Research in Globalization 11 (2025) 100326

Contents lists available at ScienceDirect

Research in Globalization

journal homepage: www.sciencedirect.com/journal/research-in-globalization

Trade and governance in developing Asia: the role of FinTech in shaping institutional quality and global integration

Ramsha Saleem [a], Mubasher Iqbal [b,*], Noman Arshed [c], Judit Oláh [a,b,d,e,f,*], Muhammad Naeem [g]

[a] Lahore College for Women University, Lahore, Pakistan
[b] Department of Economics and Quantitative Methods, University of Management & Technology, Lahore, Pakistan
[c] Department of Business Analytics, Sunway Business School, Sunway University, Selangor, Malaysia
[d] John von Neumann University Doctoral School of Management and Business Administration, 6000 Kecskemét, Hungary
[e] Faculty of Economics and Business, University of Debrecen 4032 Debrecen, Hungary
[f] Department of Management, Faculty of Applied Sciences, WSB University, Poland
[g] Department of Economics, Division of Management and Administrative Science, University of Education, Lahore, Pakistan

ARTICLE INFO

Keywords:
Trade openness
Globalization
Governance
FinTech
EC

ABSTRACT

Weak Governance infrastructures are usually considered as main reason behind the poor economic performance of developing countries. In this context, SDG_{16} is particularly designed for peace, justice, and strong institutions. Considering the increasing economic integration among nations, this study has proposed a model in which trade openness is taken as a key driver of governance improvement. Several studies also exist against economic integration; they claim that globalization works in favor of developed countries while against developing countries. However, this study is based on a panel of developing Asian countries for the period 1996 to 2022. panel quantile and Driscoll-Kraay two-step ECM methods are the key econometric approaches of this study, one of robust for non-normality, while the other is for cross-sectional dependence, respectively. This study has confirmed that trade openness initially promotes institutional improvement. But a consistent trade openness expansion eventually brings it down. Financial technologies (FinTech) are taken as a determinant of governance and a moderator of trade openness. It is confirmed that FinTech enhances governance quality and supports a more sustainable relationship between trade and institutions. Among control variables, inflation deteriorates governance quality, whereas educational expenditures and debt servicing contribute in favor of governance.

Introduction

In today's world of technological advancement, the benefits of globalization are evident everywhere. Particularly, it helps in achieving sustainable development (Uddin et al., 2023). With the emergence of the United Nations, the importance of the SDG_s increased (United Nations, 2023). It required a sound governance roadmap, and usually, developing countries lack this aspect (WGI, 2024). Among SDG_s, SDG_{16} is exclusively designed for sustainability regarding peace, justice, and strong institutions. Strong institutions are the foundation of effective governance, as they facilitate enforcement of law in society. In this way maintenance administrative capacity becomes easy and society observes protected property rights through improved regulatory quality. As described by Acemoglu and Robinson in *Why Nations Fail*, nations succeed when institutions are inclusive, transparent, and accountable, while failure is rooted in extractive institutions that concentrate power and restrict economic freedom (Acemoglu & Robinson, 2012). Sound institutional framework, further controls corruption and in this way political stability emerges, as a result, a steady state of economic development becomes easy to achieve (Rhodes, 2007).

Apart from these social benefits, economic development is also subject to institutions. Countries with strong institutions experience higher investment, inclusive growth, and social stability. Oppositely, those with institutional weaknesses often face policy failures, capital flight, and long-run economic stagnation (Azimi et al., 2025). For developing countries, governance emerges as a fundamental pillar to reinforce institutional resilience and achieve long-term developmental goals (Fischer and Nisa, 2025). In the light of growing economic integration and the role of international trade in development, it is quite expressive for developing countries to broaden their economic prospects

* Corresponding authors at: Lahore College for Women University, Lahore, Pakistan.
E-mail addresses: ramsha.saleem@lcwu.edu.pk (R. Saleem), mubasheriqbal88@gmail.com (M. Iqbal), nomana@sunway.edu.my (N. Arshed), olah.judit@econ.unideb.hu (J. Oláh), muhammad.naeem@ue.edu.pk (M. Naeem).

https://doi.org/10.1016/j.resglo.2025.100326
Received 6 August 2025; Received in revised form 25 November 2025; Accepted 25 November 2025
Available online 26 November 2025

by participating into global markets (Akçay, 2025). In this way, they will get the chance to explore new economic activities, promote productive efficiency through access to scale economies, and encourage the attainment of advanced technologies (Kablamaci, 2019). Grounded in institutional theory and the trade governance nexus framework, this study views trade openness not only as a catalyst for economic growth but also as a channel to influence institutional quality through development (Al-Marhubi, 2007). In this way, this study aligns with SDG_{16}, which emphasizes peace, justice, and strong institutions.

This study is designed for developing Asian countries to test how trade liberalization helps in determining governance. However, Fig. 1 is constructed to analyze the governance trend in those countries. It reflects the overall trend of governance indicators (Each line shows the trend of the composite governance index constructed from six governance indicators). As per WGI, governance indexes range from −2.5 to 2.5. For developing Asian countries, the situation is quite disappointing; the average trend of governance falls in a negative phase because −2.5 is for the worst and 2.5 is for the best.

Generally, discussing developing countries, their economic structure falls in the emerging phase. However, their dependency on trade can enhance the pace towards economic growth (Chen & Groenewold, 2019). The mechanism behind it is simple. Expansion in trade empowers domestic economic actors on production and consumption grounds. As a result, it paves the way for a favorable environment for institutional development. In this situation, the question is how trade liberalization is managed. It could be said that trade openness, when effectively managed, becomes a robust driver for shaping governance structures towards sustainability, or the attainment of SDG_{16} (Bisiriyu & Dhar, 2025).

Financial Technologies (FinTech) combines finance with technological advancements enhance financial service delivery, and to support efficient governing practices (Aghili, 2024). It facilitates financial inclusion, strengthens market performance, and increases transparency in transactions (Ahmed and Huo, 2021). The contribution of FinTech in governance lies in its ability to modernize institutional operations and support digital financial solutions. As a structural factor, FinTech not only influences governance directly but can also act as a moderating variable in the relationship between trade openness and governance (Alemu et al., 2025). It interacts with effectiveness of trade openness and moderates it by allowing smoother financial operations leading to promote institutional sustainability through FinTech-oriented mechanisms (Bian et al., 2024).

Institutional theory and the trade governance nexus framework is the key motivation of this study to test how trade openness and financial technologies influence governance structures in developing Asian economies. The use of governance in institutional performance is largely done in the literature, but as a regressor or an independent factor towards sustainability. Whereas in this study it is taken as predicted factor along with its key determinants particularly for developing Asian countries, offering a reverse and less discovered perception that complements the existing literature. In the partially relevant studies this area is considered linearly for a diverse set of countries, which limits contextual insights of institutional framework sustainability. Given that governance is shaped by both external economic engagement and internal structural capacities, this study explores how trade openness may exert a non-linear effect on governance, reflecting the idea that benefits may diminish or reverse beyond certain thresholds. The first objective is to test the non-linear impact of trade openness on governance quality. The second is to examine the determining role of FinTech, which may enhance transparency and institutional performance, and to assess its interaction with trade openness in shaping governance. Lastly, the study investigates how key macroeconomic controls such as inflation, education, and debt servicing contribute to governance in the selected region.

The first section was the introduction, and already done. Literature on this subject is discussed in the second section; it also holds the research gap and how the present study claims novelty. The data collection and empirical models are described in the third section, while the interpretation is in the fourth section. The last section of the study holds some concluding remarks along with some policy implications and the study's limitations.

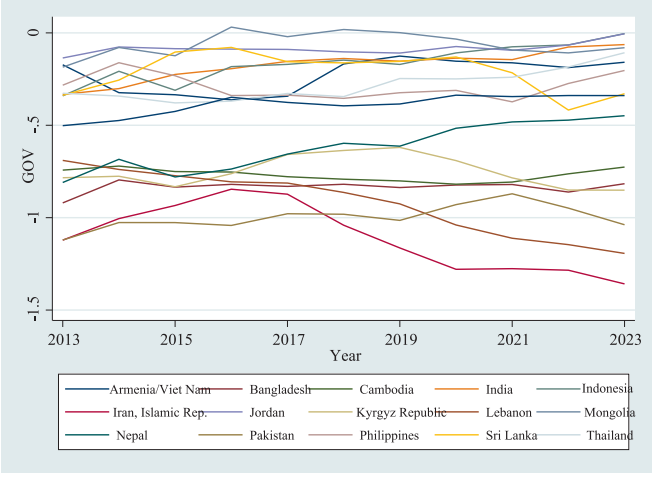

Fig. 1. Overall trend of governance over time. .
source: self-constructed

Literature review

In this study, determinants of governance are part of the discussion. A massive part of the literature exists that has examined the impact of governance in achieving different angles of sustainability. But the drivers of governance side were missing. To maintain the economic performance, developing countries are heavily dependent on trade, though mostly developing countries bear a trade deficit, their survival depends on trade. As trade runs the economic cycle, it also determines the performance of institutions (North, 1990; Williamson, 2000). Economic integration caused the direct involvement of developed nations with the developing world, so it assures the transparency and accountability of institutions. It also highlights weaknesses in political and regulatory systems (Ali, Fiess, and MacDonald 2010; Busse and Hefeker 2007). In developing countries, trade eliminates financial deficiencies. Expanded economic integration increases human capital, physical capital, financial capital, and social capital with economic development that brings institutional sustainability (Janowski, 2015; Lee et al., 2021; Lee-Geiller, 2024).

