INTERNATIONAL JOURNAL OF ADVANCED RESEARCH
International Peer-Reviewed Research Journal
ISSN (Online): 3106-7980 | ISSN (Print): 3106-7972
Volume 3 • Issue 7 • November 2026

DIGITAL TRANSFORMATION AND BUSINESS RESILIENCE: THE ROLE OF FINANCIAL INNOVATION AND E-COMMERCE

Hafiz Syed Muhammad Ali Hussain[*1], Wajid Alim[2], Saleh Nawaz Khan[3], Alia Fiaz[4]

[*1] *M.Phil. Scholar, Lahore School of Accountancy and Finance, University of Lahore, Pakistan*
[2] *Associate Professor, Lahore School of Accountancy and Finance, University of Lahore, Pakistan*
[3] *Assistant Professor, Cholistan IBA, Cholistan University of Veterinary and Animal Sciences, Bahawalpur, Pakistan*
[4] *M.Phil. Scholar, Lahore School of Accountancy and Finance, University of Lahore, Pakistan*

[*1]m.ali88@hotmail.com, [2]wajid@uolcc.edu.pk, [3]salehnawaz@cuvas.edu.pk, [4]allaysheerazahmed@gmail.com

DOI: https://doi.org/10.5281/zenodo.24032080

Keywords
Digital Transformation, Business Stability, Financial Innovation, E-commerce, Cybersecurity, Access to External Finance, and Panel Data.

Article History
Received: 05 August 2026
Accepted: 19 October 2026
Published: 04 November 2026

Copyright @Author
Corresponding Author: *
Hafiz Syed Muhammad Ali Hussain

Abstract

Digital transformation has become central to firms' efforts to improve operational flexibility, market surplus, financial efficiency, and resilience. This paper examines the relationship between digital transformation and business stability, with financial innovation and e-commerce as key independent variables, cybersecurity as a moderator, and access to external finance as a control variable. The study uses a quantitative panel-data design based on 440 observations from 88 cross-sectional units over five years (2020–2024). After selecting the best model and conducting diagnostic tests, random-effects regression is used for estimation. Financial innovation and e-commerce are positively and significantly associated with business stability, confirming H1 and H2. Cybersecurity also directly affects business stability, although its moderating effect is weaker. In the primary moderating model, the financial innovation-cybersecurity interaction is not statistically significant at the 5% level, but its significance varies across robustness tests. Thus, H3 is specification-sensitive. The e-commerce-cybersecurity interaction is also insignificant in the primary moderating model. Access to external finance is associated with business stability. Financial innovation, digital capability, and financial accessibility have emerged as important but distinct dimensions of business stability.

INTRODUCTION

Digitalization has changed how organizations conduct financial transactions, communicate with clients, operate, and adapt to their environment. It involves not only adopting technologies but also changing processes, capabilities, and business models (Vial, 2019; Verhoef et al., 2021). This issue is especially relevant in developing markets, where companies often face financial, infrastructural, and institutional constraints, as well as limited market coverage. In these conditions, financial innovation (Fl) is a key means of accessing and managing financial resources. Digital banking, mobile payments, FinTech solutions, electronic transactions, and related products can reduce costs and payment times while increasing financial flexibility. These capabilities are particularly valuable during periods of uncertainty, helping explain the

positive correlation between financial innovation and business stability (BS).

E-commerce (E-Com) is another key variable in this study. Digital platforms allow firms to reach clients beyond geographic boundaries, establish additional sales channels, and respond more effectively to customer demand. They also enable firms to diversify income sources and maintain operations when physical sales channels fail. Thus, digital finance and e-commerce are linked to greater operational flexibility and stability. However, greater reliance on digital finance and e-commerce also brings new risks. Cyberattacks, data breaches, fraud, unauthorized access, and system outages can cause losses and disrupt operations. Cybersecurity (CS) therefore plays a central role in the digital business environment. It protects financial information, customer data, and transactions, and may shape how effectively firms turn financial innovation and e-commerce into stability.

Business stability also depends on access to finance. Access to external finance (AEF) supports working capital, technology investment, expansion, and responses to shocks. Firms facing constraints may be less able to adopt digital technologies or absorb disruption, so I include AEF as a control. Existing research on financial innovation, e-commerce, cybersecurity, digital transformation, and organizational issues has often developed in separate streams. Research on financial innovation typically emphasizes inclusion, development, and access; e-commerce research focuses on adoption, consumer behavior, and performance; and cybersecurity research addresses information security and risk. Relatively little integrated evidence examines how financial innovation and e-commerce relate to business stability when cybersecurity is treated as a potential moderator.

