on Equity (ROE) Tobin's Q	Board accountability Transparency and disclosure Audit committee CAMELS framework variables (capital adequacy, asset quality, management quality, earnings quality, liquidity, and sensitivity to market risk)	Board accountability has a positive and significant impact on bank profitability. Transparency and disclosure have a negative and significant impact on bank profitability.

					Audit committee has a positive but insignificant impact on bank profitability. Indian banks outperform SAARC banks in terms of corporate governance and profitability.
Hassan et al. (2024)	Asian Emerging Markets (China, India, Indonesia, Malaysia, South Korea, Philippines, Thailand, Taiwan)	Panel data analysis	Net Interest Margin (NIM)	Risk governance mechanisms (size of risk committee, CRO gender, CRO nationality, reporting line of CRO) Board governance mechanisms (director qualifications, director experience, board independence) Disclosure and transparency governance (audit committee full independence, expert-independent audit committee) Bank restructuring Control variables (bank size, consumer price index, volume of bonds and sukuk, money supply, stock exchange index)	Risk governance, board governance, and disclosure and transparency governance positively impact bank performance. Board size, director qualifications, and experience in banking and finance positively impact bank performance. Fully independent audit committees positively impact bank performance. Bank restructuring did not significantly impact bank performance.

Çiçek and Yıldırım (2024)	Turkey	Multivariate Diagonal BEKK-GARCH(1,1)	Stock returns of individual Turkish banks	Changes in the exchange rate Changes in the interest rate VIX index Square root of exchange rate volatility Square root of interest rate volatility Dummy variables capturing asymmetric responses to shocks	Half of private banks are sensitive to interest rate changes but not to exchange rate or VIX shocks. Public banks are not sensitive to any of the variables. Exchange rate and interest rate risks have a higher impact than changes in these variables. Global risk (VIX) has a higher impact on covariance than domestic risks. No significant asymmetric response to shocks in bank returns. Structural breaks exist in the interest rate covariance equations.
Yemi and Nakawooya (2024)	Nigeria	Descriptive study using a cross-sectional research design and Pearson correlation analysis.	Bank profitability	Bank size, inflation rate, interest rate	+ve. There is a significant positive relationship between the foreign exchange rate and bank profitability.

Kush (2022)	Uganda	Descriptive survey research design with correlation analysis	Financial performance of Centenary Bank Uganda Limited, head office	Level of economic stability Monetary policies International trade competitiveness	There is a significant positive relationship between economic stability, monetary policies, international trade competitiveness, and the financial performance of Centenary Bank.
Keshtgar et al. (2020)	Iran	Panel data regression using random effects	Loan-to-deposit ratio (LTD) Return on investment (ROI)	Exchange rate volatility Inflation rate Bank-specific variables (liquidity, equity, deposit-to-cost ratio)	Exchange rate volatility has a positive and significant impact on the loan-to-deposit ratio. Exchange rate volatility has a negative and significant impact on return on investment. Inflation has a negative impact on the loan-to-deposit ratio. Bank-specific variables (liquidity, equity, deposit-to-cost ratio) have a positive impact on bank performance.

Lagat and Nyandema (2016)	Kenya	Time series correlation research design with multivariate linear regression and Pearson product moment correlation analysis.	Financial performance of commercial banks (measured by return on equity, return on capital employed, and earnings per share)	Foreign exchange liberalization (represented by foreign exchange rates, inflation rates, and interest rates)	Positive relationship between foreign exchange rates and bank performance. The study suggests that a weaker Kenyan shilling (higher exchange rates) might have contributed to banks' profitability through foreign exchange trading activities.
Gaies et al. (2019)	Developing countries (67 countries)	Logit panel model, fixed-effects logit, and random-effects probit models	Occurrence of banking crises	Debt liabilities Foreign direct investment (FDI) liabilities Exchange rate stability Real GDP growth Human capital quality Political institutions	Debt liabilities increase the likelihood of banking crises. FDI liabilities decrease the likelihood of banking crises. Exchange rate stability, real GDP growth, better human capital quality, and stronger political institutions decrease the probability of banking crises.
Aizenman et al. (2024)	Panel data, 110 countries globally	Nonlinear panel regression and panel threshold regression	Real effective exchange rate	International reserves, Terms of trade, Financial institution Development, Financial openness	International reserves can act as a buffer against negative real exchange rate

					effects of positive terms-of-trade shocks, especially in countries with low financial institution development. The buffer effect of international reserves is stronger in countries with intermediate levels of financial openness.

2.2 Research questions

Depending on our research topic, aim and assigned variables we can find some research questions below, based on the fact that we aim something in the field of FinTech, good governance, bank performance and exchange rate fluctuation.

1. **How do FinTech innovations affect the profitability, operational efficiency, and customer satisfaction performance of banks?**

This question gauges how far the adoption of FinTech tools such as digital banking, blockchain, and mobile payment systems contributes to the aggregate performance metrics of banks. It aims to show if the integration of technology into banks brings about measurable improvements in financial and operational outcomes.

2. **How might good governance affect the relationship between FinTech adoption and bank performance?**

This question addresses how governance mechanisms, like board transparency, risk management, and ethical decision-making, moderate or heighten the effects of FinTech on banking performance. It seeks to establish whether governance practices reinforce positive outcomes attributed to the adoption of FinTech.

3. **What is the mediating effect of exchange rate fluctuations on the relationship between FinTech, good governance, and bank performance?**

This research question analyzes the degree at which the volatility of foreign exchange rates influences the stability of banks, especially when FinTech innovations and governance mechanisms are at play. It tries to identify whether exchange rate fluctuations act as a catalyst or constraint in achieving improved bank performance through technological and governance interventions.

2.3 Hypothesis development

As I have four research questions/objectives, I will have four corresponding hypotheses:

Hypothesis 1 (H1): FinTech innovations positively affect the performance of banks.

Hypothesis 2 (H2): The relationship between FinTech innovations and bank performance is significantly moderated by good governance.

Hypothesis 3 (H3): FinTech innovations and good governance influence bank performance and exchange rate fluctuations moderate the relationships between them.

Chapter 3: Data and Methodology of the Study

3.1 Theoretical foundation of the study

3.1.1 Fintech and Financial Sustainability

Technology is the financial sector enhancing efficiency and productivity. The process of development in FinTech will have spill-over effects that create an environment for greater efficiency and sustainability in finance. FinTech improves Financial Sustainability through innovation, efficiency, and access to financial services. It promotes sustainable development via digital transformation and inclusive economic opportunities.

According to the technology spillover theory, the adoption of FinTech solutions helps reduce transaction costs (which largely determine economic efficiency) over time through optimized resource allocation, which is enormously necessary for financial sustainability. The positive and negative impacts of FinTech development on financial efficiency are not linear rather it is like a U-shape type: through integration, the pilot will turn into the advantage ultimately Wu, Bai, and Chen (2023), which means that only during the initial acceptance period, its disruptive property may bring uncertainty to future money sustainability.

The Resource-Based View of the firm is a perspective that sees organizations as bundles of internal resources and capabilities that are the main drivers of competitive advantage and performance. It highlights the fact that unique resources can result in better performance.FS and FinTech application: In the case of FS, companies that harnessed specific technology-based capabilities will improve their financial resilience. Utilizing innovative technology allows companies to deliver services in a timely manner, reduce operating costs, and create better engagement with their customers. Well-researched governance structures that manage risks within FinTech companies, in turn focusing on profit making rather than just customer attraction as a long-term strategy, can also facilitate financial sustainability (Ferilli, Altunbas, Stefanelli, Palmieri, & Boscia, 2024).

The agency theory is about stakeholders' conflicts of interest in an organization, between principals (owners) and agents (managers). It emphasizes the need for governance mechanisms to aligned interests. Application to FS and FinTech: Implementation of FinTech can reduce information asymmetries between banks with their stakeholders hence, mitigating agency problem Such as, by improving competitiveness and risk management for banks leveraging FinTech Arena, Catuogno, and Naciti (2023b) the fixed effects of female independent directors have a positive impact on governance. This alignment of interests creates a more sustainable economic landscape where financial decisions reflect stakeholder priority.

The perspectives of institutional theory analysis organizational behavior and practices through the lens of their institutional environments. It highlights the influence of norms, values, and laws on organizational functioning. Changing regulatory frameworks and societal expectations of financial services have supported this trend by both creating new local market opportunities, as well as diminished cross border competitive advantages for FS institutions. When these institutions use FinTech solutions to comply with regulations or consumer demand for both transparency and efficiency, they are creating increased financial sustainability. This

potential of FinTech to improve compliance via innovative solutions is conducive to sustainability in the financial industry (Feyen, Frost, Gambacorta, Natarajan, & Saal, 2021).

3.1.2 Good Governance and Financial Sustainability

Good governance implies the effective, transparent, accountable and equitable management of public resources and institutions. It enables inclusion, compliance with the rule of law, responsiveness, and equitable service delivery that promotes sustainable development. Good Governance simply encourages transparency, accountability and maximum utilization of resources which provide a stable environment for Financial Sustainability. And collectively, they deliver sustained stability, success and strength in economic and business results.

As core themes of this paper, good governance may alleviate agency costs with respect to financial sustainability by inducing managers to act in the best interests of shareholders. Good governance, including independent directors on boards, can improve oversight and accountability, and thus promote long-term financial sustainability. Studies have shown that good corporate governance is related to financial returns because the opportunity for managerial opportunism is reduced and managers/vendors make decisions with higher social standards (Sulimany, Ramakrishnan, Chaudhry, & Bazhair, 2021).

Stakeholder theory states that organizations need to acknowledge the interests of all stakeholders instead of just shareholders when making decisions. FS & GG application: Well-governed entities with frameworks that consider stakeholder perspectives strengthen relationships with customers, employees, suppliers and the community; resulting in better financial sustainability. By putting stakeholder matters into consideration, companies will strengthen their reputation and lower risks that lead to better financial performance. It is a theory that sustains the notion of sustainability benefits all shareholders and the whole society (Sulimany et al., 2021).

The Resource-Based View is the first one, and it shifts the focus to internal factors of firms like resource endowment and unique capabilities as determinants of competitive advantage and firm performance. Applying to FS and GG: Good governance is a kind of resource that may posit as an attribute in building the capabilities for firms towards sustainable financial conditions. With solid governance frameworks in place, organizations are better positioned to utilize their resources effectively, manage risks proactively and create sustainable value. According to this view, high governance firms are able to produce long-term financial results faster (Ozili, 2022).

Legitimacy theory explains that organizations constantly strive to maintain their actions associated with legitimacy by the society in which they operate, also known as the social license to operate. Implementation to FS & GG: According to Aziz, Manab, and Othman (2015), implementing good governance help firms to align their operations with societal expectations and norms making it legitimate. Public trust is key to the financial survival of a company over the long term, and companies that make ethical commitments and are transparent about their actions toward them will have more public support. The relevance of this theory is in corporate governance so that a conducive environment for good business can be created.

Modern Portfolio Theory helps investors find the portfolios that minimize risk for a given return as well as maximize return for a given level of risk through diversification. Application to FS and GG: Good governance can change the risk profile of a firm by introducing transparency and accountability into financial reporting. Additionally, strong governance will assure the investors about management practices hence firms having strong governance can build investor confidence and attract investment. Financial sustainability — the ability to access capital while managing risk effectively is supported by this alignment between good governance and investment attractiveness (Al-Bakri, 2023).

