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Research article

Unlocking growth: Investigating asymmetry in the financial inclusion-growth nexus in financially inclusive middle east economies

Xinyi Shen [a], Qian Huang [b,*], Raima Nazar [c], Lee Chin [d,e]

[a] Graduate Studies Department, Xi'an Physical Education University, Shaanxi, China
[b] Sports Engineering Institute, Wuhan Sports University, Hubei, China
[c] Department of Economics, The Women University, Multan, Pakistan
[d] School of Business and Economics, Universiti Putra, Malaysia, Malaysia
[e] Econometrics Department, Tashkent State University of Economics, Uzbekistan

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ABSTRACT

Financial inclusion is a crucial element of financial development that transmits cheap financial services to provide advantages to entire segments of society and stimulates economic growth. Our investigation evaluates the asymmetric financial inclusion-economic growth nexus in the top 10 financially inclusive Middle East nations (Israel, Oman, Iran, Qatar, Turkey, Saudi Arabia, Bahrain, Egypt, United Arab Emirates, and Kuwait). Earlier studies adopted panel data tools, which yielded typical outcomes on the association between financial inclusion and economic growth despite few economies did not indicate such a link individually. Conversely, the present work adopts Quantile-on-Quantile approach which can scrutinize time-series dependency among nations exclusively to give international, though country-specific, comprehension of the variables' correlation. The outcomes show that financial inclusion boosts economic growth in our selected economies at numerous quantiles of data distribution. In addition, the results depict that the degree of asymmetry in the financial inclusion-economic growth nexus diverges by the nation. The outcomes highlight the critical need for governments and policymakers to prioritize financial inclusion and economic growth across various levels by emphasizing a strategic and comprehensive approach to ensure effective and sustainable growth.

1. Introduction

Financial inclusion (*FIN*) enables economic growth (*EG*) together with the growth of the financial sector. It encourages financial activities by increasing the accessibility of financial services, like commercial bank accounts, ATMs, online proceedings, and more [1]. *FIN* aims to provide various financial services, insurance, and payments, encompassing transactions, savings, and credit to businesses and individuals. These services are designed to fulfill their requirements in an appropriate, reachable, responsible, and sustainable manner [2]. *FIN* plays a vital role in poverty reduction. The availability of formal financial services, like savings accounts, credit facilities, and insurance, empowers individuals and households to manage their finances more efficiently and cope with unforeseen shocks. It allows them to invest in income-generating activities, accumulate savings, and access credit for education, healthcare, and

* Corresponding author.
E-mail address: huangqian168@126.com (Q. Huang).

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entrepreneurial ventures. The availability of banking services increases the likelihood that individuals will keep their savings with formal financial institutions, which, in turn, contributes to accelerated *EG* and uppermost GDP per capita due to the multiplier influence [3]. *FIN* contributes to overall economic stability. A well-functioning financial system, with widespread access to financial services, reduces vulnerability to financial shocks and crises. Financially included individuals and businesses are more likely to contribute to formal savings and investment channels, mobilizing domestic savings and routing them towards productive investments and increasing *EG* Ref. [4].

Observing the *FIN-EG* nexus implies considerable difficulties. Does *FIN* expand *EG* in financially inclusive Middle Eastern nations? Is the relation between *FIN* and EG asymmetric? How do nation-specific patterns of *FIN* and *EG* alter along with various data segments? What are the policy suggestions for utilizing *FIN* to stimulate *EG*? An appraisal of the previous work finds that these hurdles seem to have attained lesser prominence. To the greatest of our awareness, no existent literature tackles these issues. This work's contribution to the existing literature can be stated in three ways: Firstly, many investigations on the linkage between *FIN* and *EG* have been conducted (Kim, Yu, & Hassan, 2018; [5]). According to our understanding, no study has examined the interaction between the above-mentioned variables in the top financially inclusive Middle Eastern countries. Secondly, instead of relying on a single proxy of *FIN*, we utilize principal component analysis (PCA) to formulate a composite index based on six FIN components (the number of ATMs, number of commercial bank branches, outstanding deposits, loan accounts, deposit accounts, and outstanding loans). Third, most past works focused on the methodologies related to panel data to draw outcomes on the *FIN-EG* link, remembering the clue that many countries still need evidence of this kind of link on their own. This research, in contrast, employs the Quantile-on-Quantile (QQ) tool established by Sim & Zhou [6] to yield universal yet nation-related apprehension about the association between *FIN* and *EG*. With the help of the QQ methodology, every nation's time-series dependence is computed individually (Hung, 2020; [7]).

The *FIN-EG* connection has numerous features that that cannot be evaluated by adopting classical tools like OLS and quantile regression. Traditional parametrical measurements are prone to alterations and might give inadequate space for heterogeneous slopes [8]. Consequently, measuring the influence of *FIN* on *EG* prerequisites the employment of a novel econometric tool, i.e., QQ, that is resistant to deviations and could cope with heterogeneous slopes [7]. Additionally, previous works compute single parameters (inverse, positive, or unbiased) over their corresponding sample data distribution. This research highlights that a range of positive or negative relationships can be identified across different segments of the entire data distribution. Given the substantial variation in the *FIN-EG* nexus, our approach provides essential country-specific insights for policymakers and decision-makers to evaluate political, economic, and social factors at various levels of *FIN* and *EG*. By doing so, this study acknowledges the complexity and heterogeneity inherent in the *FIN-EG* relationship, which cannot be fully captured through traditional linear models. Consequently, this investigation examines the asymmetric impacts of *FIN* quantiles on *EG* quantiles, allowing for informed judgments about the relationships between these variables across lower, middle, and upper quantiles. This nuanced understanding is crucial for developing tailored *FIN* strategies that can effectively stimulate *EG*, address country-specific challenges, and harness opportunities unique to each nation's economic and financial context. The conclusions drawn from this research guide the formulation of more precise and impactful policies aimed at enhancing *FIN* and promoting sustainable economic development.

This study emphasizes Middle Eastern economies for the evaluation of FIN-EG nexus for numerous reasons. Firstly, these nations share common economic, political, and social structures, making them an interesting subject of analysis (Al-Samadi, 2023). Secondly, these countries allow for examining the region's rapid adoption and integration of innovative financial technologies within its banking and financial services sector. This technological progress offers a distinct perspective on how digital *FIN* can spur *EG*, setting the Middle East apart from regions with a more substantial reliance on traditional banking systems (Al-Samadi, 2023; [9]). Lastly, the proactive stance of Middle Eastern governments in promoting *FIN* through policies and initiatives aimed at economic diversification and reducing oil dependency provides a valuable context. Analyzing the effects of these government actions on *EG* can shed light on the efficacy of policy interventions in creating a more inclusive financial ecosystem and stimulating economic development. In order to address heterogeneity and cross-sectional dependence issues that could lead to size distortions and substantial bias, a time series technique is adopted, recognized as QQ, that analyzes every economy separately [10]. This approach differs from previous studies and allows us to handle the unique characteristics of each country better. Macroeconomic integration and the relationship between *FIN* and *EG* are crucial aspects of Middle East economies. The region has experienced instances where instability in one country quickly transmits to other economies, highlighting the interconnectedness of their financial sectors [11]. This regional emphasis not only fills a significant gap in the literature but also provides valuable insights and policy recommendations tailored to the unique economic and financial contexts of these nations. Moreover, the present work can inform governments and policymakers in formulating plans at several levels of *FIN* and *EG*. Furthermore, this investigation will establish a foundation for forthcoming research endeavors that delve into the correlation between *FIN* and *EG* and its potential ramifications for other global regions.

The subsequent part of our work is arranged as follows: Section 2 depicts the theoretical framework, while Section 3 delivers empirical literature review. Section 4 determines the description of data and introduces econometric tools. Section 5 generates initial and main outcomes along with discussion. Ultimately, Section 6 finalizes the present work together with some policy repercussions.

2. Theoretical framework

The debate on the relationship between FI and *EG* has a rich historical foundation, tracing back to early economic theories. Goldsmith [12] argued that a systematic flow of capital facilitated by commercial banks plays an imperative part in financial development (*FD*) and innovation, laying the groundwork for *EG*. Similarly, Shaw [13] and McKinnon (1973) emphasized the importance of savings mobilization and financial deepening as catalysts for economic development. Their theories suggest that an efficient banking sector, through its public networks, could accelerate the procedure of capital accumulation and allocation, thereby

fostering *EG*. Schumpeter (1912)further underscored the banking sector's critical role in economic development, positing that banks are pivotal in financing business innovations that lead to economic expansion. As the discourse evolved, King & Levine [14] contributed significantly to this field by highlighting the banking sector's role in providing a durable financial intermediation structure that enhances productivity, leading to sustained *EG*. Their research funds the notion that a well-developed banking system facilitates financial transactions and plays a vital role in economic planning and resource allocation.