This study addresses that gap. It treats financial innovation and e-commerce as core dimensions of digital transformation, business stability as the outcome, cybersecurity as a moderator, and access to external finance as a control. Using panel data from 88 firms from 2020 to 2024 (440 observations), the study estimates the associations between financial innovation and e-commerce and business stability and tests whether changes in cybersecurity alter the strength of these associations.

Literature Review and Hypotheses Development.

Background to the research. Digital transformation underpins organizational change in value creation, resource management, customer engagement, and responses to uncertainty. It encompasses not only technological issues but also process-, capability-, model-, and stakeholder-related aspects (Vial, 2019; Verhoef et al., 2021; Nambisan et al., 2019). Digital technologies can enhance not only the efficiency of business operations but also their flexibility and sustainability (Sambamurthy et al., 2003; Teece, 2007). The research is based mainly on the resource-based view (RBV) and organizational resilience. According to RBV, resources and capabilities create an advantage when they are valuable and used appropriately (Barney, 1991). Financial innovation and e-commerce can be seen as improving financial processes and customer interaction. Their value depends on complementary resources and knowledge, not on technology adoption alone (Barney, 1991; Bharadwaj et al., 2013). From this view, dynamic capabilities emphasize the ability to adapt and reconfigure resources (Teece, 2007). Financial innovation can increase financial flexibility; e-commerce can provide alternative channels. Organizational resilience links to stability: resilience is the capacity to anticipate or absorb disruption, adapt, and maintain or recover critical activities (Duchek, 2020). The technology acceptance model (TAM) and diffusion of innovations (DOI) help explain adoption. TAM stresses perceived usefulness and ease of use (Davis, 1989); DOI stresses comparative benefit, compatibility, and difficulty (Rogers, 2003). Together, they explain why organizations adopt digital financial technologies and how efficiently they support stability. The framework treats financial innovation and e-commerce as enabling digital capabilities, cybersecurity as a defensive

capability that may condition their links with stability, and access to external finance as a control for differences in financial accessibility. Access to external finance is included as a control because financial resources can affect the capacity to invest, adapt, and operate stably. Firms need finance for working capital, technology, expansion, personnel, and shocks. Constraints may therefore affect stability independently of financial innovation and e-commerce. External finance matters when internal resources are insufficient. Lending ties may increase financing possibilities (Petersen & Rajan, 1994); newer studies link financial access to productivity and development (Chowdhury et al., 2022). Externally raised finance may support digital transformation, since businesses need investment in infrastructure, platforms, expertise, and cybersecurity. According to Gaibulloev et al. (2025), the potential advantages of FinTech financing are particularly significant for businesses that rely on external financing. External access to finance, hence, is treated as a control variable rather than the focus of another hypothesis, in order to reveal the associations of Fl, e-commerce, and cybersecurity with stability.

Financial innovation and business stability

Financial innovation may refer to new financial products, services, technologies, and processes. FinTech, digital banking, mobile payments, electronic transactions, and peer-to-peer lending have improved the speed, accessibility, and efficiency of financial activity (Gomber et al., 2017; Chen et al., 2019). For firms, these developments offer additional ways to access services and manage resources. Under RBV, financial innovation is a valuable capability that enhances the efficiency and flexibility of financial activity. Digital finance reduces frictions, facilitates payments, strengthens connectivity, and provides more flexible resource management, especially during financial or operational stress. The flexibility viewpoint aligns with this direction. Organizations can more readily maintain consistent procedures when they have support for adaptation (Duchek, 2020). Digital financial services can replace common channels when they are constrained, so their involvement might shift from competence to endurance. Reimbursements will vary by firm, financial access, organizational capability, and regulation. Academic expectations remain that greater financial flexibility, efficiency, and accessibility are positively related to business stability.

H1: Financial innovation is positively associated with business stability.

E-commerce and Business Stability.

E-commerce facilitates business processes via digital means: communication, transactions, marketing, and reach independent of geography. E-commerce can range from a sales channel to a capability that affects market reach, engagement, and operational flexibility. RBV holds that value formation requires complementary resources such as technological expertise, logistics, transaction processing systems, customer information, and managerial ability (Barney, 1991; Bharadwaj et al., 2013). Without integration into other procedures, platforms may not produce value sustainably. E-commerce might enable stability by reaching further through different channels, relying less on physical facilities, and accelerating customer appointments. This increases elasticity and allows firms to continue operating if usual channels fail. This logic resonates with resilience (Duchek, 2020) and with digital transformation literature focused on agility and responsiveness (Sambamurthy et al., 2003; Vial, 2019; Verhoef et al., 2021). TAM and DOI indicate a higher probability of acceptance when technologies are seen as valuable and compatible (Davis, 1989; Rogers, 2003). Benefits also depend on structure, logistics, payment structures, skills, institutions, and trust. Technology adoption alone does not guarantee positive effects. However, when combined with complementary resources, e-commerce should affect market reach and operational flexibility.