3.1.3 Exchange Rate Fluctuation and Financial Sustainability

Exchange rate fluctuation is the continuous rise and fall of one currency in relation to another currency over time. These increase and decrease heavily based on both the market demand and supply, economics, interest rates, and geopolitical events, which in turn affects the trade, investments, and financial stability. Exchange rate fluctuations have significant impacts on FS, through its costs, revenues, and general financial stability. In enterprises with global reach, for example, the devaluation of the currency can lead to higher costs of imports, squeeze profits, or impair the repayment of foreign-denominated debts. On the other hand, favorable exchange rates provide help with competitiveness and revenues. The relationship between FS and EXf is key to risk mitigation and maintaining financial viability in a global national economy.

Purchasing Power Parity (PPP) explains the exchange rate between two currencies as determined by the relative price of a basket of goods in both countries, assuming no transaction costs or trade barriers. In the concept of PPP, exchange rate movements have an affect on import and export prices in turn affecting a firms pricing policy as well as its profit. A weaker currency means imported goods get more expensive, so profit margins could be compressed unless companies can pass those costs along to consumers. Because a company must manage income and expenses in any financial setting, its relationship with and between customers is significantly important for financial sustainability. This relates greatly with the inflationary pressures that can threaten financial stability as well such as in case of a large depreciation by the country (Krugman, 2009).

The Mundell–Fleming model is a version of the IS-LM model with international trade. In the case of free international capital mobility, the model refers to interest rates, exchange rates and output are related. Application: FS and EXf: This model says that monetary policy cannot affect output under fixed exchange rates, while fiscal policy can. In contrast, monetary policy under flexible exchange rates can affect interest and exchange rates which in turn matters for investment choices and financial viability. This model also provide a footprint for non-residential firms to evaluate the extent by which their bottom lines may be affected due to changes in exchange rate policy (Mundell, 1963). Balance of Payments Theory states that the determination of a country exchange rate is done by its balance of payments position, i.e. the difference between its exports and imports. Application to FX and EXf: Exchange Rate Changes can have a substantial effect on the balance of payments for a country. While a lower currency might stimulate exports by making them less expensive overseas, it can also raise the price of imports. For companies that are international traders, this is a vital issue to cope with for the liquidity of finances. Long-term inequilibrium can cause economic volatility to occur and operate against full market caution as well as investment (Kandil, 2009).

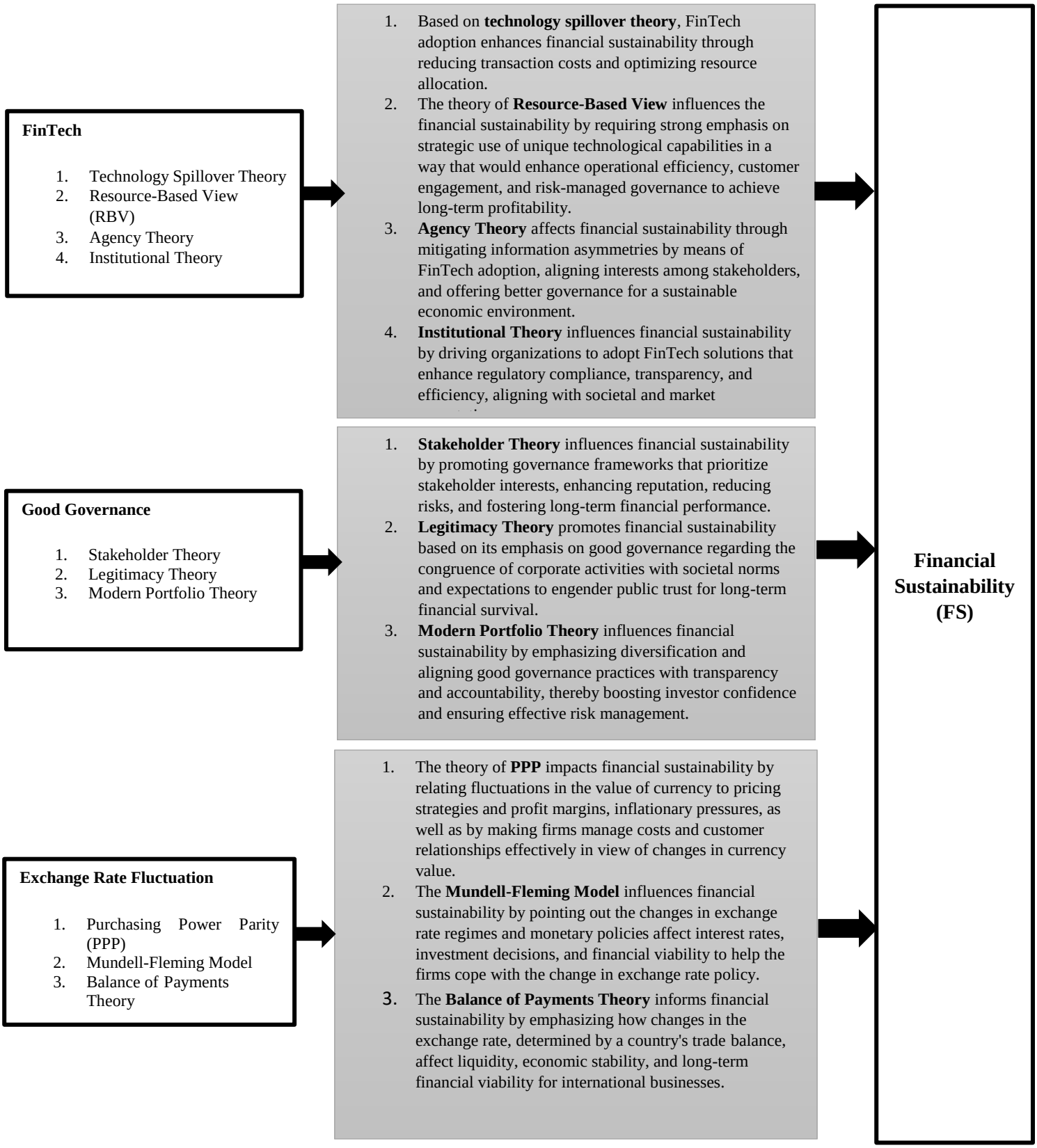

Figure 1: Mechanism Analysis

3.2 Variables Definition and Expected Sign

3.2.1 Financial Sustainability (FS)

According to Putra, Wiagustini, Ramantha, and Sedana (2021), Financial sustainability (FS) is the ability of an organization to generate and maintain sufficient revenues over time to cover both its costs, as well as investment for growth while sustaining a stable financial position. This consists of problems from idea, for example; good revenue-trade generation, acceptable costs and risks control. FS will be critical for an organization to continue functioning and avert serious financial distress or bankruptcy. It underscores the need for a clear vision, allocation of resources, and governance frameworks that ensure some degree of longevity and resilience at times when economies are changing rapidly. Financial sustainability is about being profitable, but it is also the ability to innovate and adapt to market changes for gaining a competitive advantage. Financial sustainability (FS) is a multiple-item outcome that reflects an organizations long-term ability to maintain financial viability and covers numerous contingencies. Financial sustainability can be valued with some keys of the following:

As per Gleißner, Günther, and Walkshäusl (2022), Internal Financing Ratio is one of the measure. This measure indicates how much of the capital expenses are financed by operating cash flow. If this share is higher, it means that the targeted company has a stronger ability to finance investments with internal funds rather than (external) equity financing. The debt-to-GDP ratio is another one. It measures how much public debt exists in relation to the economic output of the nation and is therefore a useful indicator for assessing whether a government can sustainably service its debts without compromising growth. Primary Deficit Index assesses the primary balance of the budget (which excl. interest) as a percentage share of GDP, representing that metric's proximity to sustainability. An indication that revenues exceed expenditures, thus pointing to long-term sustainability, is a positive primary balance.

Putra et al. (2021) identified, Total Revenue Growth Rate where this metric looks at the growth in total revenue over time and shows whether the organization is growing its revenue base. Long term financial sustainability is dependent on a path to sustained revenue growth. Internal Financing Ratio assesses the percentage of capital expenditures financed with internal cash flows rather than through external borrowing. This means that a high internal financing ratio implies the ability to self-financing more and proves low dependence on debt which contributes significantly to financial sustainability. A variety of factors are often used to measure Financial Sustainability (FS), a set of such factors was identified by Kakati and Roy (2021). They are the Net Profit Ratio, an important measure of profitability that expresses the relationship of net income to total revenue, reflecting the overall business performance. The second most important ratio is ROA (Return on Assets) and is an indicator of a company's efficiency to make profits out of its assets. OPM or Operating Margin—the profitability of a company excluding non-operating expenses and taxes. Finally, Cash Flow is a key variable, reflecting a company ability to generate cash from operating activities, which is key to keep liquidity and solvability. This is a meaningful and exhaustive work to formulate a framework to measure FinEnable of financial sustainability.

3.2.2 FinTech

FinTech, or financial technology in full, involves the use of technology to improve and further automate financial services. This generic term would include everything from mobile banking applications to more advanced blockchain solutions. The notion of FinTech, therefore, has been envisioned as a means for enhancing financial inclusion, reduction of costs, and personalization of services for both consumers and businesses. Fintech refers to the new tech that aims to automate and improve the use and delivery of financial services (Leong & Sung, 2018).

Ansari and Sen Gupta (2024) have talked about Customer Acquisition Cost (CAC), which can be used as an important variable for the measurement of FS. The metric considers the total cost related to acquiring a new customer through marketing and sales expenses. It helps assess how efficiently customer acquisition strategies are being deployed. Customer Lifetime Value (CLV) can be another variable denoted by Verdijk (2021). This variable estimates the total revenue expected from a customer throughout their relationship with the company, providing insights into long-term profitability. M. H. Rahman et al. (2024) depicted Churn Rate in respect to FinTech which is the percent of customers who stop using a service within a certain period. The lower the churn rate, the better the retention and satisfaction. Mozumder et al. (2024) and Sireesha Nanduri, Sharma, Manjula, and Lakshmi (2024) have identified Net Promoter Score (NPS) which is a metric that designates customer loyalty in terms of the likelihood of customers recommending the service to others. According to Olabanji et al. (2024), Blockchain and Cyrptocurrency Adoption can be another variable for measuring FinTech. Weng, Tang, Chen, Liu, and He (2024) has referred to Transaction Volume, which is the number of total transactions processed by the FinTech platform. High transaction volume often means high revenue and market penetration. Kamaldeen (2024) stated in African Islamic Bank, Operational Efficiency Ratio where the ratio depicts operating expenses against total revenue, therefore, it reflects the efficiency with which a firm manages costs concerning its income. The lower the ratio means higher the operational efficiency.

The paper of Kamaldeen (2024) investigates the impact of fintech, excluding cryptocurrencies, on financial stability for 198 countries over the 2012-2020 period. Key findings include: Fintech imposes heterogeneous impacts depending on instrument types; two representative instruments are digital lending and capital raising. On the whole, the impact of fintech is assessed to be adverse owing to the predominance of digital lending, though statistically insignificant. In general, digital capital raising has positive impacts on financial stability in advanced economies but negative in developing ones. While still smaller than traditional institutions, fintech is growing rapidly and creates new challenges for policymakers. Another study conducted by Safiullah and Paramati (2024) investigates the impact of FinTech firms on bank financial stability by focusing on 26 Malaysian banks from 2003 to 2018. It also finds that FinTech development enhances bank financial stability. This effect is robust across different bank sizes, types of Islamic and conventional, and levels of corporate governance. The results are robust across various model specifications and measures of both financial stability and FinTech involvement. The paper by Koranteng and You (2024) examines the

impact of Fintech on financial stability in 25 countries from 2013 to 2020, using the volume of fintech-enabled financing. Spatial models are applied to evaluate the spillover effects of financial stability across countries and identify positive spatial dependence in financial stability. Using the Spatial Durbin Model, the results show that Fintech financing positively contributes both to local and cross-border financial stability, particularly in countries with smaller volumes of Fintech and closer proximity. Crowdfunding enhances stability, while consumer lending destabilizes it.