On the other hand, the literature also explores the challenges faced by economies with low levels of *FIN*. Neaime & Gaysset (2018) observed that in economies where a significant part of the population is impoverished, the demand for financial services diminishes owing to limited savings, affecting the banking sector's capacity to support *EG*. This situation underscores the interplay between *FIN*, savings, and investment activities, highlighting the barriers to achieving comprehensive economic development.

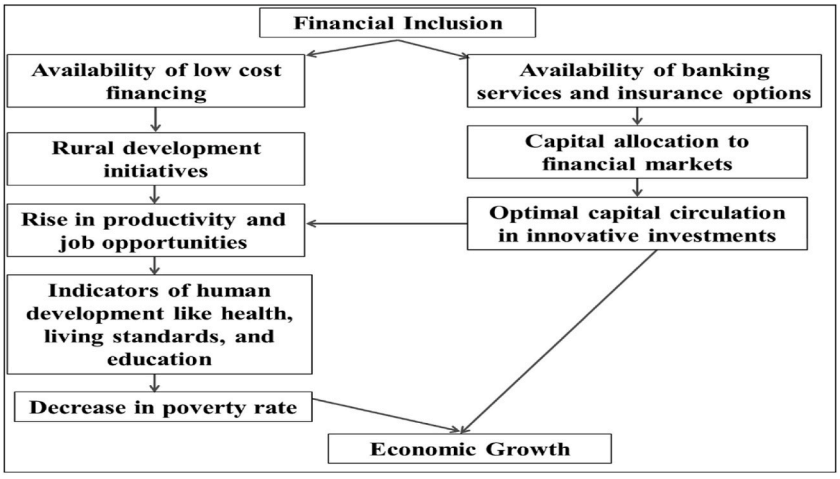
Recent studies, such as those by Sharma [15] and Sethi & Acharya [5], have shed light on the positive impacts of *FIN* on *EG*. Sharma [15] argued that savings mobilization through *FIN* is essential for poverty alleviation and can significantly enhance the demand for financial services, thereby stimulating economic activities. Sethi & Acharya [5] further elaborated on the role of *FIN* in supporting *EG* through its beneficial effects on small businesses, which in turn contributes to human capital development, including education and health, and aids in reducing poverty and inequality. These perspectives underscore the multifaceted association between *FIN* and *EG*, highlighting the critical part of *FIN* in fostering a conducive environment for sustainable economic development.

Note: Adapted from Sharma [15], Sethi & Acharya [5], Schumpeter (1912), and Ozili [16].

Fig. 1 presents a model detailing the impact of *FIN* on *EG*. Initially, providing affordable loans to underprivileged and low-income groups at fair rates spurs planned productive activities in rural sectors, boosting output, employment, and living standards [15]. This enhancement at a grassroots level significantly contributes to national production and elevates *EG*, thereby improving the living conditions of these vulnerable communities through increased incomes [5]. Consequently, *FIN* plays a crucial role in reducing poverty in rural locales while fostering *EG*. Furthermore, enabling marginalized communities access to banking services and insurance products bolsters financial market liquidity (Schumpeter, 1912). This liquidity, in turn, motivates individuals to invest their funds in financial markets, ensuring optimal asset distribution across long-term investments. Such movements in the financial markets mitigate liquidity risk, characterized by the scarcity of cash inflows, encourage more investment, amplify output growth, and better distribute income among the economically disadvantaged [16].

3. Literature review

Many empirical investigations have studied the influence of *FIN* on *EG* for multiple countries. For example, Ramesh Hegde & Guruprasad (2024) explored digital *FIN*'s impact on *EG* in specific Asian countries using a fixed-effect dummy variable model across 30 Asian countries during 2014, 2017, and 2021. The results showed a strong positive correlation between digital *FIN* and *EG*, suggesting that higher digital *FIN* is associated with increased per capita income. Similarly, Hussain et al. [17] investigated the link between *FIN* and *EG* across 21 Asian countries from 2004 to 2019 using the developed and developing country sub-samples. The findings showed a significant long-run positive impact of *FIN* on *EG* in Asia, with bidirectional causality between *FIN* and economic development. Mir, Gopinathan, & Joshi [18] analyzed the long-run relationship between *FIN* and *EG* in 53 developing nations using the CS-ARDL model. The results showed long-run cointegration, with *FIN* positively enhanced GDP per capita, validated by robustness checks. Likewise, Saha et al. [19] verified the influence of *FIN* on *EG* in 104 developing nations from 2004 to 2019. The outcomes revealed a positive correlation between growing opportunities for low-income individuals and enhancing access to financial services. Similarly, Kilimvi & Ezekwesiri [20] examined the influence of *FIN* indicators, including availability, penetration, and usage, on Africa's *EG*. The results of



Note: Adapted from Sharma (2016), Sethi & Acharya (2018), Schumpeter (1912), and Ozili (2021).

Fig. 1. Link between *FIN* and *EG*.

GMM depicted a positive connection between *FIN* components and *EG*. In the same way, Biswas [21] probed the influence of *FIN* dimensions (penetration, availability, and utilization) on *EG* in four South Asian countries from 2004 to 2021 and found that availability measures (ATMs and bank branches) positively impacted *EG*, while usage measures negatively impacted it.

Likewise, Kim et al. [22] utilized a GMM technique to examine the impact of *FIN* on *EG* in a sample of 55 OIC nations from 1991 to 2013. The findings indicated a positive connection between *FIN* and *EG*. Another study conducted by Sethi & Acharya [5] investigated the *FIN-EG* nexus for 31 economies employing FMOLS and DOLS methods and found a positive association between *FIN* and *EG*. Similarly, Akbarzadeh, Pahlavani, & Mirjalili (2020) and Dogan, Madaleno, & Taskin [23] observed that financing significantly increased *EG* in Iran and Turkey, respectively. Similarly, Kim et al. [22], and Emara & El Said [24] found that *FD* and *FIN* enhanced *EG* in OECD, OIC, and MENA economies, respectively.

Karim et al. [4] scrutinized the *FIN-EG* nexus utilizing a sample of 60 economies from 2010 to 2018. A threshold influence, indicated by using dynamic panel threshold estimation, shows that the level of *FIN* is favorable and positively impacts *EG* at upper or lower threshold levels across various regimes. Similarly, Nizam et al. [25] also found threshold influence in *FIN-EG* nexus. Nizam et al. [26] reviewed the *FIN*'s influence on firm growth in ASEAN economies. After adopting the cross-section threshold estimation technique, researchers found that the influence of *FIN* on a firm's growth became significantly inverse beyond a specific threshold level. Younas et al. [3] explored the *FIN*-shadow economy-*EG* nexus in developing nations from 2008 to 2018. Generalized methods of moments (GMM), panel ordinary least squares (OLS), and fixed effect models were applied. It was discovered that *FIN* had a statistically significant positive influence on *EG*.

However, few studies have found an inverse bond between *FIN* and *EG*. For instance, Pearce [27] highlighted that financial accessibility was limited for certain marginalized groups, including women and people experiencing poverty, which resulted in a negative correlation between *FIN* and *EG*. Similarly, Naceur & Ghazouani [28] revealed an inverse connection between credit to private sector betterment and the bank development index with *EG*. Moreover, Gurley-Calvez et al. [29] found that an increase in bank branch density hurt *EG* due to the crowding out effect, where the expansion of formal financial institutions displaced informal credit providers. Similarly, for Latin American countries, Barajas, Chami, Fullenkamp, & Sahay [30] found that *FIN* hurt *EG* in countries with high informalities.

On the other hand, few studies revealed a mixed connection between *FIN* and *EG*. For instance, Alosheibat et al. [31] analyzed *FIN*'s impact on economic growth in lower- and mid-income economies from 2011 to 2021 utilizing the ARDL methodology. The findings revealed an inverse correlation between adults over 15 owning bank cards and *EG*, while deposit accounts and loans positively correlated.

It is evident from the prior literature that most studies centered on the entire influence of *FIN* on *EG* and seldom examined the role of the *FIN* quantiles on the quantiles of *EG*. Prior research has revealed that the variables exhibit a linear relationship. Addressing asymmetric effects might result in data loss and inaccurate outcomes. Moreover, prior works have consistently elected panel data over time-series data. Panel data offers several obstacles, including generalization concerns, misuse of measurements, and improper choice. Consequently, applying QQ, a thorough technique that analyzes time-series data for every economy independently and gives robust outcomes, is recommended.

4. Data and methodology

This investigation examines the linkage between *FIN* and *EG* for the ten highly financially inclusive Middle East economies.[1] These countries are based on the World Bank's Global Findex Database, which the World Bank developed in collaboration with Gallup from surveys of over 150,000 people in 140 economies. Global Findex Database ranks countries based on several elements of financial access and easiness. In our study, *FIN* is the independent variable. The per capita GDP growth rate, which is a proxy for EG, is our dependent variable. The annual data for both *FIN* and *EG* is taken from 2004-2023.[2] The data set for the indicators of *FIN* is acquired from the websites of the Global Findex Database and International Financial Statistics. *EG* data is obtained from World Development Indicators (https://databank.worldbank.org/). The acronyms and symbols employed in this study are presented in Table 1.