Studies have differently tested the impact of trade liberalization on governance performance. For instance, Jiao and Wei (2017) observed that trade openness improves governance and reduces corruption, while Kablamaci (2019) found it beneficial for electoral democracy. Nam et al. (2023) reported a trade-off where trade openness boosts economic growth but can harm human development unless accompanied by strong governance and foreign investment. Asongu and Nwachukwu (2019) emphasized the role of digital technologies in amplifying the governance impact of openness. Similarly, Hussain et al. (2021) linked openness with renewable energy investment through better governance. However, Fankem and Feyom (2024) noted that while trade openness improves public and political governance, it may weaken institutional governance under specific conditions. Acemoglu et al. (2020) and Mohamed Sghaier (2023) warned that trade openness can worsen corruption and inequality where institutional resilience is lacking. Zhang et al. (2020) and Li and Reuveny (2003) also echoed this concern in politically fragile states. Mamba (2021) on the other hand, argued that trade alone is not determines institutional outcomes without backed by structural economic policies. Kojo Ayesu et al. (2022) and Azmeh (2025) has explored another dimension and acknowledged that trade expansion improves the social side of developing countries. Another aspect of these

indicators also exists, as evidenced by the findings of Koh et al. (2022), which are quite interesting. They find that in the Asia-Pacific, trade openness and stronger governance reduce inequality, while educational attainment unexpectedly widens it.

In the current period when economic stability has a huge importance, efficient financial services reduce transaction costs and increase transparency (Tuccaroglu et al., 2025). In the same context, Alaassar et al. (2023) have argued that FinTech helps limit corruption through digital financial services and mobile banking. Evidence from developing countries confirms that FinTech supports institutional quality and encourages economic participation, which improves government accountability (Azmeh, 2025). Li et al. (2025) find that digital inclusive finance boosts China's trade performance through technological innovation, with regional heterogeneity shaped by market, structural, and regulatory factors. However, in regions like Sub Saharan Africa and Latin America, weaker institutions limit the positive effects of trade openness and FinTech on governance (Sghaier, 2023). Still, several studies show that FinTech supports growth, discipline in the banking sector, and stronger governance outcomes (Ahmed and Huo, 2021; Ye et al., 2023; Xu, 2024). In Asia, institutional governance, trade openness, and real output influence financial development, but social and ownership patterns often limit progress toward global governance standards (Ellahi et al., 2021). These studies highlight clear gaps. First, the non-linear relationship between trade openness and governance is still underexplored. Second, FinTech as a structural factor adds value to governance but needs more attention in regional contexts. Lastly, Asian countries remain understudied in this area. This study aims to fill these gaps by focusing on trade openness, governance, and FinTech, and offering new insights from the Asian region.

In the developing countries, inflation cannot be overlooked. The negativity of the inflation can be recognized in a way that it affects institutional performance by affecting public trust and economic management. Several studies confirm that inflation weakens development outcomes. Uddin et al. (2023) find that inflation reduces human development, whereas stronger governance enhances it. Martell (2024) reports that inflation and high interest rates strain local government finances, weakening governance capacity. Minea et al. (2021) highlight that inflation targeting improves institutional quality. Similarly, Abaidoo and Agyapong (2023) show that governance boosts financial development, and they also validate that strong institutions moderate the harmful effect of inflation uncertainty on financial efficiency.

Education is an important part of human capital, particularly for developing countries. The East Asian miracle is its best example (Stiglitz, 1996). Several studies support the positive role of education in improving governance and economic sustainability. Education enhances democratic values (Karış & Tandoğan, 2019; Apergis, 2018), promotes civic participation (Reimers, 2023), and strengthens economic institutions (Pargianas, 2024). It also improves governance through social responsibility and justice (Cadenillas Albornoz et al., 2023). However, Leogrande and Costantiello (2023) report a negative link between education spending and government effectiveness, raising questions about spending efficiency.

Existing literature underscores the relationship between debt and governance. While studies by Kemoe and Lartey (2022) and Ramzan et al. (2023) suggest that public debt undermines growth, they also reveal that strong governance, particularly government effectiveness and low corruption, can ease this burden. Abbas et al. (2021) and Ali and Al Yahya, (2019) further confirm that good governance helps manage debt efficiently. Similarly, Asongu and Roux (2024) and Shi et al. (2024) link governance quality to lower debt service pressure and improved financing conditions. In light of the findings of these studies, it could be said that debt servicing pressures can affect fiscal space and government performance.

Governance literature is vast, but studies have considered its role in achieving the other SDGs. Like the role of governance, for environmental and energy sustainability. Studies also exist that have tested its role for social development, using Social Progress and Human Development Indexes, and some studies have focused on poverty. But there was a need for a comprehensive study that tested what determinants drive governance. For this purpose, this study has taken trade openness as a key driver of governance, particularly for developing Asian countries. Studies like Nam et al. (2023) and Fankem and Feyom (2024) exist that tried to do this, but their analysis is linear in nature. In this study, a quadratic relationship between trade openness and governance is assumed. Unlike the existing literature, a composite index of six governance indicators has been considered. Through this study, it will be quite easy to test how trade quadratically impacts Voice & Accountability, Political Stability and Lack of Violence, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption equally.

The empirical model of this study is further strengthened through the incorporation of FinTech. Studies like Li et al. (2025) and Tuccaroglu et al. (2025) have tested its impact on institutions. While Khanchel et al. (2025) have tested the impact of FinTech impact of the social side. Still, the impact of FinTech as a determinant and as a moderator of trade openness was missing. So, these gaps this study is designed to address. FinTech has the potential to bring transparency and improve the quality of governance. But how this mechanism works in the case of trade openness is still not clearly explained, especially for developing Asian countries where institutions are still growing and often face different challenges (Law & Azman-Saini, 2012).

Data, Variables, and research Design

This section is further divided into some subsections. First of all, section 3.1 describes the data collection and the sample size of this study. Section 3.2 is about the conceptual model, and it holds the baseline theories regarding how trade openness determines governance and under which framework FinTech moderates the trade-governance mechanism. Section 3.3 describes the suitability of Two Step Panel Quantile ECM, Two Step Driscoll-Kraay ECM, FMOLS, Principal Component Analysis, and Visual Moderating Effect. Section 3.4 discusses the econometric model of this study.

Variables and sample

This study relies on secondary data. For this purpose, World Development Indicators (WDI) and Worldwide Governance Indicators (WGI) have been used. This study has considered the period 1996 to 2022, selected based on data availability across variables and countries (The complete country list is in the appendix via Table 5). Following the World Bank income classification, this study includes in its analysis developing Asian countries that fall under the lower-middle-income and upper-middle-income categories. For Asia, all these countries have been selected whose data were available.

Table 1 provides a brief overview of all variables used. The dependent variable is the governance index (GOV), constructed using Principal Component Analysis (PCA) by combining six key dimensions: voice and accountability, political stability and absence of violence or terrorism, government effectiveness, regulatory quality, rule of law, and control of corruption (Arshed et al., 2021). These indicators range from −2.5 (weak governance) to 2.5 (strong governance). The FinTech index (FINTECH) is constructed as a composite indicator reflecting financial development and the availability of mobile and internet services, also based on WDI data (Iqbal et al., 2024). Role of trade is incorporated using trade openness as a percentage of GDP (TRD). In this study its square term (TRD^2) is included to capture a possible quadratic function (Chiang & Wainwright, 2005). The comprehensiveness of the model is maintained through control variables. Inflation (INF) is measured through annual consumer prices. The incorporation of inflation reflects the role of macroeconomic stability. The role of general public awareness is considered through the education expenditures (% of GNI).

Table 1
Variables' Description.

Variables (Symbol)	Definition	Source
Governance (GOV)	Composite index of six governance indicators.[1]	WGI
Trade (TRD)	Trade % of GDP.	WDI
Trade Square (TRD^2)	Square of trade % of GDP.	WDI
Inflation (INF)	Inflation, consumer prices (annual %).	WDI
Education (EDU)	Education expenditure (% of GNI).	WDI
Debt Servicing (DS)	Debt service (PPG and IMF only, % of exports of goods, services and primary income).	WDI
Financial Technologies (FINTECH)	Composite index of financial development, mobile and internet serviceability.	WDI
Financial Technologies (REM)	Net remittance inflows (% of GDP).	WDI

[1]Voice and Accountability, Political Stability and Absence of Violence/ Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption.