H2: E-commerce is positively associated with business stability.

Cybersecurity as a Moderator of Financial Innovation and Business Stability

Financial innovation makes organizations increasingly reliant on digital channels, networks, and online transactions. While FinTech, mobile payments, and digital banking create opportunities and improve operational efficiency, they also carry risks of fraud, privacy breaches, attacks, and other events that could undermine stability advantages. In RBV, cybersecurity is a complementary resource that secures the firm's digital resources. While financial innovation provides flexibility and efficiency, its value may diminish if the systems are insecure. Cybersecurity secures information, transactions, and infrastructure, thereby facilitating the reliable use of financial innovation. From a resilience perspective, incidents can disrupt transactions, harm confidence, and jeopardize sustainability. Improved cybersecurity might increase resilience against such threats. Cybersecurity is becoming an organizational issue rather than a technical one (Kshetri, 2018). The moderation proposition is that the positive relationship between FI and BS would be more evident in a favorable cybersecurity environment, since secure systems allow firms to capitalize on the flexibility and efficiency of financial innovation while minimizing digital risks. Cybersecurity can also influence stability without affecting the FI-BS relationship.

H3: Cybersecurity positively moderates the relationship between financial innovation and business stability, such that the positive relationship is stronger when cybersecurity is higher.

Cybersecurity as a moderator of e-commerce and Business Stability

E-commerce similarly increases reliance on platforms, online payments, electronic systems, and customer data. These technologies expand opportunities but also expose organizations to breaches, fraud, theft, unauthorized access, and service interruptions, with consequences for losses, trust, and continuity. Cybersecurity is especially salient because online transactions depend on reliability and trust. Effective security can protect payments, customer information, infrastructure, and operations (Kshetri, 2018). Under RBV, e-commerce is both a commercial digital capability and a protective one; its value may depend partly on the ability to protect the resources that support online activity (Barney, 1991). Trust is part of e-commerce. Saini and Johnson (2005) identify IT strategic flexibility and trust-building as relevant in e-commerce settings. Successful digital commerce therefore requires more than a sales channel. From a resilience perspective, e-commerce is an adaptive capability (alternative channels), and cybersecurity is a protective one (lower digital vulnerability) (Duchek, 2020). A stronger cybersecurity environment may enable greater stability and e-commerce benefits, though this may vary with technological maturity, infrastructure, institutions, and the nature of threats.

H4: Cybersecurity positively moderates the relationship between e-commerce and business stability, such that the relationship is stronger when cybersecurity is higher.

Research gap and conceptual framework

While the topic of digital transformation has been explored quite extensively, the relevant literature on business stability remains scattered. Financial innovation research usually focuses on FinTech, inclusion, efficiency, and access; e-commerce research concentrates on adoption, reach, and performance; while research on digital transformation considers issues of risk, protection, and reliability. These aspects are often explored separately. The first gap relates to financial innovation and business stability: although improved access, efficiency, and flexibility may be associated with stability, no evidence supports this association. The second gap concerns e-commerce: increased digital activity does not translate into business stability unless online operations are integrated with other business capabilities.

Thirdly, reliance on digital finance and commerce makes firms more vulnerable to fraud, data breaches, and interruptions. Thus, whether stronger cybersecurity improves the relationship between FI and BS remains an empirical question. The framework treats financial innovation and e-commerce as key dimensions of digital transformation, business stability as the dependent variable, cybersecurity as a moderator, and access to external finance as a control variable.

Research Methodology

The study uses a panel design to examine the relationship between financial innovation and e-commerce and business stability, and to test whether cybersecurity moderates that relationship. Access to external finance is included as a control. The dataset comprises 88 cross-sectional units from 2020 to 2024, for a total of 440 observations. The panel structure allows variation across units and over time and is appropriate for panel regression.

Variables and measurement

Business stability (BS) is the dependent variable. Financial innovation (Fl) and e-commerce (Ecom) are the principal independent variables. Cybersecurity (CS) enters both as a direct explanatory variable and as a moderator. Access to external finance (AEF / accextfinan) is the two-way interaction test moderator: Fl x CS (FICSR) for H3 and Ecom x CS (EcomCSR) for H4.