3.2.3 Exchange Rate Fluctuation (EXf)

Changes in the relative value of one currency with respect to another over a period of time are termed as fluctuations in the exchange rate. Such fluctuations form the very basis of the foreign exchange market and significantly affect international trade, investment, and economic stability. Exchange rates may be either floating or fixed.

Interest Rates can be used as one of the variables, which are determined by the central banks and therefore have a significant impact on currency value stated by Rastogi, Kanoujiya, and Doifode (2024). Higher interest rates attract foreign capital, increase demand for that currency, which, in turn, appreciates. Correspondingly, lower interest rates tend to lead to depreciation due to investors seeking better returns elsewhere. As per Boubaker and Mouna (2024), Inflation Rates coulb be another one. Inflation impacts purchasing power and currency value. The countries that have lower inflation rates tend to have stronger currencies because their purchasing power increases in relation to other currencies. High inflation can result in currency depreciation. The other one, which has mentioned by Ridhwan, Ismail, and Nijkamp (2024), is Economic Performance Indicators. Key economic indicators like Gross Domestic Product, employments rate, and consumer spending determined the health of a country's economy. Generally, strong economic performance boosts investor confidence and strengthens the currency. Mathieu (2024) has talked about Political stability. The stability of a country's political environment can greatly influence its currency value. Stable governments foster investor confidence, while political instability can lead to depreciation as investors seek safer assets. Yang and Peng (2024) mentioned the impact of Current Account Balances which reflects a country's trade relations, in one way or another, with other countries. While a deficit-which means importing more than exporting-can lead to currency depreciation, a surplus can strengthen it. Dimitriadou (2024) analyzed the Market Sentiment and Speculation in his study. It can be used as variables to measure the exchange rate because investor perception and speculative activities can create short-run disturbances in the exchange rates. Good sentiment toward a nation's economy will raise demand for its currency, while poor sentiment will lead to sell-offs.

According to the study of Afshan et al. (2024), Exchange rates have a positive impact on financial sustainability, as they promote international trade, market efficiency, and reduce financial risks when managed properly. They contribute to economic stability and sustainable financial practices, especially in conjunction with fintech and digital currencies. However, their

effect does depend on the broader economic context. Contrastly, in another study conducted by Sultana, Rahman, and Zimon (2024), the exchange rate negatively influences FDI in the short run, its influence is positive during the long run, which indicates that the relationship is complex. Economic growth promotes long-term FDI, while inflation negatively influences FDI. External debt, on one hand, has a positive but statistically insignificant influence on FDI. The study of T. A. T. Pham, Nguyen, Nasir, and Duc Huynh (2023) shows that exchange rate shocks can affect inflation significantly, thereby affecting financial sustainability indirectly. With respect to the ASEAN-5 economies, the asymmetric effects of changing exchange rates on inflation may mean that financial stability is disrupted, especially in the short term. This may strain the efforts of maintaining financial sustainability, considering that sustained inflationary pressures gradually oblige monetary policy and efforts for price stability.

3.2.4 Good Governance (GG)

Good governance describes the effective, accountable, and transparent management of the country's affairs and resources to ensure the general interest in development and welfare of its citizens. This involves the processes through which public institutions conduct public affairs and manage public resources, ensuring human rights while minimizing corruption and abuse of power. Good governance refers to the mechanism of handling public affairs with the participation of many institutions and actors outside of government, which requires the involvement of many stakeholders, accountability, and effective use of resources aimed at resolving social and economic problems with sustainability (Keping, 2018).

A variables could be the Rule of law, which is mentioned in the paper of Leogrande (2023). This reflects the extent to which the law is impartially applied and infringements are consistently penalized. Protection of human rights and civil liberties would mean that the legal system is indeed functional, free from any form of corruption. One variable could be the "Transparency," this factor is many times identified from research, like Liambomba (2023)'s work, as a "determinant factor" toward good governance. Transparency refers to how open and comprehensible is the information coming out of a government is for its citizens. It allows the public to be able to receive knowledge about what their government's actions and decisions are. "Consensus-Oriented, as identified in (Halim & Osmani, 2023)'s work, is one such critical factor; it impacts the governance structures and supports financial stability. Good governance strives to arbitrate diverse interests toward a common consensus regarding community objectives. This variable suggests that understanding diverse perspectives is crucial in the making of decisions. Accountability is often linked with good governance, as indeed reflected in the works of Haghighi and Takian (2024)working in this area. Accountability indicates the extent to which institutions are accountable for their acts and decisions before the public and other stakeholders. It is indispensable in ensuring that the conduct of governance is ethical and responsible.

According to Solaymani and Montes (2024), Good governance contributes positively to financial sustainability, as the study identifies that it significantly increases economic growth

while reducing CO2 emissions. In instances of appropriate governance structures, renewable energy use and clean foreign direct investments are at their best, hence driving economic growth into some congruence with environmental sustainability. Good governance also provides the stability needed for managing both financial and environmental challenges. Good governance positively influences financial sustainability, as highlighted in this research by (Yusuf et al., 2024).The findings indicate that factors such as board dynamics, audit committee proficiency, and sustainability disclosures, integral to good governance, contribute significantly to the financial robustness of Islamic banks. This alignment with sustainable principles not only enhances operational efficiency but also attracts investors, thereby reinforcing the stability and growth of financial systems.

3.3 Data and Variables of the Study

Table 2: Data, variables and data sources

Variable	Definition	Proxy	Author	Expected Sign	Possible Data Source
FS (Financial Sustainability)	According to Putra et al. (2021) Financial sustainability (FS) is the ability of an organization to generate and maintain sufficient revenues over time to cover both its costs, as well as investment for growth while sustaining a stable financial position.	1. Internal Financing Ratio 2. The debt-to-GDP ratio 3. Primary Deficit Index	Gleißner et al. (2022)	1. +ve 2. –ve 3. Mixed	1. Company Financial Statements, Government or Industry Databases 2. World Bank, International Monetary Fund (IMF), OECD (Organisation for Economic Co-operation and Development) 3. IMF, WB
		1. Total Revenue Growth Rate	Putra et al. (2021)	1. +ve	WB, IMF, OECD, Asian Development Bank (ADB)
		1. Net Profit Ratio 2. Return on Assets (ROA 3. Operating Margin 4. Cash Flow	Kakati and Roy (2021)	1. +ve 2. +ve 3. +ve 4. +ve	Dhaka Stock Exchange (DSE), Bangladesh Bureau of Statistics (BBS), National Board of Revenue (NBR), WB, IMF, OECD, Asian Development Bank (ADB)
FinTech	Fintech refers to the new tech that aims to automate and improve the use and delivery of financial services(Leong & Sung, 2018).	1. Customer Acquisition Cost (CAC) 2. Customer Lifetime Value (CLV) 3. Churn Rate 4. Net Promoter Score (NPS) 5. Blockchain and Cyrptocurrency Adoption 6. Transaction Volume 7. Operational Efficiency Ratio	Ansari and Sen Gupta (2024) Verdijk (2021) M. H. Rahman et al. (2024) Mozumder et al. (2024) and Sireesha Nanduri et al. (2024) Olabanji et al. (2024) Weng et al. (2024) Kamaldeen (2024)	1. Mixed 2. +ve 3. –ve 4. +ve 5. Mixed 6. +ve 7. +ve	1. Company financial reports, CRM systems (Salesforce), marketing analytics platforms (Google Analytics). 2. CRM systems, financial/sales reports, subscription data. 3. CRM data, subscription services data, exit surveys. 4. Customer surveys (SurveyMonkey), NPS tools (Promoter.io). 5. Blockchain transaction records, cryptocurrency exchanges (Binance,

					Coinbase), industry reports. 6. FinTech company transaction data, payment processors (PayPal, Stripe), industry reports. 7. Company financial reports, public financial statements (EDGAR), ERP systems (SAP, Oracle).
Exchange Rate	An exchange rate is the cost of one currency for another. It is certainly an essential economic variable, which affects trade, investment, and inflation (Williamson, 2009).	1. Interest Rates 2. Inflation Rates 3. Economic Performance Indicators 4. Political stability 5. Current Account Balances 6. Market Sentiment and Speculation	Rastogi et al. (2024). Boubaker and Mouna (2024) Ridhwan et al. (2024) Mathieu (2024) Yang and Peng (2024) Dimitriadou (2024)	1. Mixed 2. Mixed 3. Mixed 4. Mixed 5. Mixed 6. Mixed	1. Central Bank reports (e.g., Bangladesh Bank for Bangladesh) World Bank or International Monetary Fund (IMF) databases 2. National Statistics Offices (e.g., Bangladesh Bureau of Statistics) World Bank, IMF, or Trading Economics 3. Government economic reports (e.g., Ministry of Finance) World Bank, IMF, or OECD databases 4. World Governance Indicators (WGI) Economist Intelligence Unit (EIU) or Transparency International 5. Central Bank publications (e.g., Bangladesh Bank) IMF or World Bank data portals 6. Financial market reports from Bloomberg, Reuters, or major stock exchanges Surveys and reports from investor sentiment analysis platforms.
	Good governance refers to the mechanism of handling	1. Rule of law 2. Transparency 3. Consensus-Oriented	Leogrande (2023) Liambomba (2023)	1. +ve 2. +ve 3. +ve 4. +ve	1. World Justice Project (WJP) Rule of Law Index

Good Governance	public affairs with the participation of many institutions and actors outside of government, which requires the involvement of many stakeholders, accountability, and effective use of resources aimed at resolving social and economic problems with sustainability (Keping, 2018).	4. Accountability	Halim and Osmani (2023) Haghighi and Takian (2024)		Worldwide Governance Indicators (WGI) by the World Bank Country-specific judicial and legal system reports 2. Transparency International's Corruption Perceptions Index Open Budget Index (OBI) by the International Budget Partnership Government publications and policy disclosures 3. Public opinion surveys (e.g., Gallup, Afrobarometer) Reports by UNDP on governance structures Local governance and decision-making forums 4. Worldwide Governance Indicators (Voice and Accountability Index) Auditing reports from independent and government agencies Civil society watchdog reports and public complaint data.

3.4 Estimation Strategies

3.4.1 CSD & Slope Homogeneity Analysis

Cross-Sectional Dependence (CSD) in panel data is caused by correlations between cross-sectional units due to common shocks, spillovers or systems that are interrelated. Not accounting CSD, can yield biased estimates and lead to false inferences (Chelva, 2018). Slope homogeneity checks whether the relations between independent and dependent variables are the same across all cross-sections or vary significantly (Bersvendsen & Ditzen, 2021).

Pesaran (2004) presents a widely accepted method for detecting CSD in panel data, which is an important preliminary step in avoiding spurious results when units are interdependent. Blomquist and Westerlund (2013) present a robust framework for testing slope homogeneity that helps in identifying variations in relationships across units while controlling for CSD. These approaches are complementary and allow for more precise and reliable estimation in complex data settings.

These methods enhance the credibility of empirical findings by considering interdependencies (CSD) and heterogeneity-slope homogeneity. They reduce biases, improve efficiency, and allow more nuanced interpretations of panel data in a way that ensures results are valid and policy-relevant.

The Equation for Pesaran (2004) is as follows:

Equation 1

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \right)$$

Where,

- $\hat{\rho}_{ij}$ = Correlation coefficient between the residuals of units i and j.
- N= Number of cross-sectional units.
- T= Number of time periods.

The Equation for Blomquist and Westerlund (2013) is as follows:

Equation 2

$$\Delta_{HAC} = \sqrt{N} \left(\frac{N^{-1} S_{HAC} - k}{\sqrt{2k}} \right) \sim X_k^2$$

Where,

Δ_{HAC}= The test statistic for assessing slope homogeneity.