Usually, developing countries are trapped in debt. So, debt servicing is also included. It shows debt service payments on public and publicly guaranteed debt and IMF credits, measured as a percentage of exports.

To test the robustness of FINTECH, this study has introduced REM. It shows the inflow of foreign remittances as a share of GDP. However, these transfers follow mobile banking, online payment systems, and digital money transfer platforms. So, this is the reason it is considered a proxy of FinTech.

Conceptual model

This study has tried to develop a model in which it is assumed that governance is shaped by both external and internal factors (Al-Marhubi, 2007). Here, trade openness is considered as an external model. Based on institutional theory and the trade governance nexus framework, it is assumed that in the early phase of trade expansion, developing countries also enjoy the benefits through an improved form of governance. It happens because trade causes to increase in the income flow, expanding the production and consumption side. In this way, the government also earns, and the deficiency of resources starts to decline (Kablamaci, 2019; Sghaier, 2023). However, studies exist that claim economic integration exploits developing countries (Hickel et al., 2024). Eventually, a turning point comes where further expansion in trade deteriorates the governance features. Possibly, it can be a cause of over-imports that caused damage to the trade balance and led to an increased dependency on developed nations.

FinTech is considered both a direct determinant and a moderator of governance. As a determinant, it enhances financial access, transparency, and efficiency in service delivery. As a moderator, FinTech supports the influence of trade openness by digitizing financial systems, reducing leakages, and strengthening accountability (Alemu et al., 2025). This interaction is assumed to promote sustainable governance outcomes, as shown in Fig. 2A. An inverted U-shaped relationship is quite clear. This function is also transformed through the interaction of FinTech. This phenomenon is further described using Fig. 2(B). Where Governance is dependent on trade openness, and FinTech is moderating this relationship.

The study targets developing countries in Asia, where the trade openness governance relationship can follow either a U-shaped or an inverted U-shaped pattern depending on the level of institutional development and digital transformation. Primarily, this study assumes it is an inverted U-shaped. The proposed model reflects how the integration of FinTech with trade strategies can strengthen governance in emerging Asian economies.

Estimation approaches

Two step panel quantile ECM

This study adopts a two-step panel quantile error-correction model

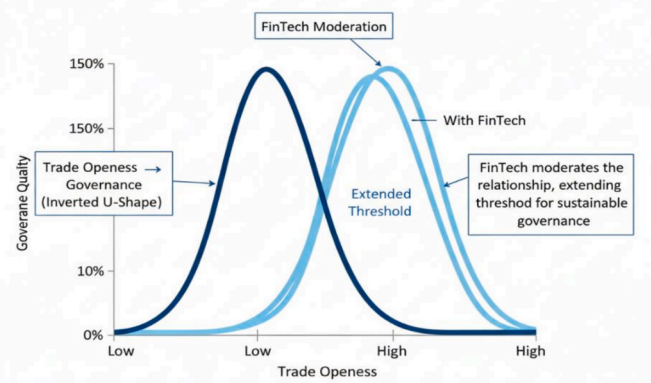

Fig. 2A. Conceptual model. .
Source: self-constructed

(ECM). This econometric approach helps to explore both the long-run equilibrium and short-run dynamics. This technique also provides different conditional distributions of the dependent variable (Machado & Santos Silva, 2019). In this study, it is demonstrated in Fig. 5. In this way, heterogeneity and non-normality in panel data is addressed (Arshed et al., 2025). Unlike mean based estimators, this approach uncovers asymmetries in the adjustment process and highlights country specific resilience or vulnerabilities. This feature makes it especially useful in policy-oriented studies where one-size-fits-all inferences could be misleading (Koenker, 2004; Lamarche, 2010).

In the first step, we estimate the long-run relationship using a static panel data model as shown by equation 1. Where, Y_{it} represents the dependent variable, $X_{k,it}$ are the explanatory variables, a_i captures the individual-specific fixed effects, and ε_{it} is the error term. The residuals $\hat{\varepsilon}_{it}$ are extracted as the long-run disequilibrium error. In the second step, we estimate the short-run dynamics and adjustment mechanism using a panel quantile regression form of the ECM as shown by equation 2. Where, $Q_\tau(.)$ denotes the conditional quantile function at quantile τ. ΔY_{it}, $\Delta X_{j.it}$ are first-differenced forms. ϕ_τ captures the speed of adjustment toward the long-run equilibrium. γ_j reflects the marginal effects of changes in explanatory variables at quantile τ. $u_{it}(\tau)$ is the quantile-specific error term.

$$Y_{it} = a_i + \beta_1 X_{1,it} + \beta_2 X_{2,it} + \cdots + \beta_k X_{k,it} + \varepsilon_{it} \quad (1)$$

$$Q_\tau(\Delta Y_{it}|Z_{it}) = \phi_\tau \hat{\varepsilon}_{i,t-1} + \sum_{j=1}^{k} \gamma_j(\tau)\Delta X_{j,it} + u_{it}(\tau) \quad (2)$$

Two step Driscoll-Kraay ECM

This study employs the two-step panel error correction model with Driscoll-Kraay standard errors, which accounts for cross-sectional dependence, heteroscedasticity, and autocorrelation across panel units (Driscoll & Kraay, 1998; Hoechle, 2007). Beyond its robustness to cross sectional dependence, the two step Driscoll and Kraay ECM is valuable because it does not require a balanced panel or homogeneity across countries, which is often unrealistic in developing Asian economies. It also remains consistent even when the time dimension is relatively small compared with the cross section. This flexibility makes it a reliable tool when analyzing heterogeneous panels over long periods, where institutional and structural variations can otherwise bias results (Vogelsang, 2012).

In the first step, we estimate the long-run relationship using a static panel data model as shown by equation 1. But in the second step, we estimate the short-run dynamics and adjustment mechanism using a panel quantile regression form of the ECM as shown by equation 3. Equation 3 is quite similar to equation 2. However, EC_{it-j} is the lagged error correction term derived from the residuals of the long-run model. γ

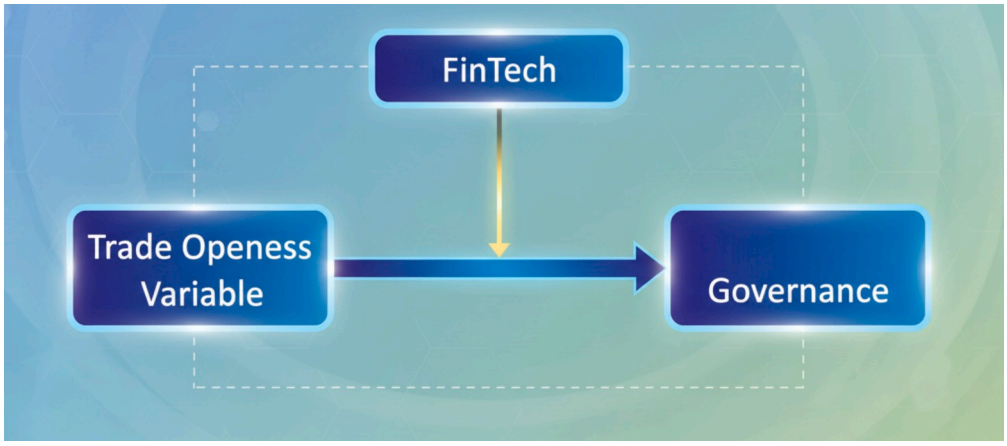

Fig. 2B. Conceptual model. .
Source: self-constructed

measures the speed of adjustment to the long-run equilibrium and η_{it} is the short-run disturbance term.

$$\Delta Y_{it} = \beta_0 + \sum_{k=1}^{p} \beta_k \Delta X_{it-k} + \sum_{j=1}^{q} \theta_k \Delta Z_{it-j} + \gamma EC_{it-j} + u_i + \eta_{it} \tag{3}$$

FMOLS

Fully Modified Ordinary Least Square (FMOLS) adjusts for endogeneity and serial correlation in the cointegrating regression. This method is based on semi parametric adjustments, letting heterogeneous intercepts across cross-sections (Pedroni, 2000, 2001). Aligned with equation 4, β estimated by FMOLS is valid even when regressors are endogenous and error terms are serially correlated. The baseline FMOLS equation for panel data is similar to the standard cointegration regression, but the estimation modifies the Ordinary Least Square (OLS) estimator to robust for serial correlation and endogeneity. The FMOLS adjusts the OLS coefficient $\widehat{\beta}$ by spread on corrections on the basis of long-run covariance of the residuals and first differences of the regressors as shown by equation 5. Where, $(y_{it} - \overline{y}_i)^*$ is the bias-corrected dependent variable that accounts for serial correlation and endogeneity (Pedroni, 2000). This estimator directly brings the long run coefficients $\widehat{\beta}_{FM}$ that are robust to feedback effects and serial correlation, certifying valid inference in the presence of cointegration relationship in the model.

$$y_{it} = \alpha_i + \beta' x_{it} + \varepsilon_{it} \tag{4}$$

$$\beta_{FM} = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} (x_{it} - \overline{x}_i)(x_{it} - \overline{x}_i)' \right)^{-1} \left(\sum_{i=1}^{N} \sum_{t=1}^{T} (x_{it} - \overline{x}_i)(y_{it} - \overline{y}_i)^* \right) \tag{5}$$

Principal component analysis

To estimate the composite indices of governance and FinTech, this study employs Principal Component Analysis (PCA) is a multivariate dimensionality reduction technique that transforms a correlated set of indicators into a smaller number of uncorrelated principal components (Jolliffe & Cadima, 2016). The first principal component, which captures the maximum variance among the original variables, is used as the representative index. Let the dataset consist of n observations and k standardized indicators. The general form of PCA can be expressed through equation 6.