Table 1. Description of Variables

Variable	Symbol	Role	Description
Business Stability	BS	Dependent Variable	Measures the stability and continuity of business activities
Financial Innovation	FI	Independent Variable	Composite indicator representing the development and adoption of financial innovation
E-Commerce	Ecom	Independent Variable	Measures the level or extent of digital and online commercial activity
Cybersecurity	CS	Moderator	Represents the cybersecurity or cyber-regulatory environment
Financial Innovation × Cybersecurity	FICSR	Interaction Variable	Tests the moderating effect of Cybersecurity on the Financial Innovation–Business Stability relationship
E-Commerce × Cybersecurity	EcomCSR	Interaction Variable	Tests the moderating effect of Cybersecurity on the E-Commerce–Business Stability relationship
Access to External Finance	accextfinan	Control Variable	Measures the availability of external financial resources

Model Specification

The empirical analysis begins with a direct effects description investigating the associations of Financial Innovation and E-Commerce with Business Stability while controlling for Cyber Security and Access to External Finance:

$$BSit = \beta0 + \beta1FIit + \beta2EComit + \beta3CSit + \beta4AEFit + \mu i + \varepsilon it$$

To examine the moderating role of Cyber Security, the model is extended by including the two interaction terms:

$$BSit = \beta0 + \beta1FIit + \beta2EComit + \beta3CSit + \beta4(FI \times CS)it + \beta5(ECom \times CS)it + \beta6AEFit + \mu i + \varepsilon it$$

The coefficient on **FI × CS** tests whether Cyber Security changes the relationship between Financial Innovation and Business Stability (H3), while the coefficient on **E-Com × CS** tests whether Cyber Security changes the relationship between E-Commerce and Business Stability (H4).

Results and Discussion

Table 2: Descriptive Statistics

Variable	Observations (N)	Mean	Std. Deviation	Minimum	Maximum
Business Stability (BS)	440	91.774	48.314	40.613	389.762
Financial Innovation Index (FI)	440	0.000	1.535	-2.247	7.175
E-Commerce (Ecom)	440	85.388	51.251	20.002	423.851
Cyber Regulatory Score (CS)	440	97.024	54.361	30.358	443.112
Financial Innovation × Cybersecurity (FICSR)	440	68.595	294.263	-213.398	3,144.087
E-Commerce × Cybersecurity (EcomCSR)	440	10,482.710	14,291.930	659.311	187,813.500
Access to External Finance (accextfinan)	440	96.812	55.280	25.710	342.920

Business stability varies substantially (mean 91.774, SD 48.314). Financial innovation has a mean near zero, consistent with index construction. E-commerce and cybersecurity have means of 85.388 and 97.024. Access to external finance has a mean of 96.812. The interaction terms have large ranges, as expected from multiplicative construction. There is sufficient variation to support the subsequent regressions.

Table 3: Correlation Analysis

Variable	Financial Innovation Index	E-Commerce	Cyber Regulatory Score	Access to External Finance
Financial Innovation Index	1.0000	0.7956***	0.8241***	0.8319***
E-Commerce	0.7956***	1.0000	0.7907***	0.7576***
Cyber Regulatory Score	0.8241***	0.7907***	1.0000	0.7972***
Access to External Finance	0.8319***	0.7576***	0.7972***	1.0000

All correlations show strong, significant relationships. Financial Innovation is strongly associated with E-Commerce (0.7956), Cyber Security (0.8241), and Access to External Finance (0.8319). E-Commerce is also associated with Cyber Security (0.7907) and Access to External Finance (0.7576). Cyber Security is strongly related to Access to External Finance, with a correlation of 0.7972. Therefore, you can check for multicollinearity using VIF instead of relying only on correlations between variables.

Table 4: Variance Inflation Factor (VIF)

Variable	VIF	1/VIF (Tolerance)
Financial Innovation Index (FintIndx)	**4.63**	0.2161
Cyber Regulatory Score (cyberreg)	**3.99**	0.2506
Access to External Finance (accextfinan)	**3.82**	0.2615
E-Commerce (ecom)	**3.32**	0.3013
Mean VIF	**3.94**	—

The Variance Inflation Factor (VIF) was used to test for multicollinearity among the explanatory variables. The VIFs range from 3.32 to 4.63, with an average of 3.94. The VIF for Financial Innovation is the highest at 4.63, followed by Cyber Security at 3.99, Access to External Finance at 3.82, and E-Commerce at 3.32. Although the explanatory variables are highly correlated, all VIFs remain below 5, and tolerances range from 0.2161 to 0.3013. This implies that, while multicollinearity is present, it is not severe enough to pose a multicollinearity issue.

