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# Digitalization and Financial Stability: A Comparative Analysis of Islamic and Conventional Banks in Pakistan

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## Abstract
Digitalization has a significant effect on the financial stability of Pakistan's banking sector. This study analyzes the influence of digitalization on financial stability in Pakistan, comparing Islamic and conventional banks. Using empirical data, it highlights how digital technologies influence risk management, operational efficiency, and overall financial performance. The results provide valuable information for policymakers and banking professionals aiming to strengthen financial stability through digital transformation. In particular, researchers have found that increasing digital channels tends to improve the financial stability of conventional banks, in line with the view that diversifying and efficient digital operations build resilience. In contrast, Islamic banks experience a modest decline in financial stability with rising digitalization, likely due to their promising digital platforms and the distinctive risk-sharing structure of Islamic finance. In sum, the findings indicate that digitalization supports profitability and stability in Pakistani banks, while technology and macroeconomic variables influence Islamic and conventional banks differently.

***Keywords:*** *Conventional Banking, Islamic Banking, Digitalization*

***JEL Classification:*** *G21, O33, Z12*

## 1. Introduction

Digitalization is revolutionizing the banking sector of Pakistan, impacting both conventional banks and Islamic banks. By improving efficiency, risk management, and customer services, digital tools play a pivotal role in strengthening financial stability. The related study brings a comparative evaluation of how digitalization affects financial performance and resilience in Pakistan's dual banking sector, offering insights for regulators, policymakers, and banking professionals. According to prior research, the integration of advanced technologies such as cloud computing, AI, blockchain, and big data in the banking industry has modernized financial services. This fast paced digitalization creates considerable challenges related to data privacy and cybersecurity. Most banks struggle to ensure data privacy and cybersecurity as they implement new technologies, evolving compliance management, vendor risk management and enhancing management of risk (Kawimbe & Kwalombota, 2024). Conventional banks are also involved in business and financial transactions such as currency trading and speculative derivatives, which involve more digital transactions. Additionally, conventional banks can also benefit from digitalization by offering the use of credit card transactions.

According to Devan et al. (2023) and Aro (2024), the use of AI-driven analytics and big data enables banks to decrease major operational expenses to improve targeting in lending and financing, and ultimately strengthen both performance and stability. Moreover, banks and other financial institutions are beginning to adopt blockchain-based digital identities to authenticate individuals, further streamlining customer verification processes. These developments in the recent era signify a broader shift towards advanced digital infrastructure, reinforcing the relevance of studying how such technologies influence the

stability of conventional as well as Islamic bank in Pakistan. Despite several advantages, digitalization has a few drawbacks (Chaimaa et al., 2021). For instance, in Ukraine, the fintech companies offer financial products that are less complex, more adaptable, versatile, and available to clients at any time. However, digitalization now poses a risk, as the concept of the bank as a physical location becomes less relevant, leading to a reduction in the number of branches (Zabala Aguayo & Ślusarczyk, 2020; Balkan, 2021). This directly reduces the required staff in the bank, along with the need for them to realign their knowledge and skills to meet the new demands of the evolving technology-driven landscape.

Globally, the banking system has gone digital, and banking operations now touch almost every aspect of human activity. Whether we are checking our funds, making online purchases, or applying for loans, we anticipate the same secure and personalized involvement, so it is not unusual to learn that delivering a great advanced encounter has become a necessity for today's banks. Digitalization of the banking infrastructure is the delivery of banking services fundamentally through electronic channels instead of in-person branches (Kaur et al., 2021). This does not naturally rule out computerized banks from having a physical presence where they can operate.

Similarly, greater digital transactions improve overall banking stability (Kasri et al., 2022). Adoption of the advanced technology is associated with new risks like cybersecurity risk (Putrevu & Mertzanis, 2024) whereas technological advancement intensifies the competitive environment in the financial industry (Carbó-Valverde, 2017). On the other hand, it can also raise financial stability concerns (Vives, 2019). The relevant banking literature regarding the impact of digitalization on the performance of conventional banks and Islamic banks remains limited, mainly in the context of Pakistan. Although researchers have examined these areas, country-specific studies, especially comparative analyses, are still scant. To sum up, the adoption of advanced technologies is rapidly shaping the future of the economy and Pakistani banking industry, but their net effects on conventional and Islamic banks' stability are not yet clear. By providing empirical insight into how digitalization influences both conventional and Islamic banking systems in Pakistan, this research will help to fill this gap.

The Pakistani banking sector has enormously gone through the adoption of advanced technology in the last two decades in many ways, for instance, through mobile banking Fintechs integration, and including internet platforms. However, the digital banking instruments are believed to augment efficiency and account holder contact; it is unclear whether these instruments equally benefit both conventional and Islamic banks, as they have different service models and operating principles. There is a need to empirically investigate whether digitalization constantly contributes to financial stability in both banking systems across Pakistani banks.

Finally, digital transformation is considered to improve transparency, make operations more efficient, and reduce costs and scams, which contributes to financial stability. Nonetheless, they may introduce the banks to new operational risks, for instance, cybersecurity threats, national as well as across the globe, and liquidity mismatches, which could weaken the overall soundness of the financial sector of a country. In light of the fact that both banking system have variation in their capital structure, sharing of risk mechanisms, and compliance frameworks, it is important to assess whether digitalization strengthens or weakens their financial stability (Khandelwal & Aljifri, 2021).

Banks digitalization is widely acknowledged as it has great potential to strengthen the management of liquidity and risks. As digitalization has many benefits, it also brings challenges. Concerns are growing about whether the transformation of digitalization makes banks more susceptible to different types of risks, which include account hacking, fraud, IT-related threats, and operational risks.

Moreover, banks face difficult situations in implementing digitalization due to lessen expertise and skilled professionals. It is imperative to explore how both banking systems respond to these risks induced by digitalization, given the intrinsic differences. Exclusive challenges of Islamic banks, such as Shariah compliance risk, which could further impact the outcomes of digitalization. Therefore, it is imperative to check whether the digitalization effects vary across both banking system, particularly in the context of financial stability.

This paper investigates the effect of digitalization on the stability of both Pakistani banking systems. As financial sectors, especially the banks are more and more transforming its operations to digital platforms, for instance, fintech services, mobile banking, mobile wallet, and other online platforms, it becomes vital to empirically investigate whether these advancements add significantly to financial stability and efficiency. The major goals of this paper are to examine influences of digitalization on the financial stability on both banking types (Islamic and conventional) in Pakistan.