Where PC is the principal component, $X_1 + X_2 + \cdots + X_k$ are the standardized original variables. w_{1j} are the component loadings (eigenvectors) representing the weights assigned to each indicator. The weights are derived by solving the following eigenvalue problem as shown by equation 7. Where Σ is the variance–covariance matrix of the standardized indicators, λ denotes the eigenvalues, and w represents the corresponding eigenvectors. The resulting component scores are then normalized to construct the governance and FinTech indices, facilitating their use in regression analysis.

$$PC = w_{11}X_1 + w_{12}X_2 + \cdots + w_{1k}X_k \tag{6}$$

$$\Sigma w = \lambda w \tag{7}$$

Visual moderating effect

This method is considered to strengthen the visual aspect of the study. It plots simple slopes of the independent variable at high and low levels (*typically* ± 1*SD*) of the moderator, enabling a clear comparison of conditional effects (Dawson, 2014). This technique helps researchers determine whether the moderator strengthens, weakens, or reverses the proposed function. By presenting interaction effects graphically, it enhances interpretability beyond traditional coefficient-based explanations, especially in complex models. This method is widely used to support empirical findings with visual evidence of moderating dynamics, making it suitable for studies exploring contextual or conditional relationships in panel data or multivariate frameworks.

Econometric models

The econometric models of this study are presented by equations 6, 7 and 8. Primarily talking about equation 6, it reflects the long run model to be estimated using both PQR and Driscoll-Kraay two-step ECM methods. The dependent variable is on left hand side of equation. On right hand side a_i is the intercept and βs are the coefficients of each regressor. Further, ε_{it} is the error term. Equation 7 contains the short run coefficients along with convergence coefficient of PQR, and equation 8 for Driscoll-Kraay method. In equation 7, ΔGOV_{it}^{τ} is the conditional quantile change in governance, X_{it} includes all regressors from the long-run model, ECT_{it-1} is the lagged error correction term from the long-run equation, ϕ^{τ} shows the speed of adjustment. Quantile-specific dynamics are captured by τ (e.g., 25_{th}, 50_{th}, 75_{th} quantile). While the quite similar things are presented in equation 8.

$$\begin{aligned} GOV_{it} = {} & a_i + \beta_1 TRD_{it} + \beta_2 TRD_{it}^2 + \beta_3 INF_{it} + \beta_4 EDU_{it} + \beta_5 DS_{it} \\ & + \beta_6 FINTECH_{it} + \beta_7 (FINTECH_{it} * TRD_{it}) + \beta_8 \left(FINTECH_{it} * TRD_{it}^2\right) \\ & + \varepsilon_{it} \end{aligned} \tag{6}$$

$$\Delta GOV_{it}^{\tau} = \gamma_0^{\tau} + \sum_{k=1}^{p} \gamma_k^{\tau} \Delta X_{it-k} + \phi^{\tau} ECT_{it-1} + u_{it}^{\tau} \tag{7}$$

$$\Delta GOV_{it} = \delta_0 + \sum_{k=1}^{p} \delta_k \Delta X_{it-k} + \lambda ECT_{it-1} + \eta_{it} \quad (8)$$

These proposed econometric models are grounded in strong theoretical and empirical foundations. Prior studies such as Mohamed Sghaier (2023) and Fankem and Feyom (2024) have taken governance as a dependent variable against several economic determinants. However, the literature still lacks clarity on the non-linear effect of trade openness on governance. While Hussain et al. (2021) support the positive effect of trade, Zhang et al. (2020) highlight its negative implications. Building on this, the current study incorporates trade openness in a non-linear form, assuming its influence may follow a U-shaped or inverted U-shaped path. Inflation, education, and debt servicing are considered critical control variables, particularly relevant to developing economies. Following Uddin et al. (2023) and Martell (2024), this study assumes that inflation weakens governance by increasing macroeconomic uncertainty. In contrast, education and debt servicing are the controls with opposite assumptions. Education expenditures are responsible for awareness creation, while debt servicing shows a reduction in the debt. Relying on the findings of Apergis (2023) and Pargianas (2024), this study assumes that education improves governance structures. Studies also exist in favor of debt servicing (Abbas et al., 2021; Shi et al., 2024). It is assumed that debt servicing improves governance, as well.

The literature is vast on the subject of FinTech and the sustainability through digitalization, transparency, and accountability. In this study, FinTech is included as both a direct determinant and a moderator. This study has considered Ahmed and Huo (2021), Ye et al. (2023), Iqbal et al. (2024), and Ghouse and Iqbal (2024). Aligning with the methodologies and the findings of these studies, it is expected that FinTech is beneficial to improve institutional performance and strengthen the trade–governance connection.

Interpretation of the estimated results

Based on the descriptive statistics presented in Table 2, the governance index (GOV) has a mean value of approximately −0.009, indicating variation across countries with both positive and negative governance scores. The standard deviation of 1.013 reflects moderate dispersion. Trade openness (TRD) shows significant variation, ranging from 21.459 to 186.428, with a mean of 77.366, suggesting differing levels of global integration among the sampled countries. Inflation (INF) reveals substantial volatility, with extreme values from −3.749 to 171.205, and a high standard deviation of 13.713, reflecting macroeconomic instability in certain cases. Education (EDU), measured as a percentage of GDP, shows relatively moderate dispersion, while debt servicing (DS) presents high variability, underscoring the diverse fiscal responsibilities of countries. The FinTech index, constructed through PCA, exhibits both positive and negative scores, with a mean near zero and a standard deviation of 0.903, highlighting variation in digital financial penetration.

The normality of the variables is tested through the Jarque–Bera (JB) test (Jarque & Bera, 1980). This test follows skewness (to analyze symmetry) and kurtosis (to analyze the heaviness of the tails). The significant test statistic of this test for all the variables confirms the rejection of the null hypothesis of this test. The H_0 of this test states that variables are normally distributed. As with the 1 % level, the rejected H_0 confirms the departure from normality. Regarding the econometric approach of this study, the usefulness of the two-step panel quantile ECM method is confirmed. As PQR is based on the median and it is not affected by the extreme values. The normality concerns emerge due to extreme values, and the median is not affected by extreme values; as a result, this technique provides robust findings.

Table 2
Summary Statistics.

Statistic	GOV	TRD	INF	EDU	DS	FINTECH
Mean	−0.009	77.366	8.282	3.006	8.579	−0.083
Median	−0.118	71.682	5.668	2.891	7.111	−0.336
Maximum	2.274	186.428	171.205	7.1700	37.793	3.720
Minimum	−2.077	21.459	−3.749	0.600	0.124	−1.212
Std. Dev.	1.013	37.579	13.713	1.245	7.0803	0.903
Obs	413	413	413	413	413	413

GOV = Governance, TRD = Trade Openness, INF = Inflation, EDU = Education, DS = Debt servicing, FINTECH = Financial Technology

The descriptive statistics aspect of this study is further strengthened through Fig. 3. It is also considered a pre-regression diagnostic test. This comprehensive figure has four components. Firstly, the QQ plot describes whether the governance follows a normal distribution or not. The scattered Vs from the central line are showing a significant departure from normal distribution. Besides the QQ plot, there is a histogram; the red line shows the required pattern, but the actual pattern is quite different from the bell shape. So, another test has reported the non-normality. The other two portions are for association. The scatter plot also contains the moderating effect. An inverted U-shaped association between trade liberalization and governance is confirmed (red line). But when the role of FinTech is considered, this association has changed, but still follows an inverted U-shape. To test whether multicollinearity exists, a correlation heatplot is presented. The association among all regressors is weak. It implies that our proposed model does not have any multicollinearity problem.

Tables 3, 4, 5, and 6 represent the estimated results of this study. The key findings are in Tables 3 and 4. Table 5 is for the robustness of the findings of tables two-step panel quantile ECM and Driscoll-Kraay ECM using FMOLS. Table 6 is also for robustness, but through a different angle. In this study, foreign remittances inflows have been considered. At present, remittance flows rely heavily on mobile banking, online payment systems, and digital money transfer platforms. As a result, higher remittances often reflect stronger financial technology use in an economy (Niankara & Traoret, 2023).