N = Number of cross-sectional units.

S_{HAC}= HAC estimator for the variance-covariance matrix of the slope coefficients.

k = Degrees of freedom for the test.

$\sim X_k^2 =$ Indicates the test statistic follows a chi-squared distribution with

k degrees of freedom.

3.4.2 Unit Root Analysis

Unit Root Test is an important step in the process of time series econometric analysis because it help us to find out whether the data is stationary or not. For analysis and prediction based on a time series to do, the statistical properties of the series need to be constant throughout (i.e. stationary). A time series which contains a unit root is non-stationary which can result in spurious results in econometric models. This is typically followed by a conversion of the original non-stationary series to the stationary in order to guarantee robust results (Campbell & Perron, 1991).

The Cross-Sectionally Augmented Dickey-Fuller (CADF) test, Pesaran (2007) is an extension of the traditional Augmented Dickey-Fuller test to panel data with cross-sectional dependence. The CADF test allows for cross-section averages to deal with dependencies between cross sections when unit root tests may be biased due to strong interdependence across cross sections (or individual units), unlike standard unit root tests. Pesaran (2007) The CIPS test (Cross-sectionally Augmented IPS) is a generalization of the Im-Pesaran-Shin (IPS) test which allows for cross-sectional augmentations. This technique deals with the presence of cross-sectional dependence among individual units of the panel and therefore proves more appropriate than other techniques for testing stationarity in a panel data setup containing inter-related time series. CIPS improves the power of the test and lowers the likelihood of spurious results by including averages over cross-sectional data.

CADF and CIPS tests, in addition to being a more appropriate method, also allow crossing others that traditional tests may not. This property promotes even stronger results and increases the reliability of the prediction process when dealing with large and interconnected data-sets. In addition, these tests have significant implications for econometric modeling, as a more detailed characterization of the stationarity properties of panel data enhances the validity of corresponded models and leads to better results in economic and financial research.

CIDF Test Equation:

Equation 3

$$\Delta FS_{it} = \mu_i + \theta_i FS_{i,t-1} + \gamma_i FS_{t-1} + \vartheta_i FS_t + \tau_{it}$$

Where,

- ΔFS_{it}=The change in the dependent variable (FS) for unit i at time t.
- μ_i=Individual-specific intercept for unit i.
- θ_i =Coefficient for the lagged value of the dependent variable for unit i.
- $FS_{i,t-1}$ =The lagged value of the dependent variable (FS) for unit i at time t-1.
- γ_i= Coefficient for the cross-sectional lagged dependent variable.

- FS_{t-1} = The lagged value of the dependent variable (FS) for the cross-section at time t−1.
- ϑ_i = Coefficient for the current value of the dependent variable.
- FS_t = The current value of the dependent variable (FS) for unit i at time t.
- τ_{it} = Error term for unit i at time t.

CIPS Test Equation:

Equation 4

$$CIPS = \frac{1}{N} \sum_{i=1}^{N} CADF_i$$

Where,

- CIPS = The test statistic for determining unit roots in panel data with cross-sectional dependence.
- N= The number of cross-sectional units in the panel.
- $CADF_i$ = The Cross-Sectionally Augmented Dickey-Fuller statistic for the i^{th} unit.

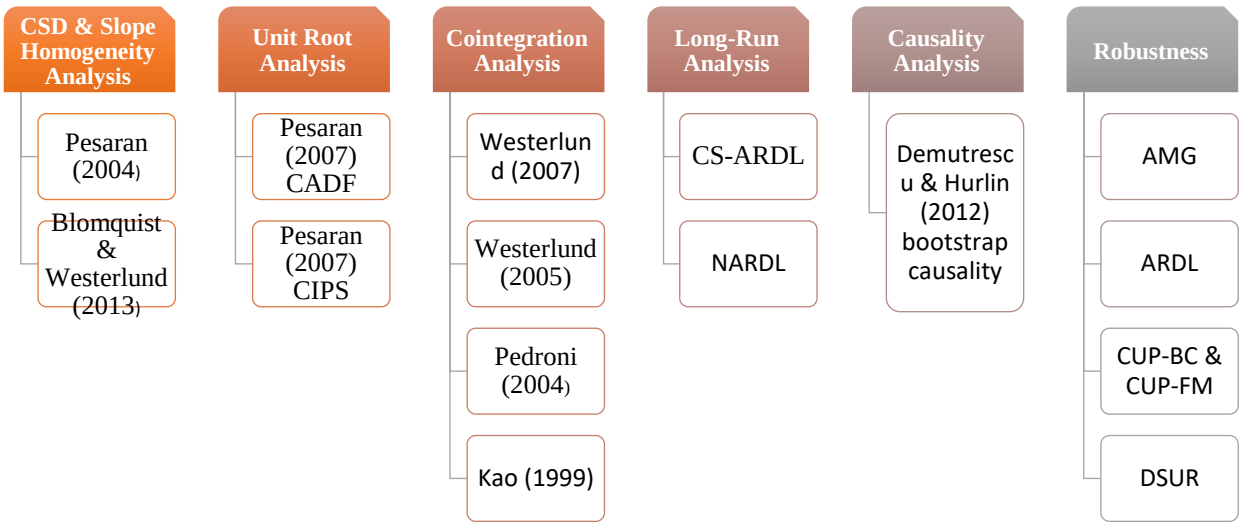

Figure 2: Estimation Strategy

3.4.3 Cointegration Analysis

Cointegration analysis unit root tests explain that two or more non-stationary time series are said to be cointegrated if the linear combination of them is stationary although they are non-stationary in their individual series. If variables are cointegrated, then their trends will follow each other over time; this tells us something substantial about their long-term relationship despite temporary variations (Hendry & Juselius, 2000).

In contrast, Westerlund (2007) deals with heterogeneity and the issue of structural break while Westerlund (2005) extends a conventional bootstrap methods to cross-sectional dependence and show that is robust to complex panel data. Pedroni (2004) allows for

heterogeneity and tests whether between-, as well as within-group relationships exist, suitable for large panels. Kao (1999) treats the data as homogenous and provides ease of use, but it is best to use with smaller datasets only. Westerlund, Pedroni, and Kao provide robust cointegration tests to study long-run relations with panel data. They incorporate heterogeneity, cross-sectional dependence, and structural breaks addressing issues with non-point analytically, producing robust results in the most challenging of datasets. Westerlund tests are able to tackle the issues of structural changes and interdependencies between individuals while Pedroni offers a more flexible panel unit root test with assumed heterogeneous cointegrating relations. Kao is very simple that is it only used for small scale datasets. These methods work together to provide thorough and robust insights related to equilibrium relationships in panel data.

Equation for Westerlund (2007) is as follows:

Equation 5

$$\Delta FS_{it} = \alpha_i + \beta_i \left(FS_{i,t-1} - \theta_i \left(FinTech_{i,t-1} + GG_{i,t-1} + EXf_{i,t-1} \right) \right) + \sum_{j=1}^{pi} \emptyset_{ij} \Delta FS_{i,t-j} + \sum_{j=1}^{qi} \psi_{ij} \Delta X_{i,t-j} + \in_{it}$$

Where,

- FS_{it}= Financial Sustainability (FS), dependent variable.
- $FinTech_{i,t-1} + GG_{i,t-1} + EXf_{i,t-1}$ = Independent variables [FinTech, Good Governance (GG), Exchange Rate Fluctuation (EXf)]
- θ_i= Cointegration vector.
- β_i= Speed of adjustment parameter.
- $\in_{it}$= Error term.

Equation for Westerlund (2005) is as follows:

Equation 6

$$\Delta FS_{it} = \beta_i \left(FS_{i,t-1} - \theta_i \left(FinTech_{i,t-1} + GG_{i,t-1} + EXf_{i,t-1} \right) \right) + \emptyset_{ij} \Delta X_{it} + \in_{it}$$

Where, X_{it}= (*Fintech, GG, EXf*)

Equation for Pedroni (2004) is as follows:

Equation 7

$$FS_{it} = \alpha_i + \delta_i t + \beta_1 FinTech_{it} + \beta_2 GG_{it} + \beta_3 EXf_{it} + \in_{it}$$

Where,

- α_i= Individual-specific intercept.
- $\delta_i t$= Time trend coefficient.

- $\beta_1, \beta_2, \beta_3$ = Conitegration coefficients for FinTech, GG and EXf.
- $\in_{it}$= Residual term.

Equation for Kao (1999) is as follows:

Equation 8

$$\in_{it} = y_{it} - \alpha_i - \beta_i x_{it}$$

Where,

- $\in_{it}$= Residual term which captures the unexplained variation in y_{it} after accounting for the estimated relationship between y_{it} and x_{it}.
- y_{it}= Dependent variable, FS.
- x_{it}= Independent variables (FinTech, GG, EXf).
- α_i=The individual-specific intercept for cross-sectional unit.
- β_i=The slope coefficient representing the relationship between y_{it} and x_{it}.

3.4.4 Long-run Analysis

Long-run analysis focuses on identifying persistent relationships between variables that extend beyond short-term fluctuations. It examines whether changes in independent variables have a lasting impact on the dependent variable, helping to uncover equilibrium relationships that hold over time despite temporary deviations.

The CS-ARDL Chudik and Pesaran (2015) applies when data from various groups (countries or regions) are interconnected, which simply means any change in one group influences others. The technique permits the joint investigation of the short-term impact together with the long-run relationship. NARDL, or nonlinear autoregressive distributed lag analysis, is helpful for long-run analysis, which captures the asymmetric effects of independent variables on the dependent variable through different positive and negative shocks. This aspect is very important for understanding those complex economic relationships that respond differently based on the direction of change-for example, the differential effect of FinTech or fluctuations in exchange rates on financial sustainability.

The CS-ARDL handles the connected data across groups and yields more accurate results in panel studies. It also allows seeing both the short-term and long-term impacts within one analysis. NARDL's advantages include its modeling capabilities of nonlinear and asymmetric effects, along with impacts that lag. It therefore offers a much better description of long-run dynamics. The strengths of this approach are enhanced robustness and explanatory power by considering interactions and nonlinearities of the variables. Together, these methods will help us understand how such factors as FinTech, Good Governance, and Exchange Rate Fluctuation influence Financial Sustainability over time.

CS-ARDL Equation:

Equation 9

$$\Delta FS_{it} = \alpha_i + \sum_{j=1}^{p} \beta_{ij} \Delta FS_{i,t-j} + \sum_{k=0}^{q} \gamma_{ik} \Delta FinTech_{i,t-k} + \sum_{m=0}^{q} \gamma_{ik} \Delta GG_{i,t-m} + \sum_{n=0}^{q} \gamma_{ik} \Delta EXf_{i,t-n} + \emptyset_{i\,\overline{FS_t}} + \epsilon_{it}$$

Where,

- ΔFS_{it}=The change in Financial Sustainability (FS) for entity i at time t.
- α_i=The intercept term that represents the base level of FS for each entity.
- $\sum_{j=1}^{p} \beta_{ij} \Delta FS_{i,t-j}$ = This is the short-run lagged effects of FS on itself over p lags.
- $\sum_{k=0}^{q} \gamma_{ik} \Delta FinTech_{i,t-k}$= Captures the short-term impact of changes in FinTech on FS, including lagged effects up to q periods.
- $\sum_{m=0}^{q} \gamma_{ik} \Delta GG_{i,t-m}$= Models the short-term effects of changes in Good Governance (GG) on FS.
- $\sum_{n=0}^{q} \gamma_{ik} \Delta EXf_{i,t-n}$= Reflects the short-term influence of Exchange Rate Fluctuation (EXf) on
- FS.
- $\emptyset_{i\,\overline{FS_t}}$= Accounts for cross sectional dependence by incorporating the average FS $(\overline{FS_t})$ across all entities.
- ϵ_{it}= Error term.