Table 5: Pooled Ordinary Least Squares (OLS)

Variable	Coefficient (β)	Std. Error	t-value	p-value	95% Confidence Interval
Financial Innovation Index (FintIndx)	8.9893	0.8365	10.75	0.000	7.3451 – 10.6334
E-Commerce (ecom)	0.2853	0.0176	16.25	0.000	0.2507 – 0.3198
Cyber Regulatory Score (cyberreg)	0.2592	0.0186	13.92	0.000	0.2226 – 0.2958
Financial Innovation × Cybersecurity (FICSR)	0.0064	0.0037	1.75	0.081	-0.0008 – 0.0136
E-Commerce × Cybersecurity (EComCSR)	0.0001	0.0001	1.48	0.140	-0.00005 – 0.00032
Access to External Finance (accextfinan)	0.1233	0.0174	7.07	0.000	0.0890 – 0.1575
Constant	29.8952	2.0628	14.49	0.000	25.8408 – 33.9496

According to Pooled OLS, Financial Innovation ($\beta = 8.9893$, $p < .001$), E-Commerce ($\beta = 0.2853$, $p < .001$), and Cyber Security ($\beta = 0.2592$, $p < .001$) are positively and significantly related to

Business Stability. Access to External Finance has a positive and significant beta coefficient (β = 0.1233, p < .001), indicating that financial accessibility is positively related to Business Stability while controlling for the other variables. The interaction between Financial Innovation and Cyber Security is not statistically significant at the 5% level of confidence (β = 0.0064, p = .081). The same applies to the E-Commerce x Cyber Security interaction, which is also insignificant (β = 0.0001, p = .140). Therefore, the Pooled OLS estimates suggest preliminary evidence of positive direct relationships; however, the proposed moderating relationships do not receive empirical support at the conventional 5% level of significance. Hypotheses will be tested using the panel-data model selected further.

Table 6: Hausman Test

Test	Chi-square (χ^2)	Degrees of Freedom	p-value	Recommended Model
Hausman Specification Test	1.19	5	0.9460	Random Effects

The Hausman specification test was used to determine whether the Fixed Effects or Random Effects model was appropriate. The test result was $\chi^2(5) = 1.19$, with a p-value of 0.9460. Since the p-value is greater than 0.05, the null hypothesis is accepted, indicating that there is no substantial systematic difference between the Fixed Effects and Random Effects models. Thus, the Random Effects model will be used for future panel regression analyses.

Table 7: Random Effects Model Without Moderation

Variable	Coefficient (β)	Std. Error	*z*-value	p-value	95% Confidence Interval
Financial Innovation (FintIndx)	9.8097	0.6922	14.17	0.000	8.4530 – 11.1664
E-Commerce (ecom)	0.2882	0.0175	16.43	0.000	0.2538 – 0.3226
Cybersecurity / Cyber Regulatory Score (cyberreg)	0.2672	0.0181	14.73	0.000	0.2317 – 0.3027
Access to External Finance (accextfinan)	0.1214	0.0175	6.96	0.000	0.0872 – 0.1557
Constant	29.4852	2.0612	14.30	0.000	25.4453 – 33.5252

As shown in the Random-Effects model, Financial Innovation is significantly and positively associated with Business Stability (β = 9.8097, p < .001), supporting H1. E-Commerce is also positively and significantly related to Business Stability (β = 0.2882, p < .001), supporting H2. A positive and statistically significant association is found between Cyber Security and Business Stability (β = 0.2672, p < .001), indicating that a strong cyber security environment leads to greater Business Stability. The model also reports a significant, positive coefficient for Access to External Finance (β = 0.1214, p < .001). Thus, the Random-Effects model estimates provide significant evidence for the positive relationships suggested in H1 and H2, as well as for Cyber Security and Access to External Finance.

Table 8: Random Effects Model with Moderation.
Financial Innovation × Cyber Security (FICSR) and **E-Commerce × Cyber Security (EcomCSR).**

Variable	Coefficient (β)	Std. Error	z-value	p-value	Result
Financial Innovation (FintIndx)	8.9824	0.8363	10.74	0.000	Significant
E-Commerce (ecom)	0.2857	0.0176	16.27	0.000	Significant
Cyber Regulatory Score (cyberreg)	0.2595	0.0186	13.93	0.000	Significant
Financial Innovation × Cybersecurity (FICSR)	0.0064	0.0037	1.75	0.080	Significant at 10%
E-Commerce × Cybersecurity (EComCSR)	0.000138	0.0000923	1.49	0.135	Not significant
Access to External Finance (accextfinan)	0.1227	0.0174	7.04	0.000	Significant
Constant	29.8816	2.0698	14.44	0.000	Significant

According to the Moderated Random Effects Model, Financial Innovation (β = 8.9824, p < .001) and E-Commerce (β = 0.2857, p < .001) have positive and significant effects on Business Stability. Cyber Security also shows a positive and significant coefficient (β = 0.2595, p < .001). Access to External Finance is likewise positive and significant (β = 0.1227, p < .001). For the interaction terms, the interaction between Financial Innovation and Cyber Security is positive (β = 0.0064) but not significant at the 5% level (p = .080). Thus, H3 is not supported at the standard 5% significance level. The interaction between E-Commerce and Cyber Security is positive (β = 0.000138) but not statistically significant (p = .135). Therefore, H4 is not supported at the 5% significance level.