All the estimated results have confirmed a quadratic relationship. As per our findings, it implies that due to continuous expansion, initially trade expands the positivity through better governance quality and robust institutional performance. This aspect of economic globalization is aligned with studies including Němečková and Hayat (2022) and Fankem and Feyom (2024). But these circumstances could not prevail for a long period of time. Due to over-liberalization, institutional performance comes down. These adverse impacts are validated by Acemoglu and Robinson (2012) and Mohamed Sghaier (2023). Here, there is a need to revisit the economic structures of developing countries. Usually, developing countries suffer from a trade deficit (M > X). The adverse trade liberalization impacts are subject to over-dependency on trade (Iqbal et al., 2019).

Estimated results have confirmed that the impact of trade openness can be strengthened through the incorporation of FinTech in the model and the attainment of SDG_{16} can be assured. Consistent with the institutional theory and trade-governance nexus, our findings have confirmed that FinTech as a determinant enhances governance by improving financial access. The technological driven financial system also assures transparency, and provide a satisfactory service delivery. When FinTech interacts with trade openness, the inverted U-shaped relationship transforms into a U-shaped pattern (the coefficients of interaction terms). This indicates that FinTech moderates the adverse effects of excessive trade by digitalizing financial systems and supporting accountability structures, thus contributing to governance resilience. These findings are consistent with Ahmed and Huo (2021) and Ye et al. (2023), who highlight the transformative role of FinTech in improving institutional performance and reinforcing sustainable governance outcomes.

The estimated findings identify interesting patterns regarding control variables. Inflation erodes governance quality in developing Asian nations by significant amounts, as predicted by the institutional

Table 3
PQ and Driscoll-Kraay Long Run Results.

	PQ Long Run Estimates			Driscoll-Kraay Long Run Estimates		
Variables	**Coeff.**	**Std. Error**	**Prob.**	**Coeff.**	**Std. Error**	**Prob.**
TRD	0.05051***	0.00821	0.000	0.03966***	0.00397	0.000
TRD^2	−0.00028***	4.61E-05	0.000	−0.00024***	0.00002	0.000
INF	−0.01182***	0.00445	0.008	−0.00989***	0.00220	0.000
EDU	0.18842***	0.05952	0.001	0.23474***	0.07543	0.007
DS	0.03420**	0.00844	0.000	0.03160***	0.00238	0.000
FINTECH	0.76919*	0.45177	0.089	0.87577*	0.33578	0.020
FINTECH*TRD	−0.02543*	0.01303	0.051	−0.02996***	0.00874	0.004
$FINTECH*TRD^2$	0.00021***	7.69E-05	0.004	0.00023***	0.00005	0.001
C	−2.71101***	0.30679	0.000	−2.23014***	0.19249	0.000

*Significance levels: ***p < 0.01, **p < 0.05, *p < 0.10
GOV = Governance, TRD = Trade Openness, INF = Inflation, EDU = Education, DS = Debt servicing, FINTECH = Financial Technology

Table 4
PQ and Driscoll-Kraay Short Run Results.

	PQ ECM			Driscoll-Kraay ECM		
Variables	**Coeff.**	**Std. Error**	**Prob.**	**Coeff.**	**Std. Error**	**Prob.**
Δ(TRD)	0.00827*	0.00451	0.067	0.00777**	0.00315	0.026
$\Delta(TRD^2)$	−3.39E-05	2.14E-05	0.114	−0.00003	0.00001	0.102
Δ(INF)	−0.00258**	0.00103	0.013	−0.00308***	0.00066	0.000
Δ(EDU)	0.00153	0.03207	0.961	−0.00922	0.02159	0.675
Δ(DS)	0.00721***	0.00185	0.000	0.00535**	0.00247	0.047
Δ(FINTECH)	0.30623**	0.13179	0.020	0.22572**	0.09320	0.029
Δ(FINTECH*TRD)	−0.00914***	0.00293	0.002	−0.00750***	0.00216	0.003
$\Delta(FINTECH*TRD^2)$	4.62E-05***	1.71E-05	0.007	0.00004***	0.00001	0.008
ECM	−0.02115*	0.01117	0.059	−0.04084***	0.00942	0.001

*Significance levels: ***p < 0.01, **p < 0.05, *p < 0.10
GOV = Governance, TRD = Trade Openness, INF = Inflation, EDU = Education, DS = Debt servicing, FINTECH = Financial Technology

Table 5
FMOLS Estimates (Robustness).

Variables	**Coeff.**	**Std. Error**	**Prob.**
TRD	0.0097***	0.0027	0.001
TRD^2	−6.14E-05***	1.39E-05	0.000
INF	−0.0028**	0.00093	0.002
EDU	0.1458***	0.0217	0.000
DS	0.0156***	0.0022	0.000
FINTECH	0.3884***	0.1229	0.001
FINTECH*TRD	−0.0151***	0.0027	0.000
$FINTECH*TRD^2$	0.00010***	1.44E-05	0.000

*Significance levels: ***p < 0.01, **p < 0.05, *p < 0.10
GOV = Governance, TRD = Trade Openness, INF = Inflation, EDU = Education, DS = Debt servicing, FINTECH = Financial Technology

degradation theory, based on which macroeconomic instability degrades institutional performance and distorts administrative capacity (Martell, 2024; Uddin et al., 2023). Education and debt servicing, serve to reinforce governance. These empirical results correspond with human capital theory and fiscal prudence models, respectively. Educations increase governance by exercising civic consciousness, responsibility, and participatory involvement (Apergis, 2018; Pargianas, 2024). Analogously, efficient debt servicing also indicates fiscal responsibility and institutional effectiveness, which enhance investor confidence and regulatory reputation, thus enhancing the quality of governance (Abbas et al., 2021; Shi et al., 2024). These regulating factors influencing power further endorse the role of macro-financial stability and educational growth in acting as catalysts for institutional resilience in developing Asian nations.

In this study, the intercept is reported through C (Table 3 and Table 6). The intercept term is the representative of the dependent variable in the case when there is no regressor. Comparatively lower intercept in the quantile model (Table 3) highlights deeper structural weaknesses. Regarding the error correction mechanism, the ECM coefficient is –0.02115 in the Driscoll-Kraay model and –0.04084 in the quantile model. The negative and statistically significant values of ECM in both approaches confirm the existence of a stable long-run equilibrium. This indicates that any short-term deviations in governance performance are gradually corrected over time, supporting the reliability of the models in capturing the dynamics of governance in developing Asian

Table 6
Driscoll and Kraay Two Step ECM (Robustness).

Variables	**Coeff.**	**Std. Error**	**Prob.**	**Coeff.**	**Coeff.**	**Std. Error**	**Prob.**
TRD	0.028***	0.0098	0.008	Δ(TRD)	0.0086	0.0075	0.261
TRD^2	−0.00012*	6.01E-05	0.065	$\Delta(TRD^2)$	−2.7E-05	3.39E-05	0.428
INF	−0.0027**	0.00102	0.013	Δ(INF)	−0.0032**	0.00094	0.002
EDU	0.061	0.065	0.355	Δ(EDU)	−0.012	0.020	0.547
DS	0.011***	0.0031	0.002	Δ(DS)	0.0051*	0.0026	0.064
REM	0.101***	0.026	0.001	Δ(REM)	0.018	0.024	0.463
REM *TRD	−0.0021**	0.00077	0.010	Δ(REM*TRD)	−0.00037	0.00057	0.527
REM $*TRD^2$	8.99E-06*	4.81E-06	0.073	$\Delta(REM*TRD^2)$	1.11E-06	2.77e-06	0.691
C	−1.653***	0.337	0.000	ECM	−0.037***	0.0098	0.001

*Significance levels: ***p < 0.01, **p < 0.05, *p < 0.10
GOV = Governance, TRD = Trade Openness, INF = Inflation, EDU = Education, DS = Debt servicing, REM = Financial Technology

countries.

The post-regression diagnostics in the form of visuals are presented through Figs. 4, 5, and 6. To begin with, Fig. 4 it shows the moderating role of FinTech. Basically, it is a visualized version of regression analysis. It can be seen that trade initially improves the governance framework, but later on, it is responsible for deteriorating it. When FinTech enters the model, the function transforms completely and shifts upward, resulting in a significant delay in the turning point. It implies that FinTech enhances the desirable outcomes of trade.

The quantile process of the estimated model is presented in Fig. 5. Each part of this Figure is consistent with the overall findings. Prominently, on each quantile, the coefficient of trade liberalization is positive and negative for its square term. So, the heterogeneous inverted U-shaped relationship is also confirmed. Still, the coefficient of inflation is negative, and the coefficients of education expenditures and debt servicing are positive. It implies that on each quantile, inflation is responsible for governance deterioration, while education expenditures and debt servicing are responsible for improving it.

FinTech, as a determinant, shows a consistently positive influence across all quantiles. The interaction between trade and FinTech confirms a transformation in the association, promoting institutional sustainability. Fig. 6 illustrates that as governance improves across quantiles, the magnitude of the adjustment through the error correction term increases, indicating stronger and more efficient correction mechanisms over time.