The primary concern with prior considerations is that they adopt a single proxy to reflect *FIN*, like the number of ATMs per 1000 km^2 [15], branches of commercial banks per 1000 km^2 [15], and demand deposits acquired by the rural areas [32]. However, *FIN* measured by a single proxy yields deceptive or biased outcomes. Furthermore, merging numerous alternates into a single equation is a complex process [1]. The principal component analysis (PCA) is employed to originate an exhaustive *FIN* index. This index combines six variables: the number of commercial bank branches per 1000 km^2, the number of ATMs per 1000 km^2, the ratio of loan accounts per 1000 adults in commercial banks, the value of payable deposits with commercial banks, the ratio of deposit accounts per 1000 adults in commercial banks, and the value of payable loans from commercial banks. By aggregating these factors, the *FIN* index effectively summarizes all the original data on *FIN* with minimal loss of information.

The PCA analysis is conducted following the work of Banna et al. [1]. The jth element can be stated in PCA, in Equation (1), as follows:

$$FIN_{j=} W_{j1}X_1 + W_{j2}X_2 + W_{j3}X_3 + W_{j4}X_4 + W_{j5}X_5 + W_{j6}X_6 \quad (1)$$

[1] Israel, Iran, United Arab Emirates, Bahrain, Kuwait, Turkey, Saudi Arabia, Egypt, Oman, and Qatar.
[2] *FIN* data before 2004 is not available.

Table 1
The list of symbols and acronyms.

Acronyms or symbols	Narration	Acronyms or symbols	Narration
FIN	Financial inclusion	τ	τ^{th} quantile of economic growth
EG	Economic growth	FD	Financial development
PCA	Principal component analysis	h	Bandwidth parameter
QC	Quantile cointegration	s	Number of quantiles
QR	Quantile regression	μ_t^{θ}	Quantile error term
QQ	Quantile-on-quantile Estimation	ρ_{ϕ}	quantile loss function
J-B	Jarque-Bera	$Sup_{\tau}\ \lvert V_n(\tau)\rvert$	Value of supremum norm for the coefficients (α and γ)

Here, FIN_j represents the *FIN* index. W_j signifies the weights for the parameters of *FIN*. X_1, X_2, ..., X_6 denote the values of diverse indicators of *FIN* as discussed above.

4.1. Quantile cointegration (QC) test

The model's specific form might be expressed taking α (τ) as the vector of constant in Equation (2) as under:

$$X_i = \alpha + \alpha' Y_i + \sum_{k=-s}^{k} \Delta Y'_{i-k} \Pi_k + \nu_i \tag{2}$$

and

$$Q_{\tau}^{X}\left(X_i M_i^{X}, M_i^{y}\right) = \beta(\tau) + \alpha(\tau)' Y_i + \sum_{k=-s}^{s} \Delta Y'_{i-k} \Pi_j + F_{\nu}^{-1}(\tau) \tag{3}$$

In Equation (3), $\beta(\tau)$ denotes a drift component, $\alpha(\tau)$ the consistent criterion, and $F_{\nu}^{-1}(\tau)$ the residuals for multiple quantiles of the provisional distribution. The cointegrating Equation (4), when the explanatory variable's quadratic component is included, is as follows:

$$Q_{\tau}^{X}\left(X_i M_i^{X}, M_i^{y}\right) = \beta(\tau) + \alpha(\tau)' Y_i + \delta(\tau)' Y_i^2 + \sum_{k=-s}^{s} \Delta Y'_{i-k} \Pi_k + \sum_{k=-s}^{s} \Delta Y^2_{i-k} \Pi_k + F_{\nu}^{-1}(\tau) \tag{4}$$

Since such QC test, the null hypothesis as H_0: α (π) = α is considered, with that the cointegration coefficients can be obtained using equation (4). Our study's null hypothesis (supremum rule) is expressed by $\widehat{V}_n(\tau) = [\widehat{\alpha}(\tau) - \widehat{\alpha}]$. The current work, $Sup_{\tau}\left|V'_n(\tau)\right|$ is used as a test statistic throughout whole quantile distributions, and by running 1000 Monte Carlo simulations its essential values are obtained.

4.2. Quantile-on-quantile (QQ) estimation

For econometric estimation, we have used Quantile-on-Quantile (QQ) method. The OLS approach depends on conditions that may only sometimes be satisfied when dealing with complex data. Furthermore, it can be misleading as it assumes a single provisional mean coefficient to handle data with multiple modes of distribution. On the other hand, applying the QQ instrument, as discovered by Sim & Zhou [6], is a preferable option for exploring various facets of the association between *FIN* and *EG*. Typical quantile regression (QR) merely regresses the conditional mean effect of *FIN* on specific *EG* quantiles. Sim & Zhou [6] introduced the QQ model to tackle various problems in a typical QR model. In this situation, it integrates classic QR with non-parametrical estimation. It studies the influence of *FIN* quantiles on the quantiles of *EG*. Consequently, the issue of interdependence is tackled. Therefore, the QQ approach is opted in our paper to ascertain complications in the *FIN-EG* bond that cannot be tackled through other traditional methodologies, i.e., QR or traditional OLS.

The bellow-mentioned non-parametrical quantile model is applied in its popularized form accompanied by the empirical investigation of Hussain et al. [17] and Kim et al. [22].

$$EG_t = \alpha^{\theta}(FIN_t) + \mu_t{}^{\theta} \tag{5}$$

In Equation (5), EG_t and FIN_t correspond to economic growth and financial inclusion in period t, respectively. θ denotes the θ^{th} quantile for *EG*. Since there is no prior information available on the *FIN-EG* nexus, the factor load $\alpha^{\theta}(.)$ remains anonymous. μ_t^{θ} represents the quantile residual component alongside θ^{th} quantile.

In the vicinity of FIN^{τ}, the local linear model is occupied as follows:

$$\alpha^{\theta}(FIN_t) \approx \alpha^{\theta}(FIN^{\tau}) + \alpha^{\theta'}(FIN^{\tau})(FIN_t - FIN^{\tau}) \tag{6}$$

In the model mentioned in Equation (6), $\alpha^{\theta'}$ exhibits the derivative of α^{θ} (FIN_t) in relation to FIN_t and is called the partial impact. $\alpha^{\theta}(FIN^{\tau})$ and $\alpha^{\theta'}(FIN^{\tau})$ represents the functions of θ and τ, respectively. $\alpha^{\theta'}(FIN^{\tau})$ can be denoted by $\alpha_1(\theta,\tau)$ and $\alpha^{\theta}(FIN^{\tau})$ can be shown by

$\alpha_0(\theta,\tau)$. Hence, the updated form of local linear regression can be defined in Equation (7) as follows:

$$\alpha^{\theta}(FIN_t) \approx \alpha_0(\theta,\tau) + \alpha_1(\theta,\tau)(FIN_t - FIN^{\tau}) \tag{7}$$

The QQ equation for our study can be obtained by inserting equation (7) into equation (5):

$$EG_t = \frac{\alpha_0(\theta,\tau) + \alpha_1(\theta,\tau)\ (FIN_t - \ \mathrm{FIN}^{\tau})}{(*)} + u_t^{\theta} \tag{8}$$

Equation (8) depicts the functional version of the QQ model. The part (*) represents the θ^{th} provisional *EG* quantile. The nexus between θ^{th} *FIN* quantile and τ^{th} *EG* quantile is depicted in Equation (8). The α_0 and α_1 are boundaries that are double-indexed by θ and τ, demonstrating the quantile-based *FIN-EG* link. The values of α_0 and α_1 might change on the basis of the quantiles of the independent and dependent variables. By joining their corresponding distributions, Equation (8) validates the quantile dependency between *FIN* and *EG*.

4.3. Robustness of the QQ technique

By offering exact estimates for numerous quantiles of explanatory variables, the QQ model can produce the estimates of the standard QR regression. The QR model can measure the influence of the θ^{th} *FIN* quantile on *EG* in this study, whereas its quantile-based coefficients of *FIN* are indexed by θ only. By contrasting the QR method, the QQ tool investigates the influence of the θ^{th} *FIN* quantile on the τ^{th} *EG* quantile and indexes the quantile association with each τ and θ, which leads to more classified data. Therefore, by putting the simple average of the QQ coefficients across τ, the QR parameters can be calculated. The QR models' slope coefficient, denoted by $\gamma_1(\theta)$ can be stated as follows:

$$\gamma_1(\theta) \equiv \overline{\widehat{\alpha}}_1 = \frac{1}{s}\sum\nolimits_{\tau} \widehat{\alpha}_1(\theta,\tau) \tag{9}$$

Here, 's' shows the number of quantiles, whereas τ is the range of quantiles.

In the present case, the QQ regression's robustness can be verified by matching the evaluated QR coefficients to the τ-averaged QQ parameters.

5. Findings and discussion

This section offers the study's introductory and key findings, along with a comprehensive discussion.