NARDL Equation:

Equation 10

$$\Delta FS_{it} = \beta_{0i} + \beta_{1t} FS_{t-1} + \beta_{2i} FinTech_{t-1} + \beta_{3i} GG_{t-1} + \beta_{4i} EXf_{t-1} + \sum_{J=1}^{M-1} \gamma_{ij} \Delta FS_{it-j} + \sum_{J=0}^{N-1} \gamma_{ij}^{+} \left[\left(\Delta FinTech_{t-j}^{+} + \sum_{J=0}^{N-1} \gamma_{ij}^{-} \Delta FinTech_{t-j}^{-} \right) \right] + \left[\sum_{m=0}^{q-1} \gamma_{im} \Delta GG_{t-m}^{+} + \sum_{m=0}^{q-1} \gamma_{in} \Delta GG_{t-m}^{-} \right] + \left[\sum_{m=0}^{q-1} \gamma_{im} \Delta EXf_{t-m}^{+} + \sum_{m=0}^{q-1} \gamma_{in} \Delta EXf_{t-m}^{-} \right] + \mu_i + \varepsilon_{it}$$

The decomposition of FinTech, GG, and EXf can be extracted in the following way:

$$FinTech_i^{+} = \sum_{k=1}^{t} \Delta FinTech_{ik}^{+} = \sum_{K=1}^{T} MAX(\Delta FinTech, 0)$$

$$FinTech_i^{-} = \sum_{k=1}^{t} \Delta FinTech_{ik}^{-} = \sum_{K=1}^{T} MIN(\Delta FinTech_{ik}, 0)$$

$$GG_i^{+} = \sum_{k=1}^{t} \Delta GG_{im}^{+} = \sum_{K=1}^{T} MAX(\Delta GG_{im}, 0)$$

$$GG_i^{-} = \sum_{k=1}^{t} \Delta GG_{im}^{-} = \sum_{K=1}^{T} MIN(\Delta GG_{im}, 0)$$

$$EXf_i^+ = \sum_{k=1}^{t} \Delta EXf_{im}^+ = \sum_{K=1}^{T} MAX(\Delta EXf_{im}, 0)$$

$$EXf_i^- = \sum_{k=1}^{t} \Delta EXf_{im}^- = \sum_{K=1}^{T} MIN(\Delta EXf_{im}, 0)$$

3.4.5 Causality Analysis

Causality analysis determines if the change of one variable causes a change of another; it helps determine the one-way direction of influences between factors (Cox & Wermuth, 2004). The panel causality test by Dumitrescu and Hurlin (2012) is designed for heterogeneous panel data, where the individual cross-sections (countries, firms, etc.) may each have different relationships among their variables. The bootstrap method therefore considers cross-sectional dependence and small sample size to provide more robust results.

Dumitrescu and Hurlin (2012) bootstrap panel causality test is robust in the case of panel data and allows heterogeneity across units. It can address cross-sectional dependence. The bootstrap approach ensures that the reliability in small samples can detect unidirectional and bidirectional causality, thus being ideal for the analysis of complex economic and financial relationships.

Causality Equation:

Equation 11

$$FS_{it} = \alpha_i + \sum_{k-1}^{p} \gamma_{ik} FS_{i,t-k} + \sum_{k-1}^{p} \beta_{ik} FinTech_{i,t-k} + \sum_{k-1}^{p} \delta_{ik} GG_{i,t-k} + \sum_{k-1}^{p} \theta_{ik} EXf_{i,t-k} + \mu_{it}$$

Where,

- FS_{it}= Financial Sustainability, dependent variable.
- α_i= Unit specific effects capturing unobservable factors.
- $FinTech_{i,t-k}$ =FinTech lagged by k.
- $GG_{i,t-k}$ = Good governance lagged by k.
- $EXf_{i,t-k}$= Exchange Rate Fluctuation lagged by k.
- γ_{ik}= Coefficients of lagged FS, measuring persistence.
- μ_{it}= Error term for residual effects.
- β_{ik},δ_{ik},θ_{ik}= Coefficients for lagged independents variables, indicating causality effects.

Heterogeneous Non-Causal Test Statistic:

Equation 12

$$W_{NT}^{Hnc} = N^{-1} \sum_{i-1}^{N} W_{i,t}$$

Where,

- W_{NT}^{Hnc}= Panel wide average of causality test statistics.

- N = Number of units.
- $W_{i,t}$= Causality test statistics for each individual unit.

Z-Statistic for Panel Causality:

Equation 13

$$Z=\sqrt{\frac{N}{2P}\times\frac{T-2P-5}{T-P-3}}\times\left[\frac{T-2P-3}{T-2P-}\bar{W}-P\right]$$

Where,

- Z = Standardized test statistic for panel causality.
- N = Number of cross-sectional unit.
- T = Number of time periods.
- P = Number of lags in the model.
- $\bar{W}$= Average causality test statistic across units.

3.4.6 Robustness

Robustness in econometrics refers to the quality of a model to provide reliable and consistent results under different assumptions and conditions, even when some properties of the data or model specifications are not perfectly met. It is a guarantee that the model will behave well in respect to potential problems such as heterogeneity, autocorrelation, or structural breaks (Neumayer & Plümper, 2017).

DSUR stands for Dynamic Seemingly Unrelated Regression, which captures the dynamic interrelationships of several time series variables, especially when there is a presence of correlation across equations. It is useful in dealing with endogeneity and cross-equation dependencies. AMG (The Augmented Mean Group) approach is applied to panel data in order to estimate the long-run relationships, taking into consideration individual heterogeneity. It allows for flexible modeling, accounting for the different characteristics across cross-sectional units. CUP-BC & CUP-FM (Cross-sectional Unit Panel Bootstrapping and Cumulative Panel FM): These bootstrap panel methods make the statistical inferences robust by taking care of cross-sectional dependence and heteroscedasticity, thus making the results more reliable. The ARDL model is applicable for the estimation of both short-run and long-run relationships between variables in small sample sizes. This is very useful in the analysis of cointegration.

These models, while being highly useful, provide a number of benefits in terms of their ability to handle cross-sectional and temporal dependence, allow heterogeneity across units, and accommodate structural breaks in the data. They help produce robust estimates, identify long-term relationships, and detect causality-all essential ingredients of any economic and financial analysis. This enhances the reliability and validity of the research findings and aids sound decision-making and policy formulation.

Equation for DSUR:

Equation 14

$$FS_{it} = \alpha_i + \beta_i FinTech_{it} + \gamma_i GG_{it} + \delta_i EXf_{it} + u_{it}$$

Where,

- FS_{it}= Financial Sustainability for unit i at time t.
- α_i= Intercept for unit i.
- β_i, γ_i, δ_i= Coefficients for the effects of FinTech, GG and EXf on FS.
- $FinTech_{it}$, GG_{it}, EXf_{it} = Independent variables.
- u_{it}= Error term.

Equation for AMG:

Equation 15

$$Y_{it} = \alpha_i + \beta_i x_{it} + \gamma_i \bar{Y}_t + \epsilon_{it}$$

Where,

- Y_{it}= Dependent variable (FS).
- x_{it} = Explanatory variables.
- $\bar{Y}_t$ = Cross-sectional mean of Y.
- α_i, β_i, and γ_i =Parameters to be estimated.
- ϵ_{it} = Error term.

Equation for CUP-BC & CUP-FM:

Equation 16

$$\hat{\beta}_{CUP-BC} = \arg\min \sum_{i=1}^{N} (FS_{it} - \alpha_i - \beta FinTech_{it} - \gamma GG_{it} - \theta EXf_{it})^2$$

Where,

- $\hat{\beta}_{CUP-BC}$= Estimated coefficients for predictors.
- FS_{it}= Financial Sustainability for unit i at time t.
- α_i= Intercept for unit i.
- β_i, γ_i, δ_i= Coefficients for the effects of FinTech, GG and EXf on FS.
- $FinTech_{it}$, GG_{it}, EXf_{it} = Independent variables.
- $\sum_{i=1}^{N}$ = Summation across all units.

ARDL Equation:

Equation 17

$$FS_t = \alpha + \sum_{i=1}^{p} \beta_i FS_{t-i} + \sum_{j=0}^{q} \gamma_j FinTech_{t-j} + \sum_{m=0}^{q} \gamma_{ik} \Delta GG_{i,t-k} + \sum_{n=0}^{q} \gamma_{ik} \Delta EXf_{i,t-l} + \epsilon_t$$

Where,

- FS_t= Financial Sustainability at time t.

- α= Constant term.
- $\sum_{i=1}^{p} \beta_i FS_{t-i}$ = Long-term effect on lagged FS.
- $\sum_{j=0}^{q} \gamma_j FinTech_{t-j}$= Effect of lagged FinTech.
- $\sum_{m=0}^{q} \gamma_{ik} \Delta GG_{i,t-k}$= Effect of lagged Good Governance.
- $\sum_{n=0}^{q} \gamma_{ik} \Delta EXf_{i,t-l}$= Effect of lagged Exchange Rate Fluctuations.
- ϵ_{it}= Error term.

Chapter 04: Estimation and Interpretation

Slope heterogeneity (SH) test developed by Bersvendsen and Ditzen (2021) examine if relationships differ between groups or change over time. Such that for the model it is highly significant at the 1% level (*) on both Delta Statistic (4.6529) and Adjusted Delta Statistic (5.4082) proving the effects of variables are not constant. These results reveal differential effects between groups, suggesting that slope heterogeneity should be accounted for in such analyses.

Table 3: Slope of heterogeneity test

Panel B: SH test of Bersvendsen and Ditzen (2021)			
	Delta Statistic	Adjusted Delta Statistic	SH exits
Model	4.6529***	5.4082***	Yes

As shown in the below mentioned table, the results of all the test variables display a considerable cross-sectional dependence. For all variables, the highest statistics Breusch and Pagan (1980) recorded, with FS being the most dependent variable (346.615), and then EXf (330.299) and the last FINTECH (302.922). This illustrates cross-sectional dependence later confirmed several times over by Pesaran (2004) and Pesaran, Ullah, and Yamagata (2008) although the CSD statistics are of different levels but in general lower in Pesaran (2004). Under the assumption of cross-sectional dependence, the unit root assumptions affect Pesaran (2006) because dependency strength differs across a variable.

While other tests dropped the residuals to lower than statistically significant values, Juodis and Reese (2022) also report significant dependence. FDI, for instance, displays especially high values for the dependency tests, Breusch and Pagan (242.365) and Pesaran et al. (2008) (223.879) across all tests. GG also indicates high dependence in Pesaran (2008) (225.228). Panel level based shocks expressed in global factor, common shocks or general policy effect on all panel units are what results in variability of test results. This highlights the necessity for models that capture these dependences for proper analysis.

Table 4: Cross sectional dependency test

	(Breusch and Pagan 1980)	Pesaran (2004)	Pesaran, Ullah et al. (2008)	Pesaran (2006)	Juodis and Reese (2022)
FS	346.615***	21.051***	235.489***	18.986***	11.2355***
FINTECH	302.922***	21.805***	206.272***	36.226***	11.987***
EXf	330.299***	39.172***	100.586***	38.201***	11.1148***
GG	219.705***	45.913***	225.228***	38.636***	9.3934***
FDI	242.365***	35.513***	223.879***	24.051***	12.0537***
TO	232.768***	37.815***	182.084***	46.001***	8.4177***

Panel Unit Root Tests Results of panel unit root tests show most of the variables are nonstationary at level. Due to this nonstationary regression, results cannot be trusted because it needs to be fixed. But once the first differencing has been applied, we see that all of the variables are stationary, where the associated test statistics are highly statistically significant (*). This indicates that the variables are (1) order integrated.