Conclusion and policies

Primarily, this study is designed for developing Asian countries to determine how these countries can achieve SDG_{16}. For this purpose, the Two-step Driscoll-Kraay and Panel Quantile ECM methods are the key econometric approaches of this study. As per our assumptions and the pre-regression diagnostics have validated cross-sectional dependence, non-normal distribution of the dependent variable, and cointegration.

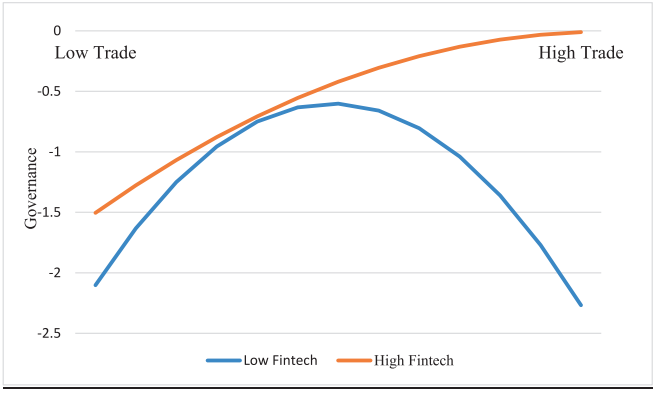

Fig. 4. Visual moderating effect. .
Source: self-constructed

The step Driscoll-Kraay ECM method is cross-sectional dependence robust. On the other hand, the two-step Panel Quantile ECM method is particularly suited for capturing distributional heterogeneity. In the presence of outliers, it provides robust estimations and, making it valuable for diverse economies (Arellano & Bond, 1991; Pesaran, 2006). However, traditional Auto Regressive Distributed Lag lacks these features. Other econometric approaches like GMM and FGLS are also there, where GMM is suitable for endogeneity and FGLS is the best option when heteroskedasticity and autocorrelation exist.

The impact of trade liberalization is tested on governance, while governance is measured through the composite index of six governance indicators, as proposed by WGI. Trade liberalization initially strengthens SDG_{16}, but eventually, there comes a turning point where further expansion deteriorates governance. Here comes the role of a suitable moderator of trade liberalization. In this study, FinTech is taken as its moderator and a governance's determinant. As a determinant, FinTech

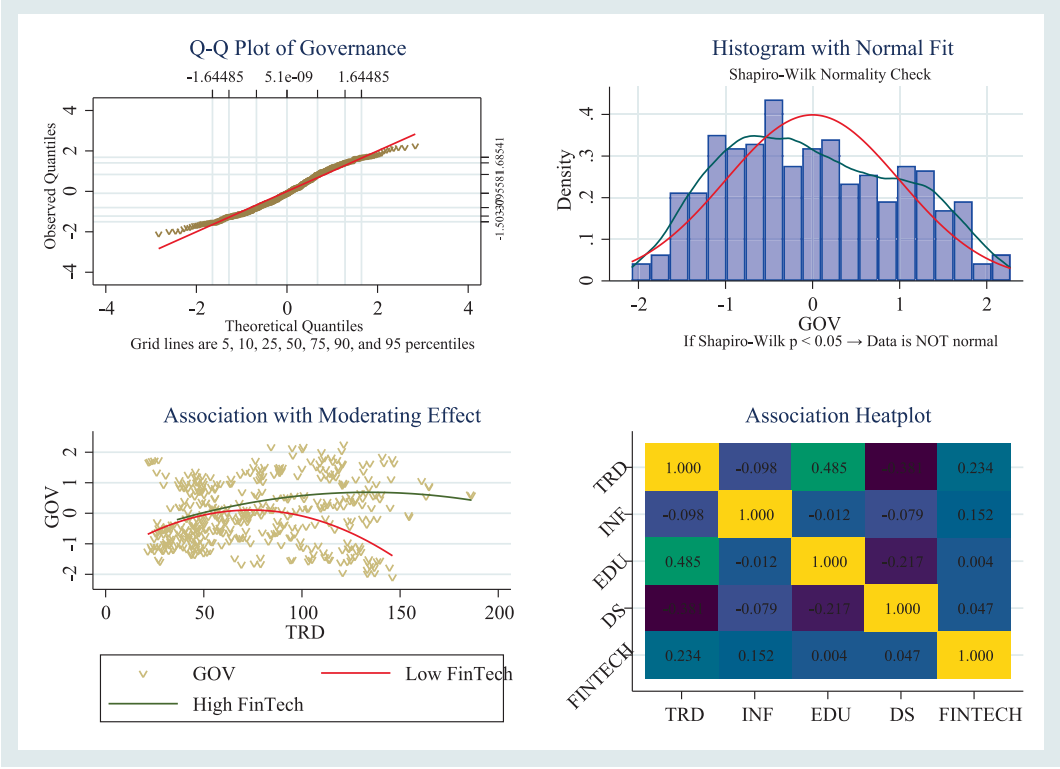

Fig. 3. Visual pre-regression diagnostics. .
Source: self-constructed

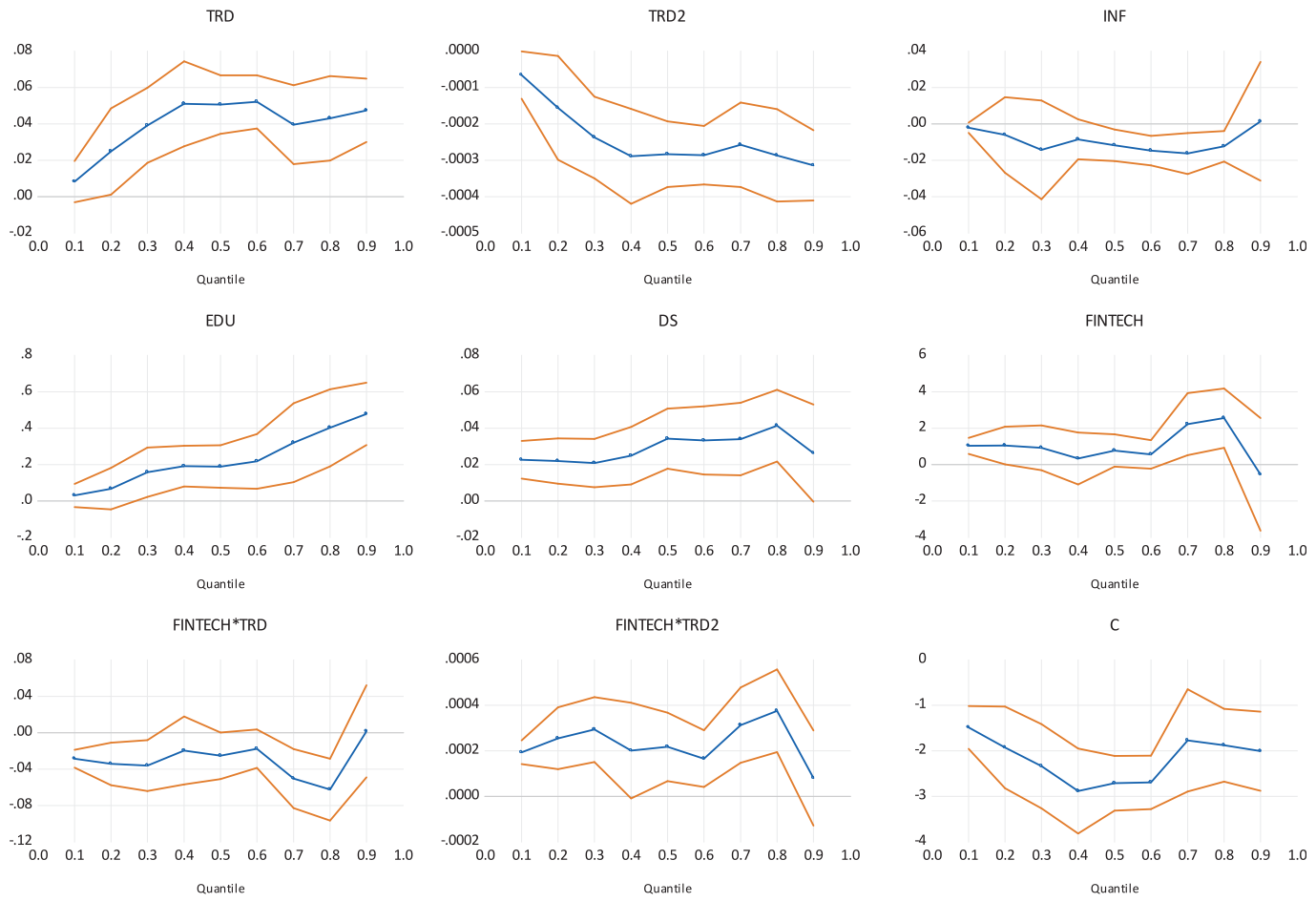

Fig. 5. Long run coefficient quantile process. .
Source: self-constructed

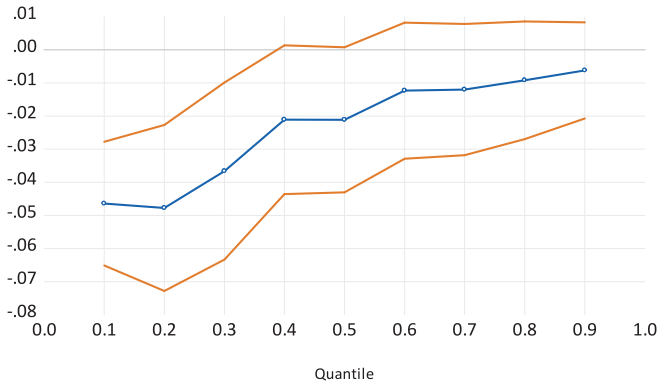

Fig. 6. ECM quantile process. .
Source: self-constructed

favorably determines governance, and as per our expectations, it also moderates trade liberalization and brings a significant delay in the turning point, and maintains the governance-beneficial impact. The proposed function is also strengthened through inflation, debt servicing, and education expenditures as control variables. The impacts of educational expenditures and debt servicing are in favor of governance while inflation is responsible for deteriorating it.