The research objectives mentioned above are the basis for the support of the development of research questions in this paper. These questions are used to investigate the connection between digitalization and a variety of aspects of both types of Pakistani banks' financial stability. This study has remarkable policy relevance to both types of Pakistani banks. This paper offers empirical findings on how digitalization influences the financial stability of Islamic and conventional banks in Pakistan. Understanding its influence on bank's financial stability is crucial for policy authorities, managers, including customers, depositors, investors, academicians, and researchers. Particularly, these empirical findings are significant for Islamic banks, which normally operate with a much stringent structure of compliance and requires digital approach that must be aligned with Islamic law.

Similarly, as it is well accepted that the implementation of digitalization requires extra cost and human expertise, and there are some other risks, specially IT related risk and other banking frauds, banking-related scandals are also more closely related to the whole digitalization process than it is very likely that the banks become more vulnerable. These findings may have direct implications for economic and financial inclusion, such as providing access to financial products, particularly those excluded earlier, and increasing the availability of credit to individuals, which ultimately leads to financial stimulus and economic growth in Pakistan. In addition to that, the empirical intuition can provide the SBP and decision makers in restructuring differentiated digital banking guidelines and regulations for both types of banking system on the basis of their explicit needs and technology readiness. However, if the process of digitalization is related to more financial stability of both banking system, then, for achieving overall financial system stability, government can focus on making a policy that favors digitalization in the banking industry.

This research work offers empirical findings that provide support for reshaping risk-management policies aimed at upholding systemic soundness. It assists to recognize whether digitalization enhances resilience in both Islamic and Conventional or tends to expose to new vulnerabilities. It assists in recognizing whether digitalization enhances resilience in both Islamic and conventional banks or tends to expose to new vulnerabilities. Hence, this paper gives important perspective on reforming regulatory framework, protecting the protection and integrity of data, digital security, and prudent planning in the era of digitalization of Pakistan's banking sector.

## 2. Literature Review

Relevant studies related to digitalization in the banking industry are reviewed. In modern digital era, banking services are increasingly important in handling transactions related to financial segment. Essentially, banking related to digitalization relates to managing all banking activities, such as transactions, payments, and account management, via mobile phones, tablets, or computers. It can also be described as the digitalization of traditional banking services that were previously available only in

physical bank branches. These services include activities like depositing money, withdrawing the funds, transferring the transactions, managing & checking savings accounts, credit management, bill payments, and other account-related services.

Previous studies highlight that digitalization significantly impacts banking operations, efficiency, and financial stability. While global research emphasizes technology adoption and risk management, limited literature focuses on Islamic versus conventional banks in Pakistan, despite their structural and regulatory differences. Empirical evidence suggests that digital tools can enhance liquidity, profitability, and resilience, yet findings often conflict due to varying adoption rates and sector-specific practices. This review identifies a clear research gap in comparative analyses within Pakistan's dual banking system, justifying the need to investigate how digitalization differentially influences FS in both types of banks, offering actionable insights for regulators, policymakers, and banking professionals.

Primary components related to digitalized banking are services of web and mobile banking, which enables account holders to access their services without visiting the branches of bank (Gomber et al., 2017). Digital banking is conceived to contribute to the development of digital economies by improving GDP. This takes place by facilitating ease to access to a wide range of financial product which include loans to businesses and individuals. Digital banking can contribute to greater consumption, which will lead to positive effects on economic activity overall and growth (Ozili, 2019). Moreover, digital banking is observed as a tool of boosting financial stability and enhancing financial settlement, which can benefit both border economy and individual clients. By refining the efficiency in banking services and accessibility, it can better enable the allocation of resources and economic growth.

Furthermore, benefits given by the regulator are well supported by empirical research, which highlights that circulation of soiled money and boost financial security. The regulatory authorities can better monitor transactions through the transparency offered by digital banking, which can help minimize financial crimes, including fraud and money laundering. Financial innovations, which include crowdfunding, provides substitute financing platform and boost financial inclusion. The most recent studies are explored in this literature review, as how digitalization impacts the stability of both banking system, highlighting emerging trends and key findings. Stability is a critical concern of financial institutions. Also, current studies have highlighted both negative and positive on financial stability with respect to digitalization. In conventional banks, financial institutions can be exposed to digitization in conventional banks with respect to system failures, fraud, and cybersecurity. The more reliance of banks on digital platforms can result in more exposure to data breaches, cyberattacks, and technical glitches.

Jameaba (2022) proposed that as conventional banks convert to digitalization, they encounter risks linked to the infrastructure of technology, which could affect financial stability and customer confidence. As far as Islamic banking system is concerned, process of digitalization can have both risks and opportunities. The digitalization process of Islamic banking can enhance the services by giving access to products that are Shariah-compliant to underserved markets. The digital platforms of Islamic banks must ensure to comply with Islamic principles, which adds a layer of complexity in their operations. The robust governance frameworks and regulators must ensure that digital services of Islamic finance must be align with Islamic law as digitalization is a new risk to Islamic banking.

Despite many challenges, digitalization has great potential to boost stability by enhancing risk management tools and better managing regulatory compliance. Digital platforms can allow banks to observe the transactions in real time, which enables quick detection of money laundering and fraud. Xu & Yang (2024) in their study examined how blockchain-enabled banking positively impacts customers' financial matters. It emphasizes that the technology of blockchain introduces faster, novel and more secure means of transferring money at much reduced costs as compared to traditional banking. Further, the researchers said that these advancements can boost financial stability by giving customers added,

efficient, and reliable financial services. The rise of fintechs has been a main source of digitalization in Islamic and conventional banking. Fintechs, which includes peer to peer lending and digital wallets, have unsettled traditional banking and formed new openings for financial inclusion. The conventional banking system incorporated fintechs for offering quick payments, better customer experiences, and personalized services.

Mainardes and Freitas (2023) examine that fintechs solutions embraced by conventional banks saw a rise in loyality of customer and share of market as digital services and products became more incorporated into customers' daily lives. Islamic banks are also expanding their reach and offer Shariah compliant products through exploring fintech. This integration of Islamic finance into fintech solutions has steered to the establishment of platforms of digital Islamic finance, where the customers can have a access of investments, loans, and products related to insurance which are shariah complant. Kurbonova (2023) found that Islamic fintech as an advanced solution that provides financial literacy, enhancing economies in less developed areas, enabling individuals and smaller businesses. Particularly, blockchain has attained attention through its ability to provide transparent and secure transactions in both sectors. Trade finance and cross-border payments are explored through blockchain by conventional banks, while block chain are used to ensure the shariah compliant transaction transparency by Islamic banks.