5.1. Preparatory results

Table 2 indicates the descriptive statistics of *EG* and *FIN*.

Table 2 reveals that Israel has topped in financially inclusive Middle East economies, containing an average value for *FIN* (1.86) that fluctuates between 1.31 and 2.40. UAE is placed second, with a mean *FIN* (1.79) ranging from 1.22 to 2.87. Bahrain is third, followed by Qatar, Kuwait, and Saudi Arabia. If per capita *EG* is considered, then Turkey is at the top of the list, holding a mean value for the growth rate of 3.16 %, which ranges from −6.12 to 8.42 %. Egypt is second, with the mean value of per capita *EG* of 2.45 %, fluctuating from −0.45 to 5.07 %. Israel is third, followed by Kuwait and Saudi Arabia. The extremely significant values of the Jerca-Berra (J-B) test imply that *FIN* and *EG* are not normally distributed in all economies. Indeed, our data's non-normal distribution property shows the logic of the QQ tool that is useful for such kind of data [7]. According to the ADF[3] unit root test, almost all variables are stationary at first difference. As a result, followed by Shahzad et al. [7], the stationary data series is employed by transforming *FIN* and *EG* to first differences.

The correlation analysis indicates that the correlation coefficients of *FIN* and *EG* are significantly and positively correlated with each other in all nations. According to Table 3, the UAE holds the highest correlation coefficient (0.85), followed by Qatar (0.84), Israel (0.82), and Oman (0.76).

5.2. Major results

QC test outcomes are given in Table 4 τ identifies the τ^{th} *FIN* quantile. The supremum norm coefficients (α and γ) have been derived from Equation (4), which indicates parameters' stability.

The QC estimates demonstrate that the cointegration relationship between *FIN* and *EG* tends to vary across the quantile distribution for all economies. It is indicated that the supremum norm values are greater than their critical threshold values (CV1, CV5, and CV10), indicating the existence of a significant, asymmetric and long-run *FIN-EG* linkage in our sample nations.

Fig. 2 shows the slope estimations α_1 (θ, τ), which points out the impact of θ^{th} *FIN* quantile on θ^{th} *EG* quantile through various θ and τ value**s** in financially inclusive Middle East countries. **Oman**, in Fig. 2 (f), shows that the strong positive effect of *FIN* on *EG* is

[3] Augmented Dickey-Fuller.

Table 2
Descriptive analysis of *FIN* and *EG*.

Economies	Mean	Min.	Max.	Std. Dev	J-B Stats	ADF (Level)	ADFΔ
Panel 1: Financial Inclusion (*FIN*)							
Israel	1.86	1.31	2.40	0.27	6.13*	−1.79	−6.12*
UAE	1.79	1.22	2.87	0.58	6.66*	−1.94	−5.61*
Bahrain	1.34	0.56	3.39	0.67	7.61*	−2.10	−3.55**
Qatar	1.29	0.96	1.59	0.48	6.15*	−1.73	−3.68**
Kuwait	1.25	0.75	1.89	0.48	9.69*	−1.34	−5.62*
Saudi Arabia	1.20	0.61	2.46	0.51	6.38*	−1.29	−4.31*
Turkey	1.15	1.24	1.83	0.43	9.55*	−1.68	−4.82*
Egypt	1.09	0.80	1.31	0.14	8.90*	−0.91	−6.18*
Oman	0.96	0.80	1.13	0.08	10.60*	−1.54	−5.69*
Iran	0.90	0.85	1.09	0.09	8.57*	−1.40	−4.28*
Panel 2: Economic Growth (*EG*)							
Israel	2.26	−3.57	6.80	2.25	2.50*	−1.56	−5.70*
UAE	1.15	−4.45	6.98	3.20	4.73*	−2.09	−5.73*
Bahrain	0.48	−3.56	4.22	2.11	7.27*	−1.73	−7.70*
Qatar	1.19	−5.73	14.71	5.57	10.74*	−5.71*	−6.24*
Kuwait	1.27	−4.88	6.38	5.42	3.11*	−1.58	−4.45*
Saudi Arabia	1.24	−5.65	8.27	3.70	4.52*	−1.96	−3.98*
Turkey	3.16	−6.12	8.42	4.02	2.36*	−1.85	−4.14*
Egypt	2.45	−0.45	5.07	1.74	7.74*	−1.63	−3.95*
Oman	0.07	−5.80	6.35	3.50	5.23*	−1.66	−4.49*
Iran	1.06	−4.96	6.83	3.54	2.40*	−1.83	−4.15*

Note:* and ** exhibit the level of significance at 1 % and 5 %, respectively.

Table 3
Correlation analysis of *FIN* and *EG*.

Country	Correlation	*t*-Stats	*P*-value
Israel	0.82	20.30*	0.00
UAE	0.85	14.39*	0.00
Bahrain	0.68	8.65*	0.00
Qatar	0.84	9.69*	0.00
Kuwait	0.75	5.47*	0.00
Saudi Arabia	0.71	4.10*	0.00
Turkey	0.73	9.34*	0.00
Egypt	0.69	8.90*	0.00
Oman	0.76	4.06*	0.00
Iran	0.68	2.94*	0.00

Note:'*' refers the significance level at 1 %.

dominant. The *FIN* quantiles have a weak positive relationship with the bottom *EG* quantiles (i.e., 0.05–0.30). It shows that *FIN* had no impact on *EG* during the recession. Furthermore, this effect becomes a powerful positive interrelation within points, which amalgamate whole *FIN* quantiles interlinked with the low-medium to higher-mid *EG* quantiles (0.4–0.75). It asserts that *FIN* has a favorable influence on *EG* during the healthy growth and recovery period. This outcome is support by the empirical outcomes of Hussain et al. [17], who also detected that *FIN* enhanced *EG*. However, all the *FIN* quantiles are negatively connected with the peak *EG* quantiles, which implies that *FIN* reduces *EG* during the economic boom.

In Fig. 2 (a), Israel depicts the positive and strong influence of *FIN* on *EG*. The positive, powerful relationship between *FIN* and *EG* exists in the segments that combine all quantiles of *FIN* (0.05–0.95) and lowest to fairly-upmost quantiles of *EG*. This powerful and convincing association between *FIN* and *EG* shows that the *FIN* improves the *EG* in both periods of lowest and highest *EG*. Furthermore, this nexus becomes negative among the localities, which combine all quantiles of *FIN* and the topmost quantiles of *EG*. It states that *FIN* reduced *EG* during the economic boom in Israel. In Fig. 2 (e), Turkey shows strong, weak, and moderate relationships between *FIN* and *EG* in different periods. A weak and direct association prevails in the parts that link all *FIN* quantiles with lesser *EG* quantiles (0.05–0.30). It implies that *FIN* did not increase *EG* during the period of economic recession. Moreover, this association grows into a fragile negative association among the vicinities, which link whole *FIN* quantiles with moderately low to medium *EG* quantiles. Furthermore, an extremely positive tie between *FIN* and *EG* is identified in places that interrelate entire *FIN* quantiles, linking upper-mid to upper *EG* quantiles (0.60–0.95). It specifies that *FIN* acts as an engine of *EG* during the times of economic boom in Turkey. The outcomes are consistent with the empirical studies of Dogan et al. [23], who found that *FIN* reduced poverty and increased *EG* in Turkey.

In Fig. 2 (b), the UAE shows a positive and powerful connection between *FIN* and *EG* is shown within the vicinities that affiliate the bottom to median *FIN* quantiles (0.05–0.50), linking all the *EG* quantiles. It shows that *FIN* enhances *EG* during the lower and mid-levels of *FIN* in UAE. However, a weak and positive *FIN-EG* association prevails among the vicinities that link the moderate-high

Table 4
Outcomes of QC test (*FIN* and *EG*).

Economies	Coefficients	$Sup_\tau \lvert V_n(\tau)\rvert$	CV1	CV5	CV10
Israel					
FIN vs. *EG*	α	539.40	325.36	295.73	236.58
	γ	289.90	198.90	128.75	97.36
UAE					
FIN vs. *EG*	α	8310.25	5286.20	3138.01	2525.35
	γ	179.62	108.45	53.87	37.32
Bahrain					
FIN vs. *EG*	α	6236.56	5687.90	3681.80	2782.70
	γ	3272.90	2690.70	2188.72	1858.45
Qatar					
FIN vs. EG	α	3930.90	3768.26	248.52	205.90
	γ	164.71	159.80	48.09	42.70
Kuwait					
FIN vs. *EG*	α	1240.72	938.76	549.09	208.70
	γ	787.80	585.95	496.90	370.70
Saudi Arabia					
FIN vs. *EG*	α	1838.70	1547.70	1040.70	996.84
	γ	952.76	688.64	495.73	346.95
Turkey					
FIN vs. *EG*	α	8750.50	6730.08	4770.12	1470.70
	γ	397.10	205.67	102.10	95.05
Egypt					
FIN vs. *EG*	α	7114.35	3495.18	3086.12	2226.39
	γ	610.44	302.80	215.19	119.15
Oman					
FIN vs. *EG*	α	9384.07	7203.03	5904.70	2621.05
	γ	250.69	167.40	127.56	97.18
Iran					
FIN vs. *EG*	α	8590.32	6367.30	5708.25	4888.70
	γ	2450.60	1490.20	1445.45	1435.20

Note: To estimate t-statistics, an evenly-spaced grid of 19 quantiles (0.05–0.95) is employed for QC. The maximum norm values of the coefficients (α and γ) are given along with their critical values at the 1 % (CV1), 5 % (CV5), and 10 % (CV10) significance levels.