At their level, each variable is nonstationary, as shown by the panel unit root test results, which implies that their statistical properties may change over time and thus makes the direct regression analysis impossible. For Financial Sustainability (FS), the test statistic is -2.182 at level and moves to -3.187* after the first differencing, thus proving it is stationary. This same conversion occurs for FinTech (FINTECH), with the test statistic going from −1.112 to −3.499, and exchange rate fluctuation (EXf), going from −1.908 to −5.093. It should also be differenced, consistent with Good Governance (GG), changing to -2.565* from -2.522. In the same line, FDI moves from −2.734 to −3.889* and TO from −2.659 to −7.099* after the first differencing. These results show each of the variables is (1)or needs to be differenced for both it and the other variables to be stationary before conducting other tests.

Hence, both variables are following a random walk and their trends must be included in further analysis. First differencing makes sure that we do not end up with spurious relationships and gives a better reliability for regression models.

Table 5: Panel unit root test

Variables	CADF test statistic		CIPS test statistic		Herwartz and Siedenburg - 2008	
	Level	First difference	Level	First difference	Level	First difference
FS	-2.182	-3.187***	-1.237	-5.751***	1.0278	4.1744***
FINTECH	-1.112	-3.499***	-1.58	-2.921***	1.9917	6.9216***
EXf	-1.908	-5.093***	-2.088	-6.062***	1.1813	5.4675***
GG	-2.522	-2.565***	-2.322	-5.944***	0.1171	6.944***
FDI	-2.734	-3.889***	-1.746	-6.602***	-0.0688	5.8748***
TO	-2.659	-7.099***	-2.596	-6.635***	0.9593	4.0698***

The table on panel cointegration test provides the results from the cointegration tests of Westerlund and Edgerton (2008) and Westerlund and Edgerton (2007). Westerlund and Edgerton (2008) test statistics, LMr and LMΦ are statistically significant for all test scenarios (no shift, mean shift, and regime shift) ($P < 0.05$ or $P < 0.01$). This shows that these variables are cointegrated which means that they have long-run equilibrium relationship in presence of the shifts. Particularly for model 1, LMr and LMΦ are still significant and -4.8688 * (no shift), -4.7273* (mean shift), and -3.3095* (regime shift), showing that the variables are cointegrated over time.

In addition, the Westerlund and Edgerton (2007) cointegration test, applying Gt, Ga, Pt and Pa test statistics returns similar but also yeast strong evidence of a cointegrating relationship (results are reported in Table 1). For example, Gt (−12.892), Ga (−15.81), Pt (−15.133), and Pa (-11.487) all show a high significance (P < 0.05 or P < 0.01) indicating that the variables in the model have a long-run relationship. No matter how the cointegration model is specified or what test is run, the results show that the variables have a tendency to co-move in the long run (i.e., the variables are cointegrated).

Table 6: Panel cointegration test

	no shift		mean shift		regime shift	
	LMr	LMΦ	LMr	LMΦ	LMr	LMΦ
Model 1	-4.8688***	-2.5975***	-4.7273***	-3.743***	-3.3095***	-3.0351***
	Gt	Ga	Pt	Pa		
Model	-12.892***	-15.81***	-15.133***	-11.487***		

For Fintech, the coefficients of long-run (short-run) revealed a positive linkage with financial sustainability, indicating the financial expansion with technological innovation foster the degree of sustainability in the financial section. More precisely, a 1% positive changes in FinTech will results in acceleration of FS by 0.0923 %(0.0534%). Our study is supported by the literature of Haddad and Hornuf (2023), Wang and Nor (2022) and da Silva (2022).

As for Exchange Rate Fluctuation (EXf), the long-run coefficient is positive, where a 1% increase of EXf will contribute to a 0.0623% rise in financial sustainability. Yet, in short-term EXf avert financial sustainability as 1% increment diminishes it by 0.0298%. oUR STUDY IS SUPPORTED BY (Aizenman et al., 2024), (Yemi & Nakawooya, 2024).

GG has a positive relationship with long-run and shor-trun coefficients of financial sustainability. The long-run impact of a 1% increase in GG is an improvement of 0.0212% in FS, while the short-run increase is 0.0327%. This portion I supported by the literature of (Athar et al., 2023), (Tashkandi, 2023),(Hoque et al., 2013).

In relation to foreign direct investment (FDI), the findings confirm a significant positive impact on financial sustainability. A 1% increase in FDI results in 0.0584% (long-run) and 0.0571% (short-run) increase in financial sustainability. In contrast, the long-run and the short-run effect of Trade Openness (TO) are both positive. Holding all else equal, a 1% increase in TO increases the financial sustainability by 0.0524% (long-run) and 0.0276% (short-run). Finally, the Error Correction Term (ECT) is significant and bears a negative value (-0.1499), which implies a high adjustment speed to the long-run equilibrium when deviation occurs. That is, approximately 14.99% of the disequilibrium is absorbed/semi–convergence in the short run.

Table 7: Long-run and short-run coefficients: CS-ARDL

	Coefficient	std.error	t-stat		Coefficient	std.error	t-stat
Long -run				Short-run			
FinTech	0.0923	0.0104	8.875	FinTech	0.0534	0.0118	4.5254
EXf	0.0623	0.0084	7.4166	EXf	-0.0298	0.0042	-7.0952
GG	0.0212	0.0085	2.4941	GG	0.0327	0.0072	4.5416
FDI	0.0584	0.0028	20.8571	FDI	0.0571	0.0109	5.2385
TO	0.0524	0.0049	10.6938	TO	0.0276	0.0091	3.0329
C	0.0659	0.0044	14.9772	ECT	-0.1499	0.0053	-28.283
CD test				0.03336			
Wooldridge Test for autoco				0.288124			
Normality test				0.923109			
Remsey RESET test				0.034587			

As for FinTech, the positive ($FinTech^{+}$) and negative ($FinTech^{-}$) shocks have a large pass-through effect in both the long run and short run. Over the long run, a positive change in FinTech increases financial sustainability by 0.1112% and a negative change by 0.1081%. Positive and negative shocks lessen financial sustainability by 0.0517% and 0.0508% respectively over the short-term. This part is supported by (Naser et al., 2024).

With regard to Exchange Rate Fluctuation (EXf), a positive shock leads to drop in financial sustainability — FSD by 0.1117% (in the long-term) and by 0.0292% (in the short-term). A negative shock (EX^{-}) has a greater effect than positive, it plays a role to the long-term, decreasing financial sustainability by 0.1271%, while more conveniently, but not yet fully, an increase in sustainability by 0.011% in the short term. Our study is supported by (Çiçek & Yıldırım, 2024), (Aizenman et al., 2024), (Yemi & Nakawooya, 2024).

In the case of Good Governance (GG), a positive change (GG^{+}) leads to an improvement in financial sustainability with 0.0978% in the long run, while the short-run effect is 0.007%. This finding is supported by (Rashid et al., 2020). The long-run impact of a negative change (GG^{-}) is much more pronounced and enhances financial sustainability by 0.1497%, whereas its short-run impact is insignificant (0.0009%). And it is supported by (Saha & Uddin, 2024)

This is evident by the long-run coefficient of Trade Openness (TO) which negatively decreases financial sustainability at a magnitude of 0.1102%. It reduces financial sustainability by 0.0081% in the short term. Specifically, there is a strong long-run impact when it comes to Foreign Direct Investment (FDI), with a 1% increase having a 0.1506% improvement in financial sustainability. FDI also impact positively on financial sustainability in short run, it increase it by 0.0179%. The ECT is statistically significant at −0.1465, which shows that approximately 14.65% of the disequilibrium in financial sustainability returns to equilibrium in the long-run within one period. As per the table, the Wald tests (W_FinTech, W_EX, and

W_GG) provides evidence to confirm the asymmetric effects being significant for FinTech, Exchange Rate, and Good Governance respectively in both long run and short run.

Table 8: Asymmetric Long-run and short-run coefficients: NARDL

	LONG-RUN			Short-run		
Variables	Coefficient	st.error	t-stat	Coefficient	st.error	t-stat
FinTech+	0.1112	0.0378	2.9417	-0.0517	0.00591	-8.7478
FinTech-	0.1081	0.0324	3.3333	-0.0508	0.00387	-13.1266
EXf+	-0.1117	0.0366	-3.0519	-0.0292	0.00676	-4.3195
EXf-	-0.1271	0.0167	-7.6107	0.011	0.00251	3.984
GG+	0.0978	0.0332	2.9457	0.007	0.00376	1.8617
GG-	0.1497	0.0191	7.8376	0.0009	0.00542	0.166
TO	0.1102	0.0363	-3.0358	-0.0081	0.00346	-2.341
FDI	0.1506	0.0197	-7.6446	0.0179	0.00473	3.7843
ECT				-0.1465	0.027	-5.4259
$W_{FinTecH}$	8.1285			9.8202		
W_{EX}	10.1482			14.0322		
W_{GG}	11.2659			9.911		

Results from the causality test show intricate relationships between financial sustainability (FS), FinTech, exchange rate (EX), good governance (GG), foreign direct investment (FDI) and trade openness (TO). FinTech and EX exert the most influence on FS (Wald test statistics significant at the 1% level), followed by GG, FDI, and TO, which also have influential effects (Wald test statistics significant at the 5% level). In the same way, FS has a positive effect on FinTech, GG, FDI, and TO, suggesting that mutual linkages. The FS and GG, FS and FDI, FS and TO show bidirectional causality which implies interdependent relationship (Caglar et al. 2022). GG, FDI, and TO prove to have a high impact on FinTech, and causality is found to go from FDI and TO to FinTech at a 1% significant level. FS, FinTech, and GG have a notable influence on EX, while the impact of FS and GG is strong. GG is seen to hold causal relationships with all other variables as it affects FDI and TO at 1% significance level. In particular, GG and FDI and TO show a high degree of bidirectional causality, while FS and FinTech have a significant unidirectional effect on GG. These results emphasize the complex and interdependent relationships between the variables in promoting financial sustainability and economic development.

Table 9: Causality test

	FS	FinTech	EXf	GG	FDI	TO
FS		0.9351	(5.9713)***	(5.7098)***	(2.407)*	(2.0467)*
		[0.9856]	[6.2937]	[6.0182]	[2.5369]	[2.1572]
FinTech	(3.1137)**		(2.2274)*	1.5929	(6.0265)***	(4.5334)**
	[3.2818]		[2.3476]	[1.679]	[6.352]	[4.7782]
EXf	1.7024	(3.9638)**		(5.8342)***	1.086	(2.5717)*
	[1.7943]	[4.1779]		[6.1492]	[1.1447]	[2.7106]

GG	(2.1519)*	(2.8299)*	(4.8873)***		(4.6248)**	(3.3846)**
	[2.2681]	[2.9827]	[5.1512]		[4.8746]	[3.5674]
FDI	(2.2497)*	(2.1413)*	(5.3464)***	(5.8512)***		(4.0616)**
	[2.3712]	[2.2569]	[5.6351]	[6.1671]		[4.2809]
TO	(3.2986)**	(5.8714)***	(2.2093)*	(5.4102)***	(5.2125)***	
	[3.4767]	[6.1884]	[2.3286]	[5.7023]	[5.494]	

The results of the robustness test conducted using the MG, AMG, and CS-ARDL estimators prove the reliability of the relationships among the variables in the study. For FinTech, all three models present positive and significant coefficients, while the AMG estimator shows the highest effect with a coefficient of 0.0956 and t-stat of 15.4193. Our study is supported by the literature of Haddad and Hornuf (2023). Exchange rate fluctuation (EXf) consistently presents a negative and significant relationship across models, with CS-ARDL showing the strongest effect: the coefficient is -0.1566 and the t-stat is -17.7954. GG has an inducing effect on financial sustainability, especially in AMG (coefficient: 0.0888, t-stat: 9.7582), confirming its importance. FDI shows a strong positive impact, highly significant in all models, with the highest value of the coefficient for AMG, 0.1228 (t-stat: 58.4761). Our study is supported by the literature of Athar et al. (2023), Molla et al. (2023).