Operational performance of banks is boosted by providing new opportunities for engagement of customer, cost reduction, and improved efficiency through digitalization. The reliance on digitalization also brings some risks of cybersecurity, failure of the system and market volatility. Robust risk management and ensuring compliance with regulatory and ethical standards must be adopted by conventional and Islamic banks to navigate these challenges. As digital transformation advances in the banking sector, the capacity to balance innovation with stability will be crucial for ensuring the long-term sustainability of both types of banks in an increasingly digital world.

Recent researches have examined the connection of digitalization and financial stability, particularly in conventional banks. On the other hand, there is a lack of in-depth comparative analysis on how digitalization impacts the financial stability of conventional versus lslamic banks while this is well-known that system related to Islamic banks have different operating principals like PLS and face unique regulatory along with Shariah-compliance risks, little research compares with their stability in the digitalization era, particularly during periods of economic downturns. This paper highlighted the major objectives to travel around the influence of digitalization on the financial stability of both types of banks addresses research gap by providing a comparative analysis. This paper examines the manner in which both types of banks experience stability challenges, such as vulnerability to cyber-attacks, operational disruptions, and financial market volatility, as they increasingly adopt digital technologies.

The study examines how both types of banks experience stability challenges, such as vulnerability to cyber-attacks, operational disruptions, and financial market volatility, as they increasingly adopt digital technologies. Through a comparison of the stability of Islamic banks affected by their adherence to Shariah law with conventional banks whose stability may be more influenced by interest-based lending and digital market fluctuations, this paper gives a crucial perspective on the resilience of these institutions in the digital age. There is no substantial work on Pakistani banks with regard to the effect of digitalization on bank stability, especially for both types of banks. In this paper, digitalization is defined by all digitalized tools used in Pakistan for doing banking transactions, i.e., debit card users, credit card users, mobile banking users, web banking users, and IVR users.

Digitalization also has a huge influence on operating profit margin, as previously, performing banking operation transactions manually incurred transactional costs. It is also important to check whether in this digitalization era, financial stability is compromised or not. The paper will present a detailed

examination of the effect of digitalization on the stability of Islamic and conventional banks, contributing valuable insights for managers, policymakers, and investors in the financial sector.

## 3. Data and Methodology

Digitalization has played a key role in transforming the financial sector by transforming how transactions and banking operations are done. One significant benefit of digitalization is its potential to reduce liquidity requirements for banks. Previously, customers were limited to banking hours in traditional banking, and banks are in severe pressure to have high liquidity for the withdrawal of cash, transfer of funds, or immediate payments. Digitalization facilitates by removing these limitations and enables their customers to execute their transactions at any time.

Through real time monitoring of transactions, which is possible by increased automation and efficiency in digital banking platforms, banks can maintain stability in their operations by enhancing resilience, reducing frauds and reducing human error. This rapid shift of banks to digital banking needs continuous investment in cybersecurity for the protection of customer data and to maintain continuity in operations. In the case of Islamic banks, digitalization must also safeguard shariah compliance while protecting against the risk of the digital platform. This study examines whether digitalization has improved financial stability or brought challenges. Interest-based transaction risks are faced by conventional banks, which makes them vulnerable to fluctuations of market and factors related to external economics. This study examines how conventional and Islamic banking models have implemented digitalization while maintaining stability. Cyber security, protection of data and shariah compliance challenges are introduced by digitalization, particularly for Islamic banks. Both types of Pakistani banks warrant an investigation of the effect of digitalization on the stability to know how different banks take advantage of the advancement of technology.

### 3.1 Data and Samples

This study employs a balanced panel dataset to examine the effects of digitalization on financial stability, which includes macroeconomic and bank-level variables, with main indicators reflecting financial stability and digital adoption. The sample is aimed at capture the heterogeneity between both types of banks, allowing for a robust comparative study of how digitalization affects their operational outcomes. This study uses quarterly financial statement of both types of banks to collect bank-specific variables, which are available to download at the PSX and SBP websites. In addition to that, individual banks' websites, SBP, and SECP websites are accessible as required.

Researchers have collected the experimental data from different authentic sources, such as banks' quarterly published reports, country-specific data acquired from international monitoring funds IMF, the World Bank, World Development Indicators WDI, and International Financial Statistics. SECP has declared that all publicly listed firms in Pakistan are required to report their annual reports, governance structure, and information regarding their financial position (Jalal & Zubair, 2025). At the Pakistan level, the source of the data collected from the SBP, income statement analysis, quarterly published balance sheets, bank profiles and official bank websites and Pakistan Stock Exchange.

The data were sourced from the quarterly published financials of sixteen conventional and five Islamic full fledge banks for the period of 2018 to 2022 to analyze and answer the specific research questions. Since GDP is accessible only on annual basis, researchers have inculcated the series of GDP to make it quarterly by the banks in Pakistan. Rashid and Khalid (2017) argued inflation and GDP are included in the empirical model as control variables for macroeconomic conditions. The sample has been carefully chosen to ensure comprehensive representation and analysis of how digitalization impacts both types of banks in Pakistan. ‘All of these banks have already implemented the solutions of digital banking, namely, online banking, mobile banking and digital loan applications (Farah et al., 2018; Manzoor et al.,

2021). Their experience with digitalization offers valuable data on how conventional banks, even those with Islamic banking units, manage the shift toward digital platforms. Therefore, the sample yields important findings into the impact of digitalization on stability in both Islamic and conventional banking systems.

### 3.2 Variable Construction

In accordance with the objectives of empirically investigating impact of digitalization on the financial stability of banks, this study considers a range of variables grouped into dependent variables of bank specific and country specific variables. The dependent variable is a z-score, which is used as a measure of stability. In addition, the bank-specific variables capture internal attributes and comprise on the bank size of bank, NPL and leverage. Further, to account for the country's macroeconomic environment, we include country-specific variables such as GDP growth, interest rate, and consumer price index. Moreover, these variables together present a through organization to assess the impact of digitalization on banking industry.