FIN quantiles (0.55–0.80) to complete *EG* quantiles. Furthermore, an inverse powerful correlation between the topmost quantiles of *FIN* (0.90–0.95) and all *EG* quantiles is also found, which implies that *FIN* at its highest levels significantly enhances *EG* in the UAE. In Fig. 2 (j) for Saudi Arabia, *FIN* has a strong influence on *EG*. The *FIN* quantiles hold a moderate inverse bond with the lower *EG* quantiles. Additionally, this impact modifications within a positive, vigorous influence in the division, which assimilates the entire *FIN* quantiles, interlinking the medium-low to relatively upper *EG* quantiles (0.35–0.75). It exhibits that *FIN* enhances *EG* in times of healthy *EG* in Saudi Arabia. However, this powerful positive linkage alters into a moderate correlation among the quantiles that integrates the *FIN* quantiles with the upper quantiles of *EG*. The dominance of positive *FIN-EG* association in UAE and Saudi Arabia is supported by the study of Emara & El Said [24], who observed that *FIN* has a positive relationship with *EG* in MENA countries.

In Fig. 2 (h), Egypt shows a dominance of strong positive connection between *FIN* and *EG*. All the *FIN* quantiles have a weak positive linkage with the bottom *EG* quantiles (i.e., 0.05–0.30), implying that *FIN* does not enhance *EG* during times of economic recession. Moreover, this effect becomes a powerful positive across vicinities that tie entire *FIN* quantiles, linking the low-mid to upper-mid *EG* quantiles (0.35–0.85). The positive Finance-*EG* nexus supports Kim et al. [22], who argued that *FI* amplified *EG* in OIC economies. This especially strong nexus denotes that the *FIN* expands the *EG* in the periods of healthy *EG*. Furthermore, all the *FIN* quantiles are strongly and negatively connected with the higher *EG* quantiles (0.85–0.95). It indicates that *FIN* lessened *EG* during the phases of the economic boom in Egypt. In Fig. 2 (d), Qatar exhibits the dominance of strong positive effect of *FIN* on *EG*. The *FIN* quantiles demonstrate a powerful and positive impact on the lower to moderately higher *EG* quantiles (0.05–0.75). The explicitly vigorous/significant and positive relationship during rising *EG* shows that the *FIN* improves the *EG* in the periods of low and moderate-high *EG*. The outcome is consistent with the research of Adams, Andersson, Andersson, & Lindmark [33], who observed that commercial banking and insurance increased *EG*. A weak positive association among the areas is indicated, which combines all *FIN* quantiles with the topmost *EG* quantiles (0.80–0.95). It indicates that *FIN* does not enhance *EG* at higher levels or during an economic boom in Qatar. The strong positive impact of *FIN* on *EG* in Qatar and Egypt aligns with the studies of Emara & El Said [24] and Dogan et al. [23].

In Fig. 2 (i), Bahrain dominates the positive nexus between *FIN* and *EG*. A powerful positive conjunction is realized throughout the locations that tie *FIN* quantiles interlinking the bottom-to-mid-low and moderately higher *EG* quantiles (0.05–0.35 & 0.65–0.80). It demonstrates that *FIN* enhances *EG* during both low and middle-high levels of *EG*. However, this positive and strong link converts into a fragile positive association in the domains that combine entire *FIN* quantiles with the uppermost quantiles of *EG* (0.85–0.95). It implies that *FIN* does not increase *EG* during periods of economic boom. Moreover, this positive association becomes a strong negative across sections, which tie overall *FIN* quantiles interlinking the moderately low to median *EG* quantiles (0.40–0.50). In Fig. 2 (g), Kuwait shows a positive and vigorous influence of *FIN* on *EG*, which is supreme. The *FIN-EG* nexus grows stronger and positive among the vicinities that link medium to topmost quantiles of *FIN* (0.60–0.95) with mid-high to foremost quantiles of *EG* (0.65–0.95). It

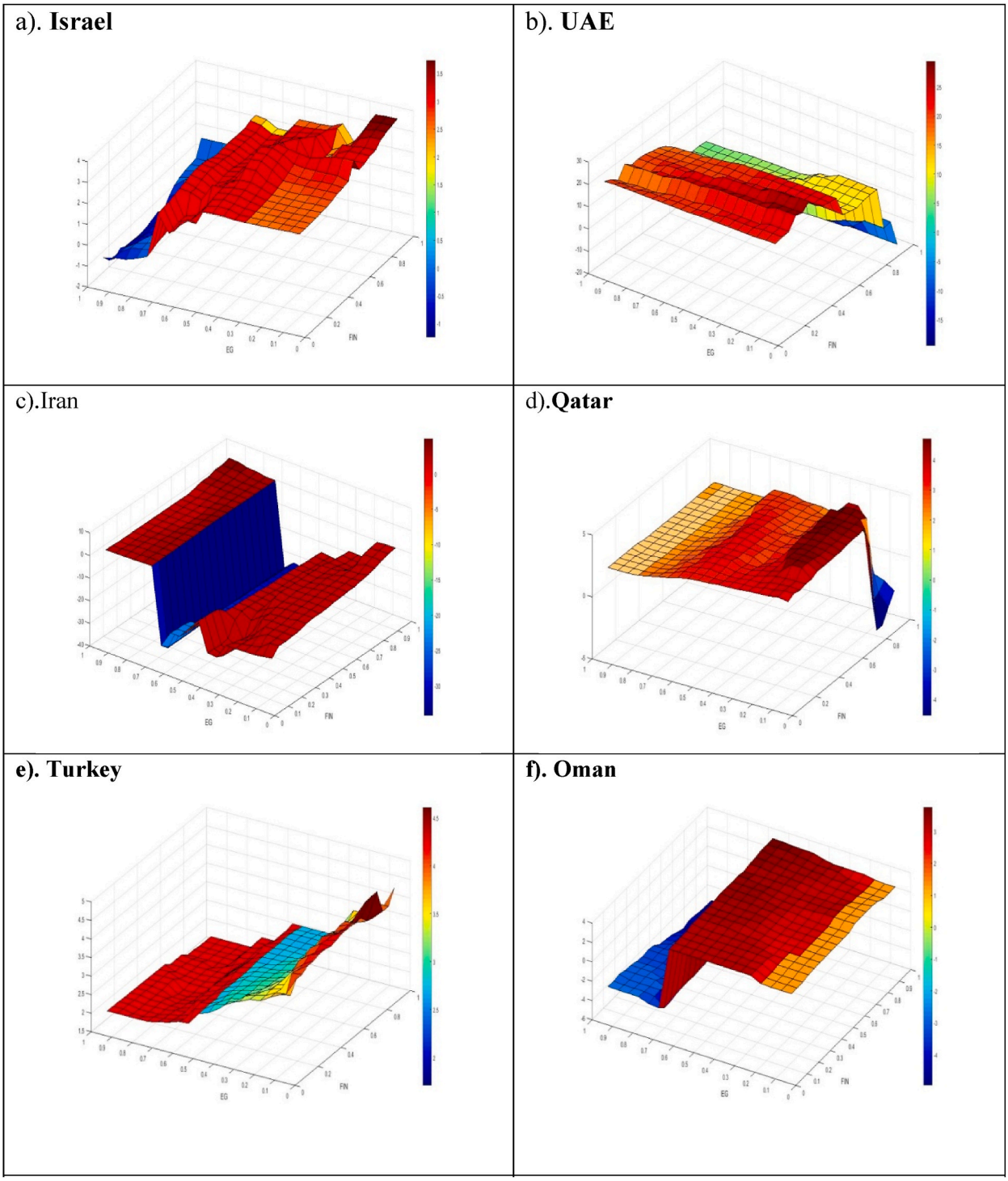
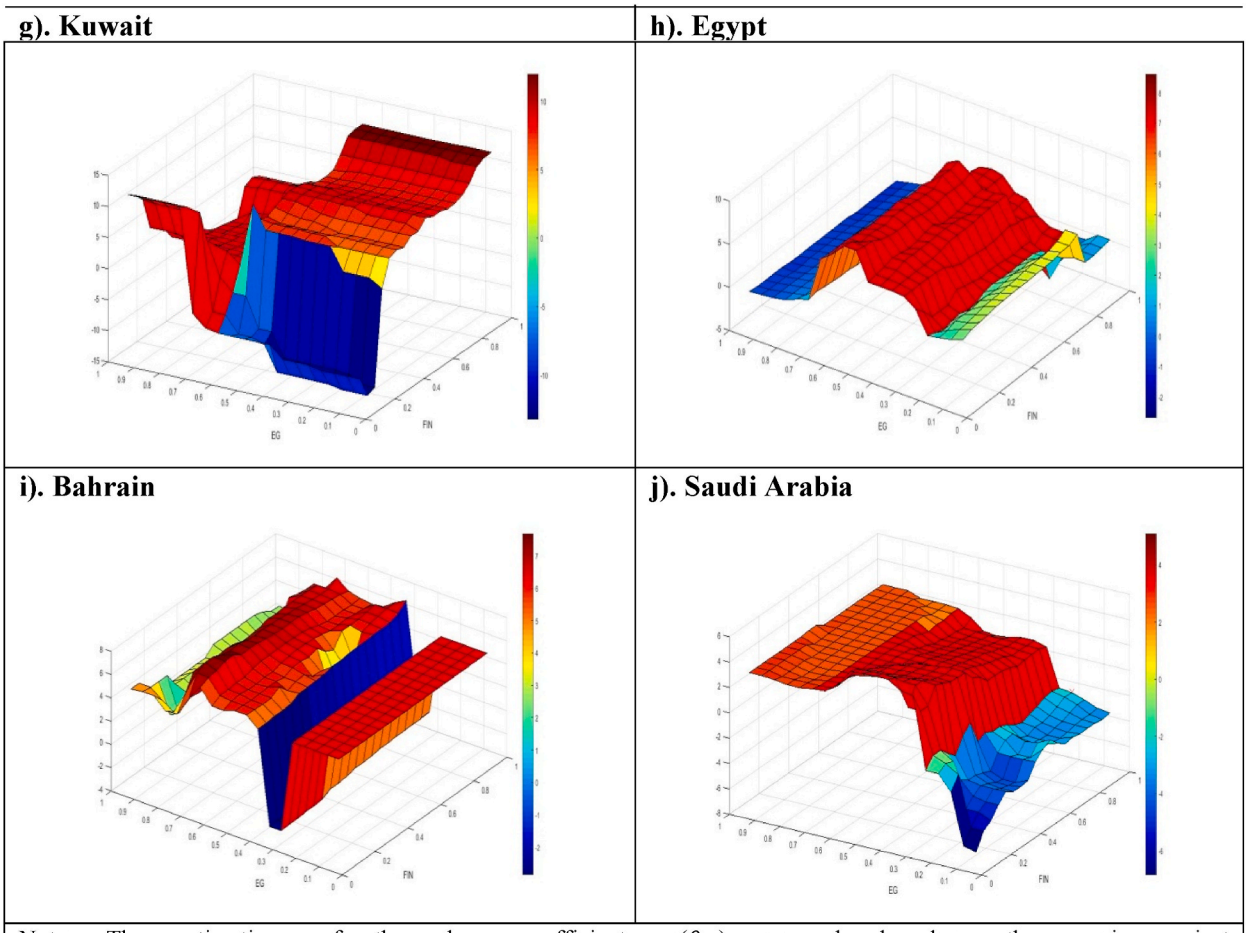