TO also presents a consistent positive influence, especially under AMG, with a coefficient of about 0.1305 (t-stat: 21.0483). The constant terms reflect stability in the models, with AMG having a slightly smaller value (coefficient: 2.2874, t-stat: 2.5401). The models are valid, as confirmed by diagnostic tests such as the CD test, Wooldridge test, normality test, and Remsey RESET test, since all p-values are below 0.05, hence robust and well-specified. These results confirm the consistency and reliability of the relationships among the variables in determining financial sustainability.

Table 10: Robustness test

	MG			AMG			CS-ARDL		
	Coef	t-stat	std.error	Coef	t-stat	std.error	Coef	t-stat	std.error
FinTech	0.0379	0.0115	3.2956	0.0956	0.0062	15.4193	0.0359	0.0093	3.8602
EXf	-0.0736	0.0109	-6.7522	-0.0247	0.0085	-2.9058	-0.1566	0.0088	17.7954
GG	0.0148	0.0109	1.3577	0.0888	0.0091	9.7582	0.0454	0.0069	6.5797
FDI	0.0948	0.0044	21.5454	0.1228	0.0021	58.4761	0.0496	0.0098	5.0612
TO	0.0426	0.0021	20.2857	0.1305	0.0062	21.0483	0.0262	0.0094	2.7872
C	5.1668	1.149	4.4967	2.2874	0.9005	2.5401	5.9459	0.396	15.0148
CD test		0.0229			0.0233			0.0294	
Wooldridge Test		0.0318			0.0321			0.0223	
Normality test		0.0219			0.0256			0.028	
Remsey RESET test		0.0305			0.0267			0.0241	

Chapter 05: Discussion of the Study Findings

Financial sustainability (FS) has become an important goal in the contemporary financial landscape, and the current study highlights the transitional impact of FinTech, quality governance, and exchange rate shocks on FS. Financial technology or FinTech facilitates financial sustainability significantly through various routes, which, in turn, drives efficiency, inclusiveness, and strategic competitiveness in the banking industry. The adoption of FinTech enables banks to leverage the power of digital innovations, simplify operations, and expand into more markets. The contribution of FinTech to FS is basically along the line of operational efficiency, as technologies like blockchain, artificial intelligence, and robotic process automation reduce the time used in processing transactions and operational costs. Additionally, FinTech has fostered financial inclusion through digital payment platforms and mobile banking services, mainly to the unbanked people in developing countries, a factor that drives wider participation in the financial system. FinTech also contributes to enhancing customer satisfaction through personalized services, predictive analytics, and real-time support. Empirically, FinTech has been shown to have a significant long-run and short-run impact on FS, with a 1% increase in FinTech boosting FS by 0.0923% in the long term and 0.0534% in the short term. Asymmetry effects show that, over the long and short run, positive shocks to FinTech increase FS by 0.1112% and 0.0517%, respectively, while in negative cases, FS decreases by 0.1081% and 0.0508% in the respective timeframes. Cointegration tests confirmed a stable long-run relationship between FinTech and FS; causality tests confirm there is a bidirectional relationship, pointing out the contribution of FinTech not only towards FS but also toward governance and FDI. Moreover, its risk management, green finance, and compliance functions make it versatile for sustainable financial growth. Challenges in increased competition to traditional banks, regulatory hurdles, and potential risks require strategic adaptation in a bid to harness its full benefits. Finally, FinTech is equipping banks with the needed agility and innovation to compete in an ever-changing financial landscape and thus lays a foundation for sustainable finance.

FinTech is a double-edged sword; impact of FinTech on the performance of banks has both positive and negative effect. On a different note, research has highlighted the fact that through improved operational efficiency, enhanced customer service and increased profitability, FinTechs can greatly contribute to financial performance. For instance, Haddad and Hornuf (2023), da Silva (2022), Wang and Nor (2022), and Karthika et al. (2022) found that the integration of FinTech also improves performance and supports the concept of financial inclusion. For example, Kharrat et al. (2024), found that the development in FinTech has a positive impact on bank performance in MENA region.

This evidence was further supported by Naser et al. (2024) and Ajouz et al. (2024), who mentioned that FinTech innovation enhances strategic competitiveness and financial stability. These positive results are also consistent with empirical findings on the long run and short-run significant effects of FinTech on FS, where a 1% increase in FinTech results in a 0.0923% rise in FS in the long term and a 0.0534% increase in the short term. Confirming that there is a long-run relationship between FinTech and FS are cointegration tests by Westerlund and

Edgerton (2008). Asymmetrical effects present that positive shocks to FinTech result in an increase in FS by 0.1112% in the long run and 0.0517% in the short run, while negative shocks lead to a decrease in FS by 0.1081% in the long run and 0.0508% in the short run. This, therefore, justifies the view that FinTech has a significant and positive impact on bank performance; this is also evidenced by causality tests which show that there exist bidirectional relationships between FS and FinTech, which shows that FinTech contributes significantly to economic growth as well as influencing governance and foreign direct investment.

However, its impacts are not all positive on traditional banking. For example, the studies conducted by Haoliang et al. (2024), Qi et al. (2022); Shu and Hong (2023) showed that FinTech can reduce profitability and even market share for traditional banks because of increased competition and broken business models. More precisely, Shu and Hong (2023)pointed out the negative impact of FinTech on the profitability of commercial banks in China. Similarly, Qi et al. (2022) indicated a U-shaped relationship that would mean initial negative impacts on the market power of banks before possible long-term benefits. Moran (2020) and Vives (2017) also reflected on competitive threats and regulatory pressure created by Fintech. Additionally, Sajid et al. (2023) observed that FinTech might drive banks to take on more risk because of the higher operational efficiency it enables. As such, these findings suggest the dualistic nature of FinTech impact and the necessity for strategic adaptation by banks to cope with both the positive and negative impacts concurrently and remain competitive in a rapidly transforming landscape. Therefore, our findings support these opinions because the adoption of FinTech gets banks the timely action and innovation needed to adjust to the changes in the market condition. It emphasizes the importance of underlying technological development towards the emergence of sustainable finance particularly in developing economic context.

Our study provides the rationale for both direct and non-direct evidence of the GG effects on the performance of the Financial Sustainability (FS). Research indicates that strong governance frameworks are important drivers of above-average FS outcomes and provide substantial stability and growth. Like the results from Athar et al. (2023), indicating that the increase of the quality of some governance mechanisms in banks can bring productivity gains, thus linking governance mechanisms to bank performance. This firm belief is further supported by Molla et al. (2023) which reveals that board size is positively affecting accounting performance, therefore indicating that governance structures are necessary in providing managers better control and management. The study by Tashkandi (2023) further showed that Shariah board size in Islamic banks had a positive effect on performance, thus underlining the importance of governance structures in enhancing bank operations.

The influence of good governance is found to be a critical factor in financial sustainability through various means, such as maintaining stability, resilience, and efficiency in the financial systems. The Slope Heterogeneity Test proves that its impact is context-dependent. While nonstationarity was apparent on the first order of this series, the first differenced series were indeed stationary; thus, the Cointegration Tests showed evidence for the robust long-term relationship between GG and FS. Empirical evidence indicates that a 1% increase in GG improves FS by 0.0212% in the long run and 0.0327% in the short run, thus

underlining its crucial impact. The asymmetrical effects, on the other hand, show that while positive governance shocks (GG^{+}) improve FS by 0.0978% in the long run with little short-run effects, negative shocks (GG^{-}) lead to a higher improvement of 0.1497% in the long run, though short-run effects are still negligible. That also infers that even negative conditions for governance can afford avenues of long-term improvement upon being mitigated suitably. The analyses of causality evidence unidirectional and bidirectional relationships between GG and FS, suggesting that mechanisms of governance affect FS directly, but they also affect other wider indicators of the economy, such as FDI, TO, and EX.

These findings support prior research that emphasized governance frameworks, such as board size, audit committee effectiveness, and ownership structures, in enhancing performance and stability. In general, GG proves to be a cornerstone for sustainable financial systems, which demands adaptive and forward-looking governance policies that not only strengthen immediate performance but also ensure resilience and stability in the face of evolving global financial challenges. Statistical analyses across various studies support these claims with empirical evidence. The results of the Slope Heterogeneity Test indicate non-constant effects across different groups, showing that the impact of good governance mechanisms can vary by context. The Panel Unit Root Test showed that while data at the level was nonstationary, it became stationary after first differencing, confirming the appropriateness of the analysis. Cointegration tests, particularly those by Westerlund and Edgerton (2008) , confirmed the existence of a long-term relationship between GG and FS, suggesting that good governance has a sustainable positive impact on financial systems. The coefficient impact analysis reveals that a 1% increase in GG results in a 0.0212% improvement in FS in the long run and a more pronounced 0.0327% increase in the short run, emphasizing that strong governance mechanisms contribute to financial system performance.

Asymmetrical effects show that positive shocks to GG result in a long-run increase in FS by 0.0978%, although this effect is insignificant in the short run, while negative shocks result in a more substantial long-run impact of 0.1497%, with short-term effects again being insignificant. This finding is in line with the research work of Hoque et al. (2013) and other related studies that indicate that board size, audit committee effectiveness, and ownership structures are crucial for stability and performance improvement. The causality tests also revealed that GG has a significant unidirectional and bidirectional causality with FS in influencing FDI and TO for EX. The findings are in tune with those of Rashid et al. (2020), and the study by , Saha and Uddin (2024) emphasized that corporate governance is vital for productivity and performance in banks.

The study would, therefore, confirm the hypothesis that good governance is essential in the efficient performance of financial systems, and indeed, several empirical studies have supported the positive nexus between governance practices and improved performance. However, the nuanced effects whether these are positive or negative shocks—underline the need for suitably calibrated governance policies with the potential to adapt in different scenarios and strengthen the resilience-performance nexus of financial institutions.

Exchange Rate Fluctuation (EXf) has a significant impact on the performance of FS, as supported by our study and empirical findings. EXf significantly affects FS, as revealed by empirical and literature findings. The slope heterogeneity test indicates that the estimated effects of changing exchange rates are not constant across different contexts, which are significant. The series is nonstationary at level but becomes stationary after first differencing, as confirmed by the Panel Unit Root Test, with a test statistic of -5.093*. Cointegration tests of Westerlund and Edgerton (2008 and 2007) confirm the existence of the long-run relationship between EXf and FS. According to the results, the response of a 1 percent increase in exchange rate fluctuations increases FS by 0.0623 percent in the long run, implying that there are profitability-enhancement effects, while the short-term effect is negative, in that FS decreases by 0.0298 percent. The asymmetric effect reveals that the positive shock (EX^{+}) decreases FS by 0.1117% in the long run and 0.0292% in the short run, while the negative shock (EX^{-}) has a more significant long-term negative effect on FS, decreasing it by about 0.1271%, though with a slight 0.011% increase in the short run. Causality analysis confirms a strong bidirectional relationship between EXf and FS, and vice versa. What's more, the significant interaction of EXf with good governance (GG), foreign direct investment (FDI), and trade openness (TO) also demonstrates how complexly intertwined different macroeconomic factors are and their role in sustaining financial performance.