#### 3.2.1 Financial Stability (FS)

Consistent with the study's objective, this research examines the impact of digitalization on the financial stability of the bank this paper considers z-score as dependent variable to gauge the FS of Islamic and conventional banks. Prior studies on the FS, e.g., Rashid and Khalid (2017), Kasri et al. (2022), and Mustafa (2024), along with others, the researchers have examined the bank's financial stability using the z-score. It gauges the bankruptcy risk. The z-score is a critical indicator in banking literature, reflecting a bank's resilience to economic shocks and ability to stay solvent. The researchers mostly use financial stability to assess the flexibility of banks to different types of risks, such as credit, liquidity and market risk. Moreover, financial stability provides findings into a bank's capacity to manage shocks from the market fluctuations, economic downturns, or operational failures. Regulatory bodies mostly use financial stability indicators with the aim of ensuring that banks adhere to liquidity requirements and capital adequacy requirements, promoting systemic stability.

#### 3.2.2 Bank Digitalization

In this study, our major variable is digitalization. It is important to check whether, in this digitalization era, financial stability is compromised or not. Following the prior research, we measure the digitalization of the banking sector while adding up these components, for instance, debit card users (including ATM), credit card users, mobile banking users, internet banking users, and IVR users (Potapova et al., 2022; Xu & Yang, 2024).

### 3.3 Bank-Specific Variables

The choice of bank-specific variables in this research work is based on economic theory and grounded by earlier existing empirical literature, which highlights their significant role in assessing banks' financial stability. These bank-specific variables control for internal characteristics that may influence how banks respond to digitalization. According to Adusei (2015) bank size is measured using the natural logarithm of total assets, which shows the scale of operations and the bank ability to leverage digital technologies. Uhde and Heimeshoff (2009) argued that the influence of the bank size on financial stability can also be perceived within the framework of the concentration-stability and concentration-fragility hypotheses. Similarly, leverage, which measures the capital structure and financial risk of a bank measured as total debt to total equity of a bank (Harford et al., 2008; Gadzo & Asiamah, 2018; Oli, 2021). These variables give a complete profile of bank-specific attributes, enabling for empirical examination.

### 3.4 Country-Specific Variables

In the empirical models as presented in equation (1), the researchers also include as set of country-specific variables to take into account the macroeconomic characteristic of a country that can influence financial stability of the Islamic and commercial banks. The selection of these country-specific

variables is based on theory and existing relevant literature. Specifically, GDP growth rate is included to capture the overall economic activity and its potential impact on stability of both types of banks. According to the Yao, Haris, and Tariq (2018) and Akhtar, Akhter, and Shahbaz (2017) the interest rate is used, as it provides a more precise reflection of the cost of borrowing. The researchers Iqbal et al. (2024), Awdeh et al. (2024), and Wang (2025) further said that CPI used to measure inflation, which affects financial stability of the banks. These country-specific variables augment the explanatory capacity of the model via taking into account the influence of external- macroeconomic situation on banking sector.

**Table 1: List of the Variables**

| Variable | Abbreviations | Construction |
|---|---|---|
| **Dependent Variable** | | |
| Financial Stability | FS | $Z\text{-}score = \frac{EQ/A + \mu_{ROA}}{\sigma_{ROA}}$ where $EQ/A$ is equity capital as a percentage of total bank assets, $\mu_{ROA}$ is average return on assets (ROA) and $\sigma_{ROA}$ is standard deviation of return on assets as a proxy for return volatility. |
| **Control Variables** **Bank-Specific Variables** | | |
| Digitalization | BD | Considering debit card users (including ATM), credit card users, mobile banking users, internet banking users and IVR. |
| Bank Size | BS | Log of total assets |
| Leverage | Lev | Leverage ratio = Teir 1 Capital/Total Exposure(on + off balance sheet) |
| Non-Performing Loans | NPL | Log of the non-performing loans |
| **Country-Specific Variables** | | |
| Interest Rate | IR | Karachi Interbank Offer rate (KIBOR) |
| Gross Domestic Product | GDP | GDP growth rate |
| Consumer Price Index | CPI | CPI index |

### 3.5 Empirical Models

Empirical model designed to analyze the effects of digitalization on the financial stability of banks. Section 3.5.1 explores the relationship between digitalization and the financial stability of banks. This model is estimated using panel data techniques to ensure accuracy, consistency, and robustness in

findings. The aim is to provide empirical evidence on whether digital advancements contribute to improved efficiency and resilience in the banking sector.

### 3.5.1 The Effect of Digitalization on the Financial Stability of Islamic and Conventional Banks

One of the objectives of this study is to empirically investigate the influence of digitalization on the financial stability of the banking sector in Pakistan. The empirical model used for this analysis is presented in Equation (1), providing a structured framework to assess how digital transformation influences stability across different banking models in Pakistan.

$$FS_{it} = \alpha + \beta_1 BD_{it} + \beta_2 BS_{it} + \beta_3 Lev_{it} + \beta_4 NPL_{it} + \beta_5 IR_{it} + \beta_6 LGDP_{it} + \beta_7 LCPI_{it} + \theta_i + \gamma_t + e_{it} \quad (1)$$

Equation (1) represents the empirical model to investigate the impact of digitalization on the financial stability of the bank by incorporating both bank-specific and macroeconomic variables. The selection of the variables is based on their theoretical relevance and empirical support in the literature Nguyen et al. (2023), Mursalov et al. (2025), and Wagdi and Fathi (2025). In general, the financial stability refers to the ability of a financial institution to withstand economic shocks and maintain its core functions economic shocks and maintain its core functions without significant disruption.

Financial stability in the banking sector refers to the ability of banks to operate efficiently and withstand economic shocks. It ensures the continuous provision of financial services like credit, payments, and savings. According to Laeven (2011), a stable banking system maintains public confidence and prevents systemic crises. The researchers Rashid et al. (2017), Kasri et al. (2022), and Mustafa (2024) have measured the financial stability of the bank using the z-score. It gauges the risk of insolvency of a bank. Further, a higher z-score means better financial resilience and lower-default risk (Giordana & Schumacher, 2017).