Fig. 2. Quantile-on-Quantile (QQ) estimations of the slope coefficient, α_1 (, $\boldsymbol{\tau}$).
Note: The estimations of the slope coefficient $\alpha_1(\boldsymbol{\theta},\boldsymbol{\tau})$ are placed along the z-axis againstthe quantiles of *FIN* on the x-axis and the quantiles of *EG* on the y-axis. The color spectrum in the charts represents the slope coefficients, spanning from blue (indicating low values) to red (indicating high values). A deep red hue indicates a powerful positive *FIN-EG* correlation, whereas a dark blue shade proposes a strong negative linkage. Similarly, a light red shade denotes a weak positive connection, whereas a lighter blue color implies a weak negative *FIN-EG* association. This representation effectively illustrates the intensity and pathway of the relationship between the variables in diverse scenarios.



Note: The estimations of the slope coefficient $\alpha_1(\theta,\tau)$ are placed along the z-axis against the quantiles of *FIN* on the x-axis and the quantiles of *EG* on the y-axis. The color spectrum in the charts represents the slope coefficients, spanning from blue (indicating low values) to red (indicating high values). A deep red hue indicates a powerful positive *FIN-EG* correlation, whereas a dark blue shade proposes a strong negative linkage. Similarly, a light red shade denotes a weak positive connection, whereas a lighter blue color implies a weak negative *FIN-EG* association. This representation effectively illustrates the intensity and pathway of the relationship between the variables in diverse scenarios.

Fig. 2. (*continued*).

demonstrates that *FIN* causes the rise in *EG* during the times when moderate and high levels of *FIN* combine with the period of economic boom. The results align with the empirical outcome of Emara & El Said [24], who found a positive association between *FIN* and *EG* in MENA economies. A negative powerful link is observed in the bottom to lower-middle *FIN* quantiles, linking the bottommost to mid-high *EG* quantiles (0.05–0.65). The positive association between *FIN* and *EG* in Bahrain and Kuwait aligns with the study of Hussain et al. [17].

In Fig. 2 (c), a mixed relationship between *FIN* and *EG* is found in Iran, in which both positive and negative effects of *FIN* on *EG* are shown during different periods. All *FIN* quantiles show a powerful positive effect on the bottom to median *EG* quantiles (0.05–0.5). It insinuates that *FIN* improves *EG* during times of recession and recovery of an economy. The outcome is assisted by Akbarzadeh et al. [34], who originated that financing uplifted *EG* in Iran. The mixed relationship is also supported by the research of Nizam et al. [25], who argued that there is a threshold influence in the connection between *FIN* and *EG*. According to Nizam et al. (2022), *FIN* beyond the threshold level decreases *EG*. However, an inverse association among the zones is also shown, which combines the upper-middle *EG* quantiles (0.60.85) with all the quantiles of *FIN*. Moreover, this effect again alters into a dominant positive connection in the zones that integrate whole *FIN* quantiles with high quantiles of *EG* (0.90–0.95. It declares that *FIN* acts as an engine of growth when Iran's economy is booming.

5.3. Examining the Robustness of the QQ technique

The estimation values of the QQ regression can be coordinated with the QR estimations to verify if they are identical. Fig. 3

endorses the prior findings obtained by QQ methodology. The diagrams disclose that the mean QQ estimation values of the slope coefficients are identical with the QR estimated values.

Fig. 3 indicates that our nations show a positive relationship between *FIN* and *EG*, except for Iran. Furthermore, our findings demonstrate that the link between *FIN* and *EG* is heterogeneous among all economies. According to the coefficients, the influence of