This uncertainty currently provides a strong rationale to both policy makers and risk managers to explore the means of maximizing the benefits from exchange rate variations whilst minimizing the costs to financial soundness. In their study, Çiçek and Yıldırım (2024) showed the aggregate volatility factors along with structural break in financial models and discovered a high sensitivity of private banks to domestic interest rate shocks in Turkey, while a lack of sensitivity about the public banks. Similarly, Yemi and Nakawooya (2024) a higher foreign exchange rate was positively related to profitability in Nigerian banks, inferring that currency devaluation raises profitability through foreign exchange trading. Their argument is supported by a similar study conducted by Lagat and Nyandema (2016), focusing on Kenyan banks and revealing that the depreciation of the exchange rate increased their return on equity and per-share earnings. Kush (2022) listed economic stability, monetary policies, and trade competitiveness as some key determinants of Ugandan banks' financial performance. While Keshtgar et al. (2020) noted that volatility in the exchange rate had a negative implication on Iranian bank profitability while the same factor positively affects loan-to-deposit ratio and became a two-edged sword wherein volatility increases credit risk while the same at the same time drives liquidity adjustment.

Furthermore, Gaies et al. (2019) established that stable exchange rates, institutional quality, and economic growth significantly reduce banking crises in developing countries, while Aizenman et al. (2024) showed that international reserves buffer the negative impacts of terms-of-trade shocks on exchange rates, especially in underdeveloped financial systems with moderate capital flow exposure. Empirically, the variable effects of exchange rate fluctuations are non-constant (significant slope heterogeneity at 1%), the series are nonstationary at level but stationary after first differencing (test statistic: -5.093*), and cointegration is confirmed (Westerlund and Edgerton, 2008 and 2007). A 1% rise in EXf leads

to a 0.0623% increase in FS in the long run, supporting results which indicate that exchange rate depreciation has profitability-enhancing effects; the short-run effects are a decline of 0.0298%, indicating short-term volatility challenges. EX^{+} shocks have reduced FS by 0.1117% in the long run and by 0.0292% in the short run, while the EX^{-} shocks result in a more pronounced impact on FS in the long run, reducing it by about 0.1271%, while increasing by about 0.011% in the short run, all consistent with studies emphasizing liquidity adjustments. Causality analysis indicates the presence of strong bidirectional causality between EXf and FS, as well as significant interaction with governance, FDI, and trade openness, in line with evidence of interrelated macroeconomic stability. Collectively, these findings imply that EXf provides an opportunity for profitability, as well as risks, for which governance, sound monetary policies, and appropriate reserve management become relevant in order to alleviate adverse effects and improve FS performance-a fact that imparts important lessons to policy makers and financial institutions that are facing complex exchange rate dynamics.

Chapter 06: Conclusion and Policy Suggestion

6.1 Conclusion

It highlights that the FinTech, good governance, and exchange rate fluctuations are more relevant than before to financial sustainability game with a basket of opportunities and challenges offered for the banking industry for Management. FinTech thus play a significant role in positively influencing FS through improved operation efficiencies, weathering of financial inclusions, and digitization innovation of mobile banking and AI with improved customer satisfaction. Certainly, FinTech has a huge opportunity ahead but it could also become a new challenger to traditional banks and a new challenge in the area of regulation and risk management. Fin Tech bankers to develop strategies that effectively answer to these challenges having been presented with both an opportunity and challenge they must now strategically position themselves against to gain sustainable growth and remain competitive. The third is good governance that is also important for FS as it brings stability, resilience, and responsiveness. The research indicated effective board structure and oversight as key components of a robust governance framework can drive long-term financial performance but the financial benefits may not always be immediate. Good governance practices make sure that banks operate efficiently, manage risk properly, and adjust favorably to market changes to sustain them in the long-run. Although several of these practices do improve financial performance; they can erode trust and stability that have been invested into a financial system. FS is mainly affected by exchange rate fluctuation that is not so complicated as well. The results showed that although the depreciation of exchange rates ultimately raises the profitability of banks, the short-term FS often declines; It creates a liquidity risk. Although positive exchange rate shocks can be quite beneficial, the dangers of negative shocks are high and should be monitored closely. The findings indicate that good governance, sound monetary policies and effective reserve management are the most crucial factors when it comes to minimizing the risks of exchange rate volatility and capitalizing on the potential positive impact. This study therefore emphasizes the need for financial sustainability to exercise balance in developing financial service sectors that integrates technological innovation, good governance and sound risk management through a tripartite assessment function. Banks and policymakers need to join forces to establish an environment conducive to capitalizing on the benefits of FinTech while complementing it through reinforcing governance frameworks and as necessary, exchanging rate risks. This would allow financial institutions to be more resilient against shocks, capture opportunities, and mobilize resources towards sustainable growth. The data suggest that evolving flexibility and new strategies are needed that will negotiate a transition of the financial landscape in a piece of work that permanently embeds these changes within the banking sector with the aim of long term stability and resiliency.

Some critical gaps found in our study that need to be addressed to improve financial sustainability are outdated regulations that are struggling to keep pace with rapid developments within the FinTech sector, thereby hindering innovation and regulatory oversight. The lack of accessibility together with low financial literacy aggravates inequality, hindering broad

financial gain access to amongst the marginalized population. Disruptive FinTech can exert more pressure on the profit margins of traditional banks, making strategic adaptation an imperative. Furthermore, poor governance practices undermines stability and effectiveness of financial system. Additional risk factors include exchange rate volatility that mood into destabilizes stability without a strong enough beginning health response. Unmet needs in coordinating financial and macroeconomic policies generate fragmentation through attempts to manage challenges with incompatible objectives. Vulnerabilities of digital security and inadequate data protection erode trust in digital finance even more, preventing consumer adoption and invalidating the foundation of financial flows. The last challenge is to balance between short-term and long-term policy measures, which results in policies that may solve the immediate issues but do not establish the conditions for sustained growth and long-term stability. Addressing these missing pieces of information is fundamental to creating an enabling stable, inclusive and adaptive financial ecosystem.

6.2 Policy Suggestion:

1. **Development of Regulatory Frameworks for the Integration of FinTech:** The growth of FinTech requires new approaches from governments and other regulators in terms of flexibility within the frameworks they operate, but with a sound financial system in mind. They should make it safe for digital innovation without deterring competition. Through the regulatory sandbox, startups can test their solutions in a controlled environment. Regulatory framework should be efficient in streamlining FinTech innovations, such as blockchain, AI, and mobile banking, to make financial operations more seamless, and decrease transaction costs, and boost financial inclusion, primarily in the unbanked regions. This will foster innovation, support financial sustainability and attract domestic & foreign investments (Freij, 2018).

2. **Improving Inclusive Finance and Financial Literacy:** More attention should be given to financial literacy and digital access, especially in developing countries. Meaning they should invest into educational programs that educate people about fin technology, its benefits, and appropriate use. Governments could also work together with FinTech companies and NGOs to design outreach programs to unbanked communities about financial services that enhance magnitudes of economy and stability (Grohmann, Klühs, & Menkhoff, 2018).
3. **Governance for sustainable finance through enabling environment:** Governments must incentivize financial institutions to adopt robust governance at par with international standards. This will include having independent audit committees, diversified boards, and a reporting structure that also promotes transparency. The legislation could specify governance audits, structure of the board & audit committee ensuring accountability, and performance improvement. Stability and resilience are therefore underpinned by a robust governance framework which helps the financial institutions to absorb economic shocks and contributes to long-term financial sustainability (Bhatnagar & Sharma, 2022).

4. **Risk Management and Exchange Rate Stabilization:** Effectiveness of any risk management practice to mitigate adverse consequences of exchange rate volatility is subject to enabling policies. It would imply that the central banks need to have well-planned strategies in diversifying their reserves and to hedge by financial instruments. Monetary policies should be flexible, linking interest rates and liquidity provisions to conditions for dampening volatilities and stabilizing the economy. These consist of the exchange rate coverage policy managed by governments and the administration of international financial institutions to support better economic forecasting in an effort to buffer against future financial crises (Van Wijnbergen, 1986).
5. **Incentivizing Cross-Sector Collaboration, Public-Private Partnerships:** The government must create a public and private partnership model for innovation while building viable, sustainable financial systems. This may include collaborating on technology infrastructures, conducting joint research efforts, and co-developing risk management tools. This collaboration and especially the synergies between both sectors contributing their knowledge and resources should lead to holistic solutions to address the difficulties in the financial system and make it more resilient (Cankar & Petkovsek, 2013).
6. **Introduce Green Finance and Sustainability Incentives:** As financial sustainability occurs, policymakers should explore the use of tax reliefs, subsidies and grants for sustainable projects and investments so as to create incentives for investors do green finance or eco-friendly investment. We should promote Green Bond and Sustainability-Linked Loan to align eco-friendly growth. To meet this ambition to unlock that true potential of FinTech as an integrator of sustainability tracking into financial services for ESG criteria reporting which translates into informed and responsible decisions for financial institutions and investment managers; signifies sustainability due-diligence locations carrying real and alternative data; drives data driven sustainable investment practices and capital allocation around the globe; thus impacting sustainability metrics driving the global economy (Tan, Sun, Chen, & Chen, 2021).
7. **Data protection and cybersecurity policies should be improved:** With the growth of digital services, consumer data and cybersecurity should be a policy priority. But governments need to mandate data protection regulations to ensure banks are required to use state-of-the-art cybersecurity technology. That could comprise compliance requirements that secure personal and monetary information over storage, processing, and transfer. Better security policies will naturally build up consumers' trust in digital financial services development and drive them to adopt them more, contributing to financial stability (Raul, 2021).
8. **Balancing the role of FinTech and Traditional Banks:** Policymakers must find ways to balance between competition and enablement between the traditional banks and FinTech sectors, fostering collaboration and innovation without allowing the banking system to be broken down by the new entrants. This may include creating joint innovation centers that allow traditional banks and FinTechs to work together on financial access and efficiency programs. Updated regulations may also spur banks to use new technologies to improve their service and reduce operational costs without reducing their margins (Magdy, Raouf, & Al-wakeel, 2023).

9. **Integrating the Management of Exchange Rate:** Exchange rate management should be integrated with policies for economic growth, recognizing the inter-relationship between exchange rate variability and financial sustainability. Thus central banks have to use foreign reserves to cost-allocate buffers as protection against abrupt currency depreciation. An integrated approach involves the coordination of strategies and policies including fiscal and trade interacts. Transparent communication and well laid out strategic policy announcements can also help to eliminate market uncertainties and induce stability (Mussa et al., 2000).
10. **Need of Strong Monitoring and Evaluation Assessment Systems:** Continuous measurement of the impacts of policies on financial sustainability should be an integral part of public policies. Such mechanisms should ensure data collection, analysis and reporting focused on key performance indicators that measure impact of policy interventions. Regular updates and adjustments on these assessments would allow for timely policy responses to the challenges and opportunities that lie ahead (Lopez-Acevedo & Krause, 2012) .
11. **Promoting Adaptive Governance and Responsive Policies:** Considering the ever-changing financial world, governance policies must be adaptive and responsive to new challenges. Which means adding flexible legislative processes which can be rapidly adapted to when major changes are happening. Policies, for instance, should allow for changing financial practices and regulatory dynamics in order to avoid systemic risks during an economic crisis or a technological disruption (Brunner, 2010).
12. **Diversification of the financial system:** Policy and regulatory authorities would promote diversification in financial products and services to avoid over-reliance on a single financial model or technology. Meaning that there may have to be a combination of both traditional and electronic financial service offerings with diversified risk and organizational structures. If an economy is shockproof, it increases its chance of longer-term stability, and a diversified financial system can become shockproof (Zhou & Li, 2019).

If well applied, these policy recommendations will give governments the enabling framework for guaranteeing financial sustainability. It would also mean that financial institutions are rendered more resilient, and real inclusive growth with stability, following the rapid technological changes, economic uncertainties and global financial challenges, becomes a reality.

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