This study aims to find if digitalization increases the resilience of Islamic and conventional banks in Pakistan by evaluating the FS. The focus of this study is mainly on the significance of digitalization in the scenario of financial evolution and its increasing trend in the digital system. The digitalization can enhance and, at the same time, under certain scenario can damage the financial stability of banks (Chaimaa et al., 2021; Balkan, 2021). Digitalization systemizes physical processes, lessens human errors with low operating cost. This helps to improve margins of profits which can build financial cushions for shocks. Financial stability can be impacted by bank size (BS) in both negative and positive ways (Adusei, 2015; Ibrahim & Rizvi, 2017).

The positive side is that bigger banks benefit from economies of scale (Ullah & Rashid, 2024). This increases profitability and in times of financial stress this increase profitability allows banks to build a stronger capital buffer. Bigger banks also have more diversified portfolios (Chandramohan et al., 2022). Hence, this lessens the risk of being overly exposed to any single segment or borrower group, increasing their capacity to manage shocks. The leverage ratio in equation (1) can also have both types of effects on the financial stability of banks. Its impact largely depends on how it is applied, the broader regulatory framework and the economic environment in which banks operate (Matey, 2021; Omri, 2022). One of the primary advantages of the leverage ratio is its role in risk mitigation, because it is not based on complex models or internal risk assessments, it offers a bank's financial health. In this sense, it can provide a reliable check on the bank's balance sheets and reduce the likelihood of insolvency during financial stress

or economic downturns (Adrian et al., 2022; Acosta-Smith et al., 2024). The ratio of non-performing loans to total loans is one of the most important indicators used to assess the asset important indicators used to assess the asset quality of a bank (Ozili, 2019; Floridi & Purnamasari, 2023). The researchers Koskei (2020) and Katuka et al. (2023) have utilized the NPL as a bank-specific control variable in our empirical model.

It measures the proportion of a bank's loan portfolio that is in default or close to being in default, typically defined as loans that are more than 90 days repaid past due or those that are unlikely to be repaid in full without the liquidation of collateral. The NPL ratio serves as a key diagnostic tool for regulators, analysts, and policymakers to assess the health of the banking sector (Islam et al., 2021; Singh et al., 2021). A rising NPL ratio is an early warning sign that can precede more serious financial distress, making it essential for banks to monitor and manage NPLs effectively through sound risk assessment, robust credit monitoring systems and timely regulatory interventions. Double-edged sword is interest rates (IR) in banking system principally (Gudmundsson & Zoega, 2016). Low and high interest rates for a prolonged periods have risk while a reasonable and balanced interest rate can support good healthy economic movement and careful banking practices. Lower rates may boost over-leverage and asset bubbles while high interest rates can suppress growth and lead to default (Angbazo, 1997; Smith & Van Egteren, 2005; Hoque & Hossain, 2008).

The demand of loan is decreased when interest rates are high, and borrowing for businesses and consumers becomes more expensive, which triggers a decrease in lending demand. The financial burden on existing borrowers increases with higher cost especially in the scenario with variable interest rate lending. In these cases, the chances of lending defaults increase, which have negative impact on asset portfolio of a bank. The financial stability is weakened overall due to a sustained increase in non-performing loans. This increase in non-performing loans can stress the balance sheet of the bank and reduce profitability. Giorgio and Rotondi (2011) in their study found that rules for interest rate is reflected by excessive concern for financial stability. It is well known in the literature that the growth of GDP is a main determinant for the financial stability of bank (Diaconu & Oanea, 2014). The economic decline boost risk of credit and undermines financial stability, while a performing economy normally tends to improved performance of loans, lessen credit risk and increase bank's profitability. (Koskei, 2020; Abdullah et al., 2024; Rashid et al., 2024).

Therefore, monitoring GDP growth is crucial for understanding and managing the risks faced by the banking sector and for ensuring the overall stability of the financial system (Ijaz et al., 2020). In Equation (1), LCPI represents the inflation. Following Iqbal et al. (2024) and Awdeh et al. (2024) in the empirical model, the researchers have incorporated inflation as an important factor in determining the FS of the bank. Many authors are of the view that if CPI is high, it can create several challenges for the banking sector (Ocaña & Faibishenko, 2016). One of the most immediate effects is the erosion of the real value of financial assets and liabilities. For example, if a bank issues a loan at an affixed interest rate and inflation rises significantly during the loan term, the real value of the repayments it receives in the future will be lower than expected. In essence, the bank earns less in real terms, which can negatively impact profitability.

High inflation also tends to increase uncertainty in the economy. When inflation is volatile or unpredictable, it becomes more difficult for banks to forecast future cash flows, set appropriate interest rates, and manage risk effectively. The conservative lending practices, tighten credit availability, and

show economic growth due to this uncertainty (Khan & Lo, 2019; Abaidoo & Agyapong, 2023). If the environment is of high inflation, the borrowers of loans may have greater financial pressure, if the earnings do not increase with increasing prices, which can lead to increased default rates and raise NPLs, weakening financial stability and asset quality of banks.

Conversely, low and stable inflation tends to support the preservation of the real value of loans and deposits, contribute to more predictable financial conditions, and enhance financial stability. Therefore, monitoring inflation and maintaining it within a target range is crucial for central banks aiming to support a healthy and stable banking system. Therefore, a high inflation does indeed harm bank financial stability and deteriorates banks' credit risk (Awdeh et al., 2024).

### 3.6 Estimation Method

In this research study, the researchers Rashid et al. (2017) and Kinateder et al. (2021) have applied the panel data technique and fixed-effects estimator. Based on the Hausman test (1978), the selection between the FE and the RE models is also justified. The Hausman test is also essential to decide, whether a FE or RE would be employed (Guarino et al., 2015; Farag & Malin, 2016). To identify whether the FE or RE estimator should be used in this panel data setting (Farhana, 2020; Moundigbaye et al., 2018). Furthermore, Hausman test is also recognized whether a correlation between unobservable heterogeneity and the explanatory variables exists (Amini et al., 2012). This test is used to test the correlation between the unique error and regressors. In addition to that, when the FE is compared to the RE using the Hausman test, the null hypothesis is rejected; the fixed effects model is therefore employed for empirical analysis (Amini et al., 2012; Lee-Kuen et al., 2017)

#### 3.6.1 Hausman Test

The underlying idea of the Hausman (1978) test is that both RE and FE estimators yield consistent results when there is no correlation between the individual effect and the explanatory variables. If both estimators are consistent, then in large samples the RE and FE estimates should be similar. When performing the Hausman test, the FE estimator, which is consistent is listed first. This sequence is important to ensure the test can correctly evaluate whether there is a significant difference between the two models". If the H-statistics is significant the null is rejected, and FE model is retained. Therefore, the prior study has applied the Hausman test between fixed effects and random effects see for instance Amini *et al.* (2012). This Hausman test will guide us about which test is the best for a suitable model of study.