The findings of this study have confirmed that the over-liberalization depreciates governance performance in developing Asian countries after a certain point, in this situation trade policies have to be coordinated with institutional strengthening policies. Trade ministries and economic planning bodies should avoid excessive reliance on trade openness alone and instead coordinate reforms with institutional strengthening measures. This requires parliaments, anti-corruption agencies, and oversight institutions to establish safeguards.

The empirical findings of this study are in favor of FinTech. Here, in the implications of policy recommendations, the role of the trade ministry, customs authority, and FinTech firms is main. If the developing Asian countries, in particular, and the other developing countries, in general, want to achieve governance sustainability through trade and FinTech interaction, these countries should consider the role of their central banks, securities regulators, and parliaments. In this channel, they can strengthen digital regulations and consumer protection. In this way, they can support safe FinTech use in open markets. The finance ministry, central bank, and anti-corruption agencies should promote digital payment systems. In this way, the informal trade can be discouraged and limit rent seeking. Planning ministry, telecom authority, and local governments should also allocate reasonable resources to expand digital infrastructure to help small firms use FinTech in export and import processes.

The control variables have also revealed a significant impact, and to implement the robust policies again the role of the finance ministry, planning ministry, and central bank is important. The money supply and the rate of interest should not be unnecessarily high. The monitoring of financial institutions and financial markets should be there to detect price manipulation and to protect consumers. To create awareness, education can be a useful tool. A reasonable budget must be allocated each year; it is particularly relevant to sampled countries because the literacy

rate is low in these countries. Strict monitoring of the public sector education institutions should be ensured. The global bodies, including UNESCO, UNICEF, and the World Bank's are significantly contributing to the world for social development. Educational ministers of developing countries can consult these organizations and construct a plan for better educational distribution. Developing countries are trapped in debt, and that is why it is like a curse. To come out of it requires strong management. Here, the role of the finance ministries and the central bank in collaboration with the IMF and the World Bank is considerable. These organizations should keep debt management transparent through regular reporting and exposure of public responsibilities. Developing countries should focus on sustainable long-term financing rather than short-term loans. Rather than depending on debt, developing countries should expand trade infrastructure, which must help in earning foreign exchange.

There are some limitations of the study too, which can be considered by other researchers. First of all, this study has constructed a composite index based on six governance indicators. This analysis can be further extended to six separate models based on each governance indicator. Instead of FinTech, the role of green finance can also be considered. In the light of technological advancement, the role of Artificial Intelligence, Information Communication Technology, and Industrial Revolution 4.0 and 5.0 can be considered. As this study is based on developing Asian countries, worldwide developing countries, and the comparison between developing, emerging, and developed countries can prove comprehensive in nature. Researchers can also consider the second-generation two-step panel quantile ECM method.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix

.

Table 5
List of Countries.

Armenia	Lebanon
Bangladesh	Mongolia
Cambodia	Nepal
India	Pakistan
Indonesia	Philippines
Iran, Islamic Rep.	Sri Lanka
Jordan	Thailand
Kyrgyz Republic	Viet Nam

References

Abaidoo, R., & Agyapong, E. K. (2023). Inflation uncertainty, macroeconomic instability and the efficiency of financial institutions. *Journal of Economics and Development, 25*(2), 134–152.

Abbas, Q., Junqing, L., Ramzan, M., & Fatima, S. (2021). Role of governance in debt-growth relationship: Evidence from panel data estimations. *Sustainability, 13*(11), 5954.

Acemoglu, D., & Robinson, J. A. (2012). *Why nations fail: The origins of power, prosperity, and poverty*. Crown Business.

Aghili, S. (Ed.). (2024). Leveraging Blockchain Technology: Governance, Risk, Compliance, Security, and Benevolent Use Cases. CRC Press.

Ahmed, A. D., & Huo, R. (2021). Volatility transmissions across international oil market, commodity futures and stock markets: empirical evidence from China. *Energy Economics, 93*, Article 104741.

Akçay, S. (2025). The effects of remittances on gender inequality: nonlinear evidence from highly remittance-dependent countries. *Social Indicators Research*, 1–24.

Alaassar, A., Mention, A. L., & Aas, T. H. (2023). Facilitating innovation in FinTech: A review and research agenda. *Review of Managerial Science, 17*(1), 33–66.

Alemu, M., & Mulugeta, W. (2025). Global connectivity and resilience in African Banking: Role of technology and regulation. *Research in Globalization, 10*, Article 100285.

Ali, F. A., Fiess, N., & MacDonald, R. (2010). Do institutions matter for foreign direct investment? *Open Economies Review, 21*(2), 201–219.

Ali, T. B., & Al Yahya, B. B. A. A. (2019). The effect of governance on public debt: An empirical investigation for the Arabian Gulf countries. *Journal of Economic Studies, 46*(4), 812–841.

Al-Marhubi, F. A. (2007). Openness and governance: Evidence across countries. *Oxford Development Studies, 33*(3–4), 453–471.

Apergis, N. (2018). Education and democracy: New evidence from 161 countries. *Economic Modelling, 71*, 59–67.

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies, 58*(2), 277–297.

Arshed, N., Iqbal, M., Hanif, U., & Munir, M. (2025). Nonlinear climate change effects on building energy consumption: A second-generation modeling with moderation case of BRICS countries. *Energy and Buildings, 116114*.

Arshed, N., Munir, M., & Iqbal, M. (2021). Sustainability assessment using STIRPAT approach to environmental quality: An extended panel data analysis. *Environmental Science and Pollution Research, 28*(14), 18163–18175.

Asongu, S. A., & Nwachukwu, J. C. (2019). The role of openness in the effect of ICT on governance. *Information Technology for Development, 25*(3), 503–531.

Azimi, M. N., Rahman, M. M., & Maraseni, T. (2025). Advancing sustainable development goal 8 Targets: The role of institutional Quality, economic Complexity, and state fragility in G20 nations (2000–2023). *Research in Globalization, 10*, Article 100278.

Azmeh, C. (2025). Financial globalization, poverty, and inequality in developing countries: The moderating role of Fintech and financial inclusion. *Research in Globalization, 10*, Article 100277.

Bian, W., Wang, S., & Xie, X. (2024). How valuable is FinTech adoption for traditional banks? *European Financial Management, 30*(3), 1065–1093.

Bisiriyu, S. O., & Dhar, B. K. (2025). Glodebtization: implications for sustainable development goals. *Research in Globalization, 11*, Article 100317.

Busse, M., & Hefeker, C. (2007). Political risk, institutions and foreign direct investment. *European Journal of Political Economy, 23*(2), 397–415.

Cadenillas Albornoz, V., Álvarez Contreras, C. D., Santos Álvarez, L. A., Mediano Bazán, M. V., & Rojas Acevedo, V. E. (2023). Educational governance: Sustainable development and social responsibility. *Environmental & Social Management Journal/ Revista de Gestão Social e Ambiental, 17*(4).

Chen, A., & Groenewold, N. (2019). China's 'New Normal': Is the growth slowdown demand-or supply-driven? *China Economic Review, 58*, Article 101203.

Chiang, A. C., & Wainwright, K. (2005). *Fundamental methods of mathematical economics* (4th ed.). McGraw-Hill/Irwin.

Dawson, J. F. (2014). Moderation in management research: What, why, when, and how. *Journal of Business and Psychology, 29*(1), 1–19.

Driscoll, J. C., & Kraay, A. C. (1998). Consistent covariance matrix estimation with spatially dependent panel data. *Review of Economics and Statistics, 80*(4), 549–560.

Ellahi, N., Kiani, A., Malik, Q., Raza, A., & Gul, R. (2021). Institutional governance and financial sector development: Panel evidence from Asian economies. *Cogent Economics & Finance, 9*(1), Article 1890367.