Table 9: Random Effect Model with lagged dependent variable

Variable	Coefficient (β)	Std. Error	z-value	p-value	Result
Lagged Business Stability, L1.busstab	-0.1016	0.4287	-0.24	0.813	Not significant
Financial Innovation (FintIndx)	9.0254	0.7657	11.79	0.000	Significant
E-Commerce (ecom)	0.3185	0.0219	14.55	0.000	Significant
Cyber Regulatory Score (cyberreg)	0.2805	0.0242	11.58	0.000	Significant
Financial Innovation × Cybersecurity (FICSR)	0.0259	0.0037	7.01	0.000	Significant
Access to External Finance (accextfinan)	0.2073	0.0205	10.12	0.000	Significant
Year 2022	0.0217	1.7831	0.01	0.990	Not significant
Year 2023	-1.6450	1.7860	-0.92	0.357	Not significant
Year 2024	-0.2447	1.7839	-0.14	0.891	Not significant
Constant	15.6967	2.2821	6.88	0.000	Significant

In addition to the robustness specification, the Random Effects Model includes one-period lagged Business Stability. The lagged dependent variable is insignificant (β = −0.1016, p = .813); thus, Business Stability does not persist in this specification. Financial Innovation (β = 9.0254, p < .001) and E-Commerce (β = 0.3185, p < .001) stay significant and positive. Thus, the results for hypotheses H1 and H2 appear consistent. Cyber Security (β = 0.2805, p < .001) and Access to External Finance (β = 0.2073, p < .001) remain positive and significant. It should be noted that the interaction between Financial Innovation and Cyber Security is now significant and positive (β = 0.0259, p < .001). This contradicts the insignificance of the interaction term in the primary and robustness specifications; thus, the results related to hypothesis H3 are specification-sensitive and inconsistent. Year effects stay insignificant.

Table 10: Hypotheses testing Table

Hypothesis	Pooled OLS evidence	p-value
H1: FI → BS (+)	Positive and significant	<0.001
H2: E-Commerce → BS (+)	Positive and significant	<0.001
H3: CS moderates FI → BS (+)	Positive, but not significant at 5%	0.081
H4: CS moderates E-Commerce → BS (+)	Positive, but not significant	0.140

International Journal of Advanced Research

The p-value is < 0.001, rather than p = 0.000. A p-value is not literally zero; statistical software commonly rounds a very small value to 0.000. Also, your H3 result at p = 0.081 is significant at the 10% level only if your methodology explicitly adopts a 10% significance threshold. Since most theses use 5% as the primary criterion, I recommend calling it not significant at the 5% level and, if useful, noting that it provides weak marginal evidence at 10%. Do not change the significance criterion after seeing the results. Cybersecurity is important in itself, but it is not an indicator of its importance as a moderator. Cybersecurity appears to be significantly related to Business Stability, but the interaction is much less evident.

Table 11: Pesaran Cross-Sectional Dependence Test

This test examines whether observations across countries, firms, or other cross-sectional units depend on each other.

Test	CD Statistic	p-value	Decision
Pesaran Cross-Sectional Dependence Test	0.368	0.7129	No cross-sectional dependence Fail to reject H_0

The Pesaran CD test was carried out to test for cross-sectional dependence among the panel observations. The CD statistic was 0.368, and the p-value was 0.7129. Because the p-value is greater than the 5% level of significance, the null hypothesis of cross-sectional independence could not be rejected.

Table 12: Robustness check

Variable	Coefficient (β)	Robust Std. Error	z-value	p-value	Result
Financial Innovation (FintIndx)	9.0254	0.7657	11.79	0.000	Significant
E-Commerce (ecom)	0.2863	0.0201	14.23	0.000	Significant
Cyber Regulatory Score (cyberreg)	0.2616	0.0193	13.56	0.000	Significant
Financial Innovation × Cybersecurity (FICSR)	0.0061	0.0038	1.62	0.105	Not significant
Access to External Finance (accextfinan)	0.1213	0.0169	7.18	0.000	Significant
Year 2021	0.4154	1.5312	0.27	0.786	Not significant
Year 2022	0.1742	1.4066	0.12	0.901	Not significant
Year 2023	-1.9646	1.6226	-1.21	0.226	Not significant
Year 2024	0.0973	1.4412	0.07	0.946	Not significant
Constant	30.03796	1.9943	15.06	0.000	Significant