**Hausman Specification Tests**

| | $H_o$ is true | $H_1$ is true |
|---|---|---|
| $\beta_1$(Random Effects estimator) | Consistent Efficient | Inconsistent |
| $\beta_o$(Fixed Effects estimator) | Consistent Inefficient | Consistent |
| If results show; | | |
| $H_o$: prefer RE (p > 0.05) | | |
| $H_1$: prefer FE (p < 0.05) | | |

***H₀**: Random-effects model is preferred.*
***H₁:** Fixed-effects model is preferred.*

The regression results from the FE and RE models are presented, and all assumptions in relation to the distribution of data variables in the model were tested to ensure the normality assumption before

moving forward with the empirical analysis. The Hausman (1978) test helps determine whether the fixed effects or random effects model is more suitable by testing for systematic differences between the two estimators. If the null hypothesis is accepted (i.e., the test statistic is not significant), it suggests that there is no meaningful difference between the estimators, and the random effects model is preferred due to its greater efficiency. However, if the null hypothesis is rejected (i.e., the test statistic is significant), it indicates that the fixed effects model is more appropriate, as it accounts for unobserved heterogeneity.

### 3.6.2 Fixed Effects Model

The researchers have discussed the value of intercept; they said that the value of intercept is not related to cross-section, but will be distinguished. They said that a dummy is separated and integrated with this method to indicate the magnitude of the differences aimed at the correlations for every cross-section and its assumption of a similar intercept, and will not be accepted while the standard F-statistics is significant, and thus used fixed-effect model test, if not, then the common effect model will be applied. According to the researcher's slope coefficients are constant but intercepts vary from bank to bank.

The FE model was employed to analyze the determinants of FS across twenty-one banks over the period of 2018-2022. The dataset used in this study is a panel dataset, which tracks multiple entities (banks) over time. Panel data is characterized by observations that are two-dimensional: cross-sectional (across banks) and longitudinal (across years). The FE model is specifically designed for such data structures, as it allows the analysis to account for changes within entities over time. The main purpose of this study is to examine how changes in factors internally within each bank affect financial stability. The FE model eliminates cross-sectional deviation and separate temporal impact of variation within entities. Therefore, FE model is well-suited for this purpose. This distinction is critical in banking research, where institutional and regulatory differences between banks may be significant but stable over time.

By controlling for all time-invariant omitted variables, the FE model helps ensure that the results are not biased due to variables that are not explicitly included in the regression but might otherwise affect the outcome. This is particularly important in banking studies, where not all relevant institutional characteristics can be observed or measured. This approach enhances the reliability and validity of the empirical findings, providing more accurate insights into the dynamic relationships among the studied variables in the banking sector.

## 4. Empirical Results

This part is dedicated to the empirical results of this study. This part comprises four sections. Sections 4.1 and 4.2 depict the summary statistics of the Islamic and conventional banks of Pakistan. Section 4.3 provides the empirical results of digitalization and financial stability of conventional banks. Section 4.4 gives the empirical results for the Islamic bank of digitalization and financial stability.

### 4.1 Summary Statistics for Islamic Banks

The key insights into their operational and financial behavior are provided by the descriptive statistics of the variables. In this study, the dependent variable is financial stability. Bank size is fairly uniform across institutions, with a mean 18.662 and SD 0.966, suggesting limited disparity in scale. The financial stability (z-score), with mean 2.061 and SD 0.062 reflects consistent resilience and soundness in the Islamic banking system. Macroeconomic conditions represented by GDP mean 7.740 and SD 0.0977, show minimal variation, indicating a stable economic environment over the period under study. Additionally, interest rate with a mean 10.231 and SD 3.019, and NPL mean 14.902; with SD 1.827 exhibit moderate to high variability, suggesting differences in internal performance and credit risk across

banks. Digitalization also presents a moderate variability mean of 45.900 and with SD 5.111, reflecting varying levels of technology adoption. In summary, the data indicate that Islamic banks generally exhibit stable financial soundness, with variations observed in credit risk management. Across Islamic banks, these differences point out the heterogeneity in practices of operations, which offers a rich scenario for further econometric analysis.

**Table 1: Summary Statistics for Islamic Banks**

| Variables | Mean | Std. Dev |
|---|---|---|
| Bank Size | 18.662 | 0.966 |
| Leverage | 0.045 | 0.011 |
| Non-performing loan | 14.902 | 1.827 |
| Interest rate | 10.231 | 3.019 |
| Gross domestic product | 7.740 | 0.0977 |
| Digitalization | 45.900 | 5.111 |
| Financial stability | 2.061 | 0.062 |

### 4.2 Summary Statistics for Conventional Banks

Across conventional banks, the descriptive statistics give insight over the study period into their operational consistency and financial structure. Conventional banks lean towards similar and large in scale as the bank size has a high mean of 20.758 and a lower SD of 0.796, which shows disparity is minimal in size. Conventional banks show a lower average (mean 1.938) as compared to Islamic banks with a low SD 0.052, which suggests a unvarying level of stability across institutions in terms of financial stability. Similar to Islamic banks, the interest rate appears to have moderate variability with SD 3.008 and a mean 10.240. The NPL of conventional banks is on the higher side with lesser variability than that of Islamic banks, with an NPL ratio at 17.047 and SD of 0.949, which suggest though higher credit risk but consistent in conventional banks.

In conventional banks, digitalization appears with a higher mean (59.634) and SD 7.235, which indicates broader digital technologies adoption along with some variability at implementation. Leverage stats signifies slight variation with a lower mean, which suggests a conservative capital structure. The stats of the GDP macroeconomic variable show lesser variability with SD 0.0973 and mean 7.740, which confirms during the study period a stable environment of economics. The stats show stable and relatively uniform banking environment as the variation in overall in key financial metrics is limited.

**Table 2: Summary Statistics for Conventional Banks**

| Variables | Mean | Std. Dev |
|---|---|---|
| Bank size | 20.758 | 0.796 |
| Leverage | 0.042 | 0.009 |
| Non-performing loan | 17.047 | 0.949 |
| Interest rate | 10.240 | 3.008 |
| Gross domestic product | 7.740 | 0.0973 |
| Digitalization | 59.634 | 7.235 |
| Financial stability | 1.938 | 0.05 |

### 4.3 Digitalization and Financial Stability of Conventional Banks

The digitalization is significant and positively related to financial stability, as per the results given in table 3, which indicates that an increase in digitalization increases the financial stability of

conventional banks. Financial stress is responded to more effectively as digital tools such as AI, data analytics, and machine learning can assist banks in finding potential risk more precisely, which enhances stability. Through quicker transactions and with more accessibility, digital banking solutions can enhance customer experience, which contributes to stability. Regulatory standards can be met more efficiently with the help of digitalization, which improves compliance and transparency.

As per analysis, bank size and financial stability have a negative but statistically insignificant relationship with a coefficient of -0.0232 in conventional banks in Pakistan. In bigger banks, operations can be more complex, and this can lead to vulnerabilities and make it difficult to manage risk during a financial stress period. As bigger banks can engage in business that is riskier in nature, as bigger banks are assumed to be too big to fail, which increases their chances of financial instability. They may also have more than smaller banks, a concentrated exposure to a certain type of market, which increases their chances that a blow could ominously affect their stability.

Bank's debt to equity is referred to as leverage. Both gains and losses are associated with higher leverage. If the value of asset of bank decreases or suffer losses, it may get difficult to meet its obligation of debt which can lead to greater risk of insolvency and leads to financial instability. Banks that have higher leverage are more sensitive to the market condition that are more hostile, such as changes in interest rates, economic decline, or a decrease in the value of assets. The profitability and financial stability can be grinded down as leverage can raise the liquidity risk and borrowing expense. This indicates that for the stability of conventional banks, high leverage is a key risk factor. The negative relationship (table 3) of leverage and FS, with a coefficient of -0.6884 shows that reduced financial stability is associated with higher leverage and is statistically significant at the level of 10%. The coefficient of -0.0269 shows that there is a negative relationship between financial stability and NPLs of conventional banks. This is because as the non-performing loans increases the portfolio of the bank's loan quality will also weaken, which increases credit risk and erodes capital buffers. This can also disrupt liquidity and cash flow, and can result in insolvency in severe conditions. Higher credit risk and quality of asset falling reflected by this negative relationship undermine financial stability (Guy & Lowe, 2011; Ozili, 2019; Bacchiocchi et al., 2022). This underlines the significance of handling the NPLs for the assurance of financial stability.

In table 3 the negative and significant relationship is shown for conventional banks between financial stability and interest rates Unrealized losses, asset-liability mismatch, reduced value of long term assets and loan defaults are increased by higher interest rates which ultimately weaken stability (Pambuko et al., 2018; Ergeç & Arslan, 2013; Ozili, 2019). The findings show a positive, although non-significant, relationship between FS and GDP of conventional banks. The financial stability of the banking sector can be enhanced by economic growth as economic growth increases liquidity, profitability, and investor confidence.

**Table 3: Results on the Impact of Digitalization on Financial Stability of Conventional Bank**

| Independent variables | Coefficient and standard errors |
|---|---|
| Total digitalization | 0.0085** |
| | (0.0050) |
| Bank size | -0.0232 |
| | (0.0267) |
| Leverage | -0.6884* |
| | (0.4109) |
| Non-performing loans | -0.0269*** |
| | (0.0092) |
| Interest rate | -0.0027** |
| | (0.0012) |

| | |
|---|---|
| GDP (log) | 0.0887 |
| | (0.0583) |
| CPI (inflation %) | 0.0503 |
| | (0.0337) |
| Constant | 1.6907*** |
| | (0.4214) |
| Observations | 271 |
| R-square | 0.3840 |

**Note:** Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

CPI has a positive relationship with FS but is statistically insignificant, as shown in table 3, which recommends that inflation maternally does not have influence on FS of conventional banks of Pakistan during the study period. Rashid and Khalid (2017) have similar findings. FS and asset quality could be improved as inflation boosts the value of collateral and reduces the real value of loans (Kwashie et al., 2022).

### 4.4 Digitalization and Financial Stability of Islamic Banks

Digitalization and financial stability are negatively related to each other for Islamic banks, as shown in table 4. As digitalization needs a substantial amount of investment in cybersecurity, technology, and infrastructure. It can create Shariah compliance and organizational challenges, and in short term, it may deteriorate financial stability. Digitalization in conventional banks is positively associated with FS, in contrast. This is due to improved risk management and efficiency gains. Bigger Islamic banks have greater ability to absorb shocks, capitalize strongly and get benefits from diversification (Al-kayed & Aliani, 2020; Grassa et al., 2022; Faheem et al., 2024). As shown in table 4, there is a positive and significant relationship between FS and bank size for Islamic banks. In contrast, in the case of conventional banks, the size of the bank does not always correlate with FS because of higher risk exposure and complexity.

Leverage and financial stability of Islamic banks have a highly significant and positive relationship with each other as shown in table 4. Asset-backed financing and the mechanism of PLS enhance FS and mitigates risk (Menacer et al., 2020; Omri, 2022). For conventional banks, in contrast, leverage depends on debt financing and boosts financial risk (Lestari, 2021; Srivastava et al., 2023). FS may not be affected by even the rise of non-performing loans, as Islamic banks practice risk sharing and asset-backed models. Table 4 shows that the relationship between FS and NPL is insignificant. For conventional banks, NPLs are the main risk factor (Table 3). The interest rate has an inverse and highly significant relationship with each for Islamic banks, as shown in table 4. Financial stability weakens due rise in NPL, lower asset values, and decreased demand for financing as interest rates increases even interest based lending is avoided by Islamic banks. There is a significant and positive relationship between FS and GDP, with a coefficient of 0.0653 for Islamic banks, as shown in table 4.

Investor confidence, financial stability strength, collateral values, and demand for financing increase with economic growth (Iqbal et al., 2024; Alharthi, 2017; Asafo-Adjei et al., 2021). Islamic banks use products like Mudarabah, Ijara and Murabaha which are asset-backed financing, which makes them more resistant to inflationary pressures. As shown in table 4, FS and CPI have a significant and positive relationship with each other for Islamic banks. When inflation rises, the prices of physical assets (for example, real estate, commodities, or infrastructure projects) tend to rise. As Islamic banks typically hold tangible assets as collateral or underlying their financing arrangements, the value of these assets rises with inflation. This helps maintain the security of Islamic banks' loans and investments, which enhances their financial stability. Islamic banks operate under a profit-and-loss sharing model, which allows them to share risks with their clients (e.g., in Mudarabah or Musharakah contracts). Inflation, particularly in a growing economy, can result in higher prices for goods and services, boosting the

profitability of businesses. As suggested, inflation-adjusted returns (through real asset values) may result in higher dividends for Islamic banks, which directly contribute to their financial strength and capital reserves

Moreover, during inflationary periods, people and businesses often seek stable, real-value assets to protect their wealth. Islamic banking products, being inherently linked to tangible assets, are seen as more resilient during inflationary times. Products like Ijara (leasing) and Murabaha (cost-plus financing) often involve transactions tied to real assets whose values tend to rise during inflation.

**Table 4: Results on the Impact of Digitalization on Financial Stability of Islamic Banks**

| Variables | Coefficient and standard errors |
|---|---|
| Total digitalization | -0.0035** |
| | (0.0017) |
| Bank size | 0.0155* |
| | (0.0090) |
| Leverage | 0.8578*** |
| | (0.1631) |
| Non-performing loans | 0.0003 |
| | (0.0008) |
| Interest rate | -0.0018*** |
| | (0.0005) |
| GDP (log) | 0.0653** |
| | (0.0276) |
| CPI (inflation %) | 0.0397*** |
| | (0.0148) |
| Constant | 1.3646*** |
| | (0.1606) |
| Observations | 371 |
| R-square | 0.3840 |

**Note:** Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Owing to the interest-free nature of Islamic banking operations, they may be better positioned to maintain stability during periods of inflation. This is because inflation does not directly erode the real value of Islamic banks' earnings from profit-sharing contracts, which are tied to real assets and equity-based financing. One of the unique features of Islamic banking is its emphasis on risk-sharing between the bank and its clients. During periods of inflation, the risk-sharing aspect can become beneficial. Since both the Islamic bank and the client are exposed to the potential upsides and downsides of inflationary impacts, the financial stress on individual borrowers is mitigated.

Inflation is often the result of macroeconomic policies of a country, which can be managed through government interventions such as price controls or fiscal stimulus measures. During inflationary periods, Islamic banks may benefit from these interventions that stabilize the economy, reducing systemic risk. Additionally, the inflation hedge built into Islamic banking products, such as real estate investments or commodity trading, offers protection to banks during inflationary pressures. This protection can help preserve the value of the bank's capital and improve its financial stability. Inflation, especially when moderate, can lead to less volatility in the financial markets when Islamic banks hold assets tied to real values, such as commodities and real estate. The stability of asset values and lower exposure to speculative financial markets help protect Islamic banks during periods of inflation.

## 5. Conclusion and Policy Recommendations

Both conventional and Islamic banking financial stability are impacted by digitalization, macroeconomic factors, and internal financial structures, but the effects vary between the two types of banks. Digitalization positively influences the financial stability of conventional banks, while it slightly decreases the financial stability of Islamic banks, the impact of higher leverage is positively related to financial stability for Islamic banks. NPL and Interest rates have a negative impact on financial stability in both Islamic and conventional banks, but the effect for Islamic banks is stronger. Reduced stability is observed for conventional banks with higher non-performing loans and leverage.

Islamic and conventional banks display a positive relationship with the growth of GDP, whereas inflation has a positive and more pronounced impact on the FS of Islamic banks. Digitalization due to operational and regulatory frameworks presents some challenges for Islamic banks, while for conventional banks, financial stability improves due to digitalization. Policy insights is provided by these findings for Pakistan. To boost economic growth and financial stability, digital transformation must be supported by policymakers. Differentiated approaches are needed for Islamic and conventional banks to ensure financial stability, manage NPLs and liquidity, and focus on digitalization.

For sustaining stability, it is essential for Islamic banks to adopt tailored-made policies which address profit-sharing contracts, digitalization, and inflation, while importance must be placed on reinforcement of NPL risk management, risk management of interest rate, and optimization of digitalization. For Islamic and conventional banks, financial stability severely declined due to an increase in NPLs. Therefore, credit underwriting standards and provision for loan loss should be made more stronger by the authorities. The infrastructure of secure e-banking, a digital payment framework for inter-bank and stronger standards for cyber security, should be expanded by regulators. For Islamic and conventional banks, prudential and monetary policy must be a reflection of the dual banking system of Pakistan, with requirement of capital and liquidity standardized to both Islamic and conventional banks. Compliance of Shariah and the features of dual banking must be incorporated into digitalization adoption strategies.

The findings have important implications for policymakers, regulators, and bank managers: promoting digital adoption can enhance liquidity, profitability, and resilience, while tailored strategies are needed for different banking models. Encouraging innovation, providing regulatory support, and investing in digital infrastructure will strengthen overall financial stability and foster sustainable growth in Pakistan's banking sector. Policymakers and industry stakeholders should ensure that Fintech innovations serve both segments of the market. For Islamic banks, this entails developing Shariah-compliant e-finance products (such as Islamic Fintech sandboxes or Sukuk for digital projects) so that digital services do not conflict with core principles.

In this study, the researcher has contributed to the existing literature review of digitalization of the banking sector of Pakistan while addressing the outcome/results of digital transformation with banking sector flexibility, therefore the empirical findings of the study are expected to provide valuable insights regarding future reforms and the policy initiatives in Pakistan's banking and financial system. Likewise, this study will pave the way for numerous future research explorations. Therefore to better understand the future challenges from a customer point of view, future study may consider qualitative research methods for example in-depth interviews with experts in banking and technology sectors, therefore this study is conducted in the context of Pakistan's Banking sector; on the other hand, for a

broader understanding of digitalization and its impact on the performance and financial stability, it can be expended to regional blocs or other countries to enhance generalizability. In addition to that, with the increasing trend of smart banking system and AI-powered banking tools, future studies should also investigate the effects on traditional banking models.

In addition, investigating regulatory challenges, particularly Shariah compliance issues in Islamic banking, will also increase understanding. Finally, this study considers digitalization at an aggregate level; however, in the future, the researchers may investigate the effects of its individual components (mobile banking, debit cards, and credit cards, etc.) separately for a more detailed analysis.

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