Fankem, G. S. G., & Feyom, C. (2024). Does trade openness improve or worsen public governance in sub-Saharan Africa? *International Economics, 178*, Article 100502.

Fischer, J., & Nisa, E. F. (2025). Emerging middles: Class, development and the halal economy in Indonesia and Malaysia. *Research in Globalization, 10*, Article 100276.

Ghouse, G., & Iqbal, M. (2024). Resource extraction, FinTech, and social equal access: A quantitative analysis of resource-rich countries. *Resources Policy, 99*, Article 105416.
Hickel, J., Hanbury Lemos, M., & Barbour, F. (2024). Unequal exchange of labour in the world economy. *Nature Communications, 15*(1), 6298.
Hoechle, D. (2007). Robust standard errors for panel regressions with cross-sectional dependence. *The Stata Journal, 7*(3), 281–312.
Hussain, J., Zhou, K., Muhammad, F., Khan, D., Khan, A., Ali, N., & Akhtar, R. (2021). Renewable energy investment and governance in countries along the belt & Road Initiative: Does trade openness matter? *Renewable Energy, 180*, 1278–1289.
Iqbal, M., Kalim, R., & Arshed, N. (2019). Domestic and foreign incomes and trade balance-a case of south Asian economies. *Asian Development Policy Review, 7*(4), 355–368.
Iqbal, M., Arshed, N., & Chan, L. F. (2024). Exploring the dynamics: Biodiversity impacts of natural resource extraction with moderating influence of FinTech for sustainable practices in resource-rich nations. *Resources Policy, 91*, Article 104933.
Janowski, T. (2015). Digital government evolution: From transformation to contextualization. *Government Information Quarterly, 32*(3), 221–236.
Jarque, C. M., & Bera, A. K. (1980). Efficient tests for normality, homoscedasticity and serial independence of regression residuals. *Economics Letters, 6*(3), 255–259.
Jiao, Y., & Wei, S. J. (2017). *Intrinsic openness and endogenous institutional quality* (No. w24052). National Bureau of Economic Research. https://doi.org/10.3386/w24052.
Jolliffe, I. T., & Cadima, J. (2016). Principal component analysis: A review and recent developments. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 374*(2065), Article 20150202.
Kablamaci, B. (2019). Does economic openness affect liberal and electoral democracy in a different way? empirical evidence from developing countries. *Scottish Journal of Political Economy, 66*(3), 404–433.
Karış, Ç., & Tandoğan, D. (2019). The effect of education on democracy: panel data analysis of high income countries. *Universal Journal of Educational Research, 7*(11), 2425–2431.
Kemoe, L., & Lartey, E. K. (2022). Public debt, institutional quality and growth in sub-Saharan Africa: A threshold analysis. *International Review of Applied Economics, 36*(2), 222–244.
Khanchel, I., Lassoued, N., & Khiari, C. (2025). Untangling the skein: The impact of FinTech on social and financial performance in microfinance institutions. *Regional Science Policy & Practice, 17*(8), Article 100208.
Koenker, R. (2004). Quantile regression for longitudinal data. *Journal of Multivariate Analysis, 91*(1), 74–89.
Koh, S. G., Lee, G. H., & Siah, A. K. (2022). The resurgence of income inequality in Asia-Pacific: The role of trade openness, educational attainment and institutional quality. *Jurnal Ekonomi Malaysia, 56*(3), 11–27.
Kojo Ayesu, E., Sakyi, D., Arthur, E., & Osei-Fosu, A. K. (2022). The impact of trade on African welfare: Does seaport efficiency channel matter? *Research in Globalization, 5*, Article 100098.
Lamarche, C. (2010). Robust penalized quantile regression estimation for panel data. *Journal of Econometrics, 157*(2), 396–408.
Law, S. H., & Azman-Saini, W. N. W. (2012). Institutional quality, governance, and financial development. *Economics of Governance, 13*(3), 217–236.
Lee-Geiller, S. (2024). Technology married to good governance and diversity: Explaining e-participation preparedness in government. *Technological Forecasting and Social Change, 201*, Article 123218.
Li, H., Lin, X., & Zhang, Z. (2025). How does digital finance affect imports, exports and trade balance: Evidence from China. *International Review of Economics & Finance, 99*, Article 104054.
Li, Q., & Reuveny, R. (2003). Economic globalization and democracy: An empirical analysis. *British Journal of Political Science, 33*(1), 29–54.
Machado, J. A., & Santos Silva, J. (2019). Quantiles via moments. *Journal of Econometrics, 213*(1), 145–173.
Mamba, E. (2021). Role of governance in open trade policies–growth nexus in ECOWAS countries: The use of extended IV approach in panel data. *The Journal of International Trade & Economic Development, 30*(5), 661–684.
Martell, C. R. (2024). The impact of inflation on local government fiscal health. *Journal of Public Budgeting, Accounting & Financial Management, 36*(2), 234–252.
Minea, A., Tapsoba, R., & Villieu, P. (2021). Inflation targeting adoption and institutional quality: Evidence from developing countries. *The World Economy, 44*(7), 2107–2127.
Mohamed Sghaier, I. (2023). Trade openness, financial development and economic growth in North African countries. *International Journal of Finance & Economics, 28*(2), 1729–1740.
Nam, H., Bang, J., & Ryu, D. (2023). Paradox of trade openness: The moderated mediating role of governance. *Journal of International Financial Markets, Institutions and Money, 89*, Article 101887.
Němečková, T., & Hayat, A. (2022). Does trade openness improve the quality of domestic institutions? evidence from Africa. *Equilibrium. Quarterly Journal of Economics and Economic Policy, 17*(4), 881–908.
Niankara, I., & Traoret, R. I. (2023). Towards an encompassing concept of remittance in the digital era: Assessing the role of formal banking and mobile money accounting in its spatial flow. *Journal of Open Innovation: Technology, Market, and Complexity, 9*(3), Article 100107.
North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge University Press.
Pargianas, C. (2024). The effect of education on economic institutions. *Applied Economics Letters*, 1–4.
Pedroni, P. (2000). Fully modified OLS for heterogeneous cointegrated panels. *Adv. Econom., 15*, 93–130.
Pedroni, P. (2001). Purchasing power parity tests in cointegrated panels. *Review of Economics and Statistics, 83*(4), 727–731.
Pesaran, M. H. (2006). Estimation and inference in large heterogeneous panels with a multifactor error structure. *Econometrica, 74*(4), 967–1012.
Ramzan, M., HongXing, Y., Abbas, Q., Fatima, S., & Hussain, R. Y. (2023). Role of institutional quality in debt-growth relationship in Pakistan: An econometric inquiry. *Heliyon, 9*(8).
Reimers, F. M. (2023). Education and the challenges for democracy. *Education Policy Analysis Archives, 31*.
Rhodes, R. A. (2007). Understanding governance: Ten years on. *Organization Studies, 28*(8), 1243–1264.
Shi, Y., Zheng, S., Xiao, P., Zhen, H., & Wu, T. (2024). ESG performance and cost of debt. *China Journal of Accounting Research, 17*(4), Article 100390.
Stiglitz, J. E. (1996). Some lessons from the East Asian miracle. *The World Bank Research Observer, 11*(2), 151–177.
Tuccaroglu, B., Celebi, E., & Ozgit, H. (2025). The need for blockchain technologies in international trade in conflicting regions: A case of Cyprus. *Kybernetes*. https://doi.org/10.1108/K-07-2024-1713
Uddin, I., Ahmad, M., Ismailov, D., Balbaa, M. E., Akhmedov, A., Khasanov, S., & Haq, M. U. (2023). Enhancing institutional quality to boost economic development in developing nations: New insights from CS-ARDL approach. *Research in Globalization, 7*, Article 100137.
United Nations. (2023). *The Sustainable Development Goals Report 2023*. https://unstats.un.org/sdgs/report/2023/.
Vogelsang, T. J. (2012). Heteroskedasticity, autocorrelation, and spatial correlation robust inference in linear panel models with fixed-effects. *Journal of Econometrics, 166*(2), 303–319.
Williamson, O. E. (2000). The new institutional economics: Taking stock, looking ahead. *Journal of Economic Literature, 38*(3), 595–613.
Worldwide Governance Indicators (WGI). (2024). *Worldwide Governance Indicators, 2024 Update*. The World Bank. Retrieved October 30, 2024, from https://www.govindicators.org.
Xu, H. (2024). Research on a new cross-border barter trade settlement model based on blockchain and smart contracts. *Procedia Computer Science, 247*, 146–155.
Ye, Y., Xu, Z., & Chen, W. (2023). The heterogeneous effect of financial technology on green total factor productivity in China. *Journal of Innovation & Knowledge, 8*(3), Article 100390.
Zhang, X., Zhang, J., Wan, G., & Luo, Z. (2020). Fintech, growth and inequality: Evidence from China's household survey data. *The Singapore Economic Review, 65*(supp01), 75–93.