International Journal of Advanced Research

Robust analysis using robust standard errors and year dummies largely supports the earlier results. Financial Innovation (β = 9.0254, p < .001) and E-Commerce (β = 0.2863, p < .001) are positively and significantly related to Business Stability, further confirming H1 and H2. Cyber Security (β = 0.2616, p < .001) and Access to External Finance (β = 0.1213, p < .001) are also positive and statistically significant. Yet, the interaction between Financial Innovation and Cyber Security proves to be positive but not statistically significant (β = 0.0061, p = .105), hence, no robust evidence is provided for H3. The individual influence of years 2021–2024 is not statistically significant.

Discussion

The findings provide important insights into the relationship between digital transformation and Business Stability, particularly through Financial Innovation and E-Commerce, while accounting for the roles of Cyber Security and Access to External Finance. The empirical results indicate that Financial Innovation and E-Commerce are positively and statistically significantly associated with Business Stability. However, Cyber Security's moderating effects are not statistically significant at the conventional 5% level in the primary model.

The positive relationship between Financial Innovation and Business Stability supports H1 and suggests that innovative financial technologies may enhance financial accessibility, operational efficiency, and organizational adaptability. Digital payment systems, FinTech services, and technology-driven financial solutions can facilitate financial transactions and improve access to financial resources. This finding aligns with the broader literature highlighting the importance of financial innovation in improving financial inclusion and economic development (Ozili, 2018). From the perspective of Dynamic Capabilities Theory, financial innovation may help organizations adapt to changing market conditions and strengthen their capacity to respond to financial challenges.

Similarly, the positive and statistically significant relationship between E-Commerce and Business Stability supports H2. E-Commerce enables businesses to expand market access, diversify sales channels, and sustain operations through digital platforms. These capabilities can enhance operational flexibility and reduce reliance on traditional business models. The finding aligns with Verhoef et al. (2021), who emphasize that digital transformation can reshape business

operations and strengthen organizational capabilities. It also supports the Resource-Based View, which recognizes technological resources as potentially valuable contributors to organizational performance and stability.

Cyber Security shows a positive and statistically significant direct relationship with Business Stability, underscoring the importance of safeguarding digital infrastructure and financial transactions. However, the interaction between Financial Innovation and Cyber Security is not statistically significant at the 5% level in the primary Random Effects model ($p = 0.080$). Therefore, H3 is not supported under the primary significance criterion, though the result suggests a possible relationship that warrants further investigation. Likewise, the interaction between E-Commerce and Cyber Security is statistically insignificant ($p = 0.135$), indicating that H4 is not supported. These findings suggest that Cyber Security may contribute directly to Business Stability without necessarily strengthening the relationships between Financial Innovation, E-Commerce, and stability. Differences in cybersecurity implementation, regulatory environments, and technological capabilities may help explain these results, although these mechanisms were not directly tested.

Furthermore, Access to External Finance shows a positive and statistically significant relationship with Business Stability. This finding suggests that access to financial resources may support liquidity management, business investment, and responsiveness to economic uncertainty. It underscores the importance of financial accessibility alongside digital transformation initiatives.

Overall, the study contributes to the literature by integrating Financial Innovation, E-Commerce, Cyber Security, and Access to External Finance into a unified empirical framework. The findings indicate that digital transformation is positively associated with Business Stability, while the limited evidence of cybersecurity moderation underscores the need to distinguish between direct and conditional relationships. These results offer useful implications for policymakers and business managers seeking to promote digital development, financial accessibility, and organizational resilience.

Conclusion

This study concludes that digital transformation plays a significant role in strengthening business stability by enhancing firms' financial efficiency, operational flexibility, and capacity to adapt to changing business environments. Based on panel data from 88 cross-sectional units over 2020–2024, the empirical findings show that both financial innovation and e-commerce have positive and statistically significant effects on business stability. These results highlight the importance of adopting innovative financial solutions and digital commerce platforms in improving firms' ability to sustain operations, respond to market challenges, and maintain long-term competitiveness. Furthermore, cybersecurity exhibits a positive direct association with business stability, emphasizing the importance of secure digital infrastructure in supporting sustainable business operations. Access to external finance also contributes to business stability, indicating that financial accessibility remains an important factor in supporting firms' digital and operational capabilities.