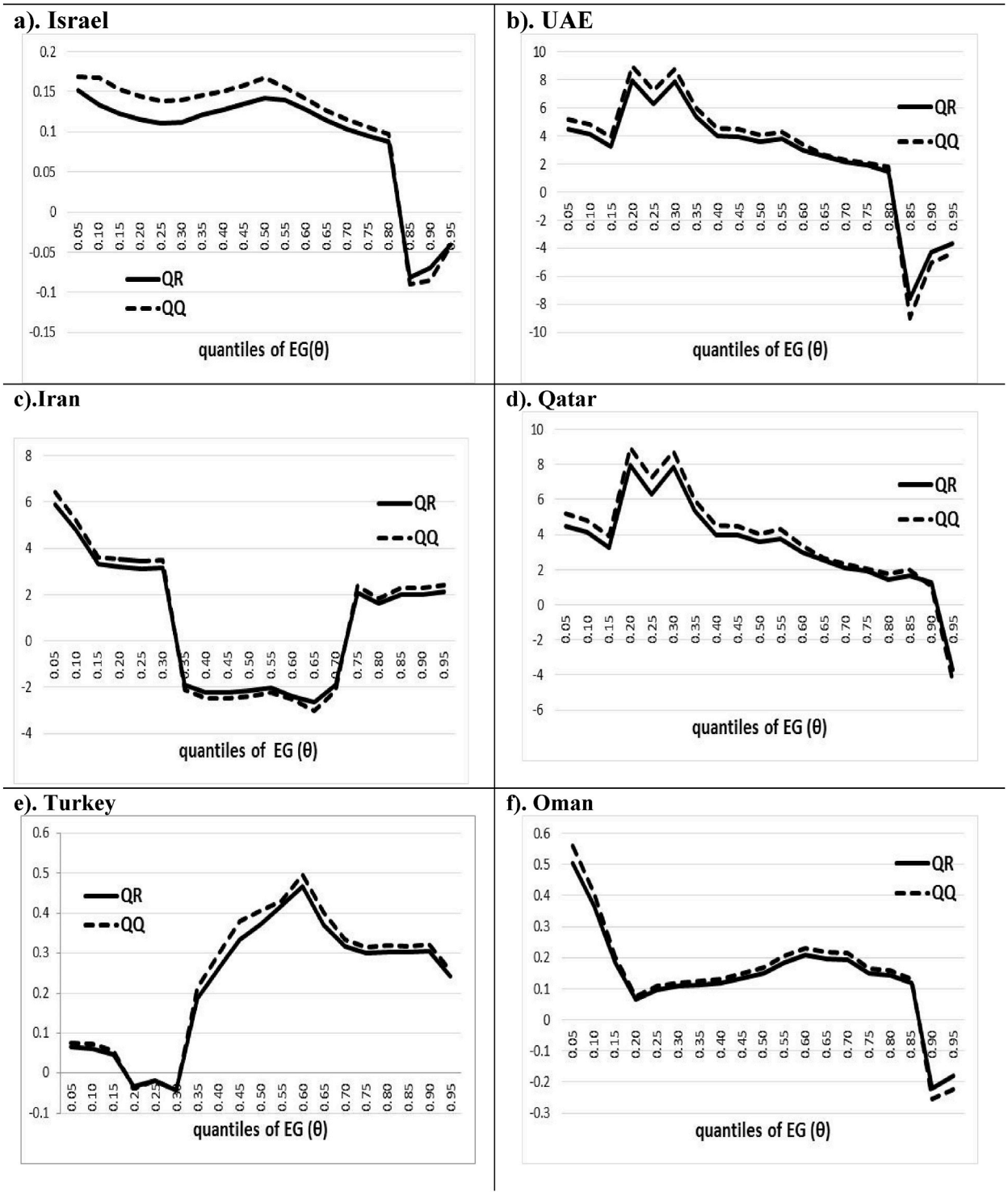
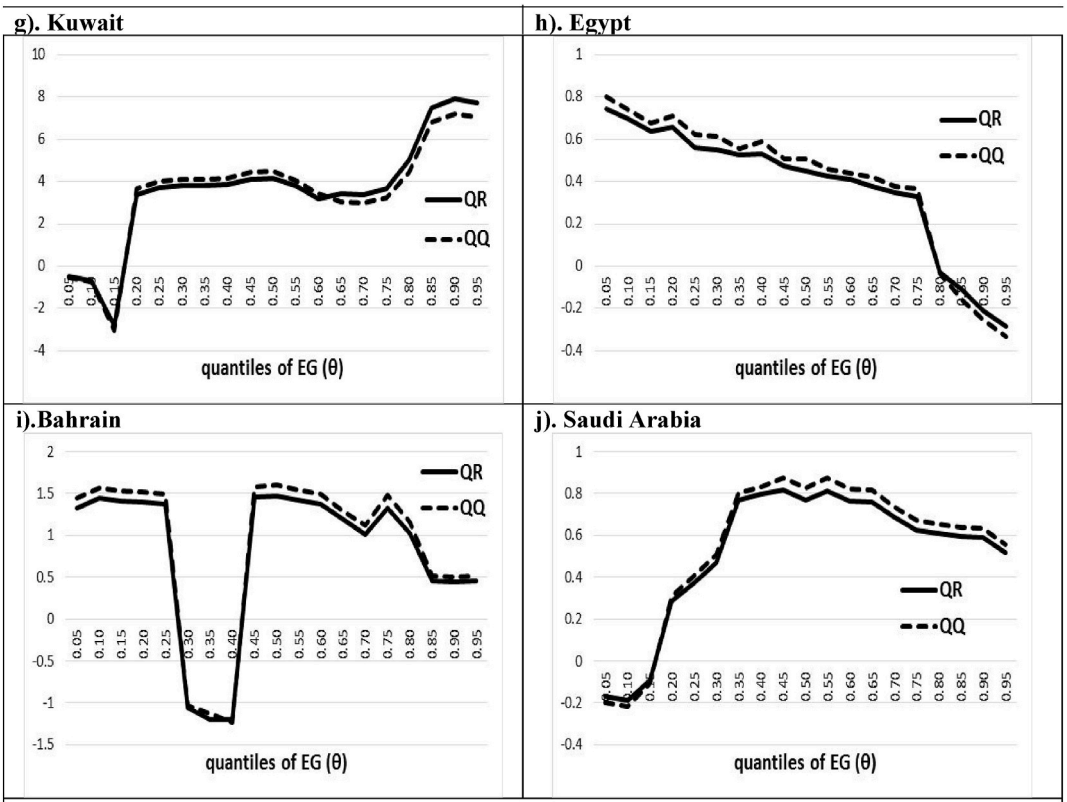


Fig. 3. Examining the robustness of the QQ method by Relating QR and QQ estimates.
Note: The estimates of the typical QR regression and the averaged QQ estimates are specified against diverse *EG* quantiles.



Note: The estimates of the typical QR regression and the averaged QQ estimates are specified against diverse *EG* quantiles.

Fig. 3. (*continued*).

FIN on *EG* is substantially bigger in Kuwait in Fig. 3 (g), Iran in Fig. 3 (c), Qatar in Fig. 3 (d), and UAE in Fig. 3 (b). However, in the case of Israel in Fig. 3 (a), Turkey in Fig. 3 (e), and Oman in Fig. 3 (f), the efficiency of *FIN* is less prominent.

5.4. Discussion of findings

The outcomes uncover a positive bond between *FIN* and *EG* in most of our opted economies. *FIN* has been realized to be an effective *EG* enhancement strategy. Our research's empirical outcomes supports our hypothesis, as do other works, for example, Neaime & Gaysset (2018), Afonso & Arana [35], and Emara & El Said [24], which recommend that *FIN* has a favorable effect on *EG*. The observation of substantial and positive *FIN* coefficients gives aid to the strategy statements about the SDGs, as *FIN* has a prime importance in almost half of the SDGs. Our findings are also support by Kim et al. [22], Hussain et al. [17], and Ramesh Hegde & Guruprasad [36]. The outcomes are partially consonant with Akbarzadeh et al. [34] for Iran; Kim et al. [22] for OIC nations; Dogan et al. [23] for Turkey, and Emara & El Said (2021) for MENA countries, who contend that *FIN* improves *EG*. However, a mixed relationship is found among the quantiles of *FIN* and *EG* in Iran, which can be featured due to patterns of *EG*, population, technological innovations, and business cycles.

In the context of Iran, the relationship between *FIN* and *EG* reveals a mixed trend encompassing both inverse and positive connections. The findings illustrate that the impact of *FIN* on *EG* is not consistently inverse; instead, it deviates from relying on factors consisting of duration, time, and geographical conditions. Firstly, the temporal aspect significantly influences the influence of *FIN* on *EG*. Over short periods, *FIN* may not immediately translate into noticeable *EG* due to the lag in the effects of increased access to financial services. At the outset, the costs associated with expanding *FIN*, like infrastructure development and financial literacy programs, might outweigh immediate economic benefits. However, over a longer horizon, the benefits of *FIN* become more apparent as the accumulation of capital, improvements in financial literacy, and increased access to credit fuel entrepreneurial activities and stimulate economic development. Secondly, the duration of *FIN* initiatives also plays a critical role. Short-term measures may lead to transient improvements in economic indicators, but sustainable *EG* requires a long-term commitment to *FIN* policies. Long-term initiatives ensure that a larger part of the population gains access to financial services, thereby enabling more inclusive *EG* where benefits are more evenly distributed across different segments of society. Geographical conditions within Iran further complicate the linkage between *FIN* and *EG*. The country's diverse geography, ranging from urban centers to rural areas, means that the effect of *FIN* deviates significantly across areas. In urban areas, where access to financial services is typically higher, the positive influences of *FIN* on *EG* are more readily observable. These areas benefit from better infrastructure, which facilitates the delivery of financial services

and contributes to the growth of small and medium-sized enterprises (SMEs). In contrast, rural and remote areas face challenges like limited access to banking services and a lack of financial literacy, which may hinder the positive effect of *FIN* on *EG*. Therefore, the geographical disparities within Iran necessitate region-specific strategies to upraise the effectiveness of *FIN* in encouraging *EG*. The mixed association between FIN and EG in Iran is aligned with the study of Nizam et al. (2022).

In Israel and Kuwait, a powerful positive *FIN-EG* connection turns apparent, exceptionally at top *FIN* quantiles. This phenomenon might be ascribed to multiple vital elements intrinsic to the dynamics of *FIN* and its influence on economic systems, particularly in more financially inclusive environments. First, at higher levels of *FIN*, a wider part of the population gains access to financial services, including insurance, credit, savings accounts, and investment products. This widespread access facilitates a more efficient allocation of resources, as more individuals and businesses can invest, save, or borrow as needed, leading to optimal economic decisions that spur growth. In countries like Israel and Kuwait, where financial systems are relatively developed, higher *FIN* enables more efficient capital markets, fostering an environment conducive to innovation and entrepreneurship. Second, the positive influence of *FIN* on *EG* at higher quantiles can be linked to improved financial structure. In more inclusive financial systems, risks are diversified across a larger pool of participants, reducing the impact of shocks on the financial system. This stability is crucial for sustained *EG*, as it builds confidence among investors and consumers alike, encouraging investment and spending. Third, higher quantiles of *FIN* often coincide with improved financial literacy and awareness among the population. In contexts such as Israel and Kuwait, where the financial sector is complex and offers a vast scale of products and services, higher levels of *FIN* are likely to be accompanied by efforts to improve financial education. It ensures that individuals and businesses are better equipped to make informed financial decisions, which in turn support more productive investment and consumption patterns, further driving EG 24.

Moreover, at top levels of *FIN*, the integration of technology in financial services, like mobile banking and online financial platforms, becomes more pronounced. This technological integration enhances the efficiency of financial transactions and lowers the cost of accessing financial services, particularly for small and medium-sized enterprises and individuals in remote areas. The increased efficiency and reduced costs associated with higher *FIN* levels can significantly boost economic activities, contributing to stronger *EG*. Lastly, in countries like Israel and Kuwait, the positive correlation between *FIN* and *EG* at higher quantiles is also assisted by a conducive regulatory and policy environment. Governments and regulatory bodies in these countries have implemented policies that promote *FIN*, such as supportive legal frameworks, incentives for banks to reach underserved areas, and initiatives aimed at fostering financial innovation. These policies not only raise the level of *FIN* but also ensure that its benefits are maximized, thereby strengthening the positive influence on *EG*.

In the UAE, Qatar, and Saudi Arabia, a powerful positive *FIN-EG* connection becomes obvious, exceptionally at top *EG* quantiles. This situation underscores the symbiotic relationship between a thriving economy and the part of *FIN* in bolstering economic resilience and diversification. Firstly, higher levels of *EG* in these economies often correlate with increased government revenues, particularly from the oil and gas sectors, which in turn enable significant public investments in financial infrastructure and services. This investment enhances the accessibility and quality of financial services, thereby facilitating *FIN*. As the economy grows, the financial sector benefits from a virtuous cycle where economic prosperity enables further financial sector development, which then support more robust *EG* through more inclusive financial participation. Secondly, at higher *EG* levels, there is typically an increase in domestic and foreign investment, leading to more diversified economic activities beyond the traditional oil-based economy. This diversification requires a sophisticated financial sector capable of support new industries and services, including small and medium-sized enterprises, that are crucial for sustainable economic development. *FIN* plays a critical role in this context by guaranteeing that a wider portion of the economy, including SMEs and individuals, has access to financial services, thereby supporting broader economic participation and innovation. Thirdly, the connection between *FIN* and *EG* boosts the top quantiles of *EG* in spite of the enhanced stability of the financial system. As economies grow, they typically develop more robust regulatory frameworks and financial institutions that contribute to *FIN*. A stable financial system, in turn, promotes confidence among consumers and investors, which is vital for *FIN*. Confidence in the financial system encourages the use of financial services and fosters a culture of saving and investment among the population.

Moreover, in the UAE, Qatar, and Saudi Arabia, higher *EG* quantiles are often accompanied by strategic efforts to modernize and innovate within the financial sector. It includes the adoption of fintech solutions, digital banking, and mobile payment systems, which significantly lower the impediments to *FIN* by making financial services more accessible and convenient. The push towards digitalization in the financial sector, fueled by economic prosperity, ensures that *FIN* can reach even the most remote or underprivileged segments of the population, further strengthening the positive link between *FIN* and *EG*. Finally, at higher levels of *EG*, there is typically a greater emphasis on social and economic policies aimed at reducing inequality and promoting inclusive growth. These policies often include measures to enhance financial literacy and targeted *FIN* initiatives designed to ensure that the gains of *EG* are broadly shared across all segments of society. By stressing *FIN* as a means to distribute the fruits of *EG* more evenly, these countries can foster a more sustainable and equitable economic development model. The positive association between FIN and EG in most of our selected economies are Funding by the studies of Neaime & Gaysset (2018), Afonso & Arana (2018), and Emara & El Said [24].

Nonetheless, the circumstance gets a diverse turn in Iran, whereas the negative *FIN-EG* interconnection is perceptible just until reaching the mid-quantiles of *EG*; beyond this threshold, it shifts into a positive association. This change can be attributed to several factors that come into play as the economy reaches a certain level of growth. Initially, at lower levels of *EG*, the expansion of *FIN* may not directly translate into immediate economic benefits due to structural inefficiencies, such as limited access to credit for small and medium-sized enterprises (SMEs) and a lack of financial literacy among the wider population. These factors can dampen the potential positive impacts of *FIN* on *EG*. However, as *EG* progresses to mid-quantiles, improvements in the regulatory framework, financial infrastructure, and overall economic stability begin to mitigate these initial inefficiencies. The economy becomes better equipped to leverage the advantages of *FIN*, such as enhanced access to financial services and increased investment and consumption opportunities. It, in turn, stimulates economic activity and supports further growth, allowing the positive aspects of *FIN* to become more pronounced.

Moreover, at this stage, there is often a greater emphasis on policy measures aimed at promoting financial literacy and inclusion as tools for economic development. These measures help to ensure that a wider segment of the population can participate in the financial system, thereby contributing to and benefiting from *EG*. As a result, beyond the mid-quantiles of *EG*, *FIN* begins to perform a more integral part in driving economic expansion, reflecting a positive relationship between the two.

As stated before, the differences in the effect of *FIN* on *EG* affect the chosen economies and are linked to variations in various economic components. The fluctuations observed in the *FIN-EG* slope coefficients across these economies indicate that economic changes, especially the state of the economy (whether it is in a recession or expansion), affect *EG* through economic mechanisms. During recessions, the positive impacts of *FIN* on *EG* may be dampened due to decreased consumer spending, higher unemployment rates, and lower investment levels. In such times, even though *FIN* might enable more people to access financial services, the overall economic downturn can limit the opportunities for productive investment and consumption. Consequently, the capacity of *FIN* to excite *EG* is reduced, reflecting a weaker or sometimes negative relationship between *FIN* and *EG*. Conversely, in times of economic expansion, the benefits of *FIN* are magnified. Increased economic activity leads to higher employment, consumer spending, and investment opportunities. In this context, *FIN* can significantly contribute to *EG* by assuring that a larger portion of the population has access to financial services. This access enables more people and businesses to invest, save, and consume, further fueling the economic boom. Thus, throughout *EG* periods, the association between *FIN* and *EG* strengthens, showcasing a more pronounced positive influence. Furthermore, the dynamics of *FIN* can also influence the resilience of an economy to shocks. In economies with high levels of *FIN*, the distribution of financial resources can be more equitable and the financial system more stable, enhancing the economy's ability to withstand adverse conditions. This resilience can moderate the negative impacts of recessions and contribute to more robust growth during expansions.

6. Conclusion and policy Implications

The present investigation has assessed how *FIN* influences *EG* in the top 10 financially inclusive Middle East nations (Israel, Turkey, Iran, Saudi Arabia, Oman, Kuwait, the United Arab Emirates, Bahrain, Egypt, and Qatar). The results of the QQ instrument have shown that *FIN* significantly increased *EG* across diverse quantiles in nine out of ten selected countries. However, the situation in Iran has presented a more intricate scenario with mixed outcomes, suggesting that the effect of *FIN* on *EG* differs in this country.

Based on the findings from this research, policymakers must encourage further and support *FIN* initiatives. In order to maximize the positive effects of *FIN* on *EG*, policies should focus on raising access to financial services across all parts of the population. It can be achieved through promoting digital financial services, which can overcome geographical barriers, and by implementing financial education programs to improve financial literacy. Moreover, regulatory frameworks should be designed to encourage innovation in the financial sector, such as fintech startups, which can offer new financial products and services tailor-made for underserved populations. Ensuring a supportive environment for these initiatives will help sustain *EG* and foster inclusivity. In the case of Iran, where the connection between *FIN* and *EG* presents a complex scenario with mixed outcomes, a nuanced approach is necessary. Policymakers should consider targeted *FIN* strategies that address the specific barriers and challenges within the country. It might include addressing structural inefficiencies in the financial system, enhancing the regulatory and legal framework to support greater *FIN*, and implementing targeted interventions to support sectors or regions that are lagging in terms of *FIN*. Additionally, further research into the unique dynamics of *FIN* in Iran is warranted to understand the mechanisms at play better and to design more effective policies. Tailoring *FIN* policies to the specific economic and social context of Iran will be crucial in harnessing its potential to contribute to *EG*.

Given the strong positive *FIN-EG* linkage observed at top quantiles of *FIN* in Israel and Kuwait, policy recommendations should focus on further enhancing *FIN* to capitalize on its potential to drive *EG*. Authorities in both countries should consider implementing targeted policies intended at increasing access to financial services across all portions of society, with a particular focus on underserved and rural areas. It could involve incentivizing financial institutions to broaden their outreach through digital banking platforms and mobile banking services, which have proven effective in increasing *FIN*. Additionally, investing in financial