However, the moderating role of cybersecurity is not consistently supported by the empirical findings. Although the interaction between financial innovation and cybersecurity shows varying significance across robustness specifications, it is not statistically significant in the primary model at the 5% level. Similarly, the interaction between e-commerce and cybersecurity remains insignificant, suggesting that cybersecurity does not necessarily strengthen the relationship between digital transformation dimensions and business stability. These findings indicate that digital transformation contributes to business stability through distinct but complementary dimensions, including financial innovation, digital capabilities, cybersecurity, and access to external finance. Overall, the study provides empirical evidence that firms can enhance business stability by adopting financial innovation

and e-commerce, supported by adequate financial resources and effective cybersecurity practices. It also offers important implications for business managers and policymakers to promote digital infrastructure, financial accessibility, and secure technological environments to strengthen organizational resilience and long-term sustainability.

Theoretical implications

Both positive Fl and e-commerce relationships support RBV: both capabilities can be sources of flexibility, market accessibility, efficiency, and responsiveness. Both are supported by the notion of dynamic capabilities, where value creation depends on integrating and exploiting digital assets in a context of constant change rather than simply adopting them. The cybersecurity findings can be viewed as a reflection of organizational resilience. The direct relationship indicates that cybersecurity plays a supportive role by helping protect the organization. For weaker, specification-sensitive relationships, the potential to amplify the organization's other digital capabilities may depend on additional conditions.

Practical implications

Managers should view financial innovation and e-commerce not only as means of efficiency and expansion but also as a means of stability. Digitalization of finance, payments, platforms, and infrastructure can give firms greater flexibility to continue operating even when conditions change. Security should be treated as a strategic capability, not just a technical one, because of its close link to stability. However, the findings suggest that having security alone may not be enough to boost stability amid financial innovation and e-commerce. This is why security must be coupled with infrastructure, people, operations, risk management, and finance. The positive AEF finding further supports the importance of financial accessibility.

Limitations and future research

The research uses secondary panel data and is constrained by the available indicators and measurements. The five-year period limits the time dimension. The model focuses on F1, E-commerce, Cybersecurity, and AEF. Many other aspects may also play a role. Further research may consider longer periods, additional measurements, more control variables, and alternative specifications. One possibility is to differentiate by firm size, industry, digital readiness, institutions, or development. Possible extensions may include Artificial Intelligence, Cloud Computing, Analytics, Platforms, and Digital Supply Chain Integration.

REFERENCES

Barney, J. (1991). Firm resources and sustained competitive advantage. Journal of Management, 17(1), 99–120.

Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. V. (2013). Digital business strategy: Toward a next generation of insights. MIS Quarterly, 37(2), 471–482.

Chen, M. A., Wu, Q., & Yang, B. (2019). How valuable is FinTech innovation?. The Review of Financial Studies, 32(5), 2062-2106.

Chowdhury, M. A. S., Chuanmin, S., Sokolová, M., Akbar, A., Ali, Z., Ali, H., & Alam, M. Z. (2022). Assessing the empirical linkage among access to finance, firm quality, and firm performance: New insight from Bangladeshi SMEs. Frontiers in Psychology, 13, 865733.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 319–340.

Duchek, S. (2020). Organizational resilience: a capability-based conceptualization. Business research, 13(1), 215–246.

Gaibulloev, K., Mirzaei, A., Moore, T., & Saad, M. (2025). The effect of fintech financing on firm performance: Evidence from emerging economies. Journal of International Financial Markets, Institutions and Money, 103, 102201.

Gomber, P., Koch, J. A., & Siering, M. (2017). Digital Finance and FinTech: current research and future research directions. Journal of Business Economics, 87(5), 537–580.

Kshetri, N. (2018). [Source cited in the manuscript as "Kshetri, 2018"; full bibliographic details require verification against the original source.]

Nambisan, S., Wright, M., & Feldman, M. (2019). The digital transformation of innovation and entrepreneurship: Progress, challenges and key themes. Research policy, 48(8), 103773.

Petersen, M. A., & Rajan, R. (1994). The effect of credit market competition on lending relationships.

Rogers, E. M., Singhal, A., & Quinlan, M. M. (2014). Diffusion of innovations. In An integrated approach to communication theory and research (pp. 432–448). Routledge.

Saini, A., & Johnson, J. L. (2005). Organizational capabilities in e-commerce: An empirical investigation of e-brokerage service providers. Journal of the academy of marketing science, 33(3), 360–375.

Sambamurthy, V., Bharadwaj, A., & Grover, V. (2003). Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms. MIS Quarterly, 27(2), 237–263.

Teece, D. J. (2007). Explicating dynamic capabilities: the nature and micro foundations of (sustainable) enterprise performance. Strategic Management Journal, 28(13), 1319–1350.

Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J. Q., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. Journal of Business Research, 122, 889–901.

Vial, G. (2021). Understanding digital transformation: A review and a research agenda. Managing Digital Transformation, 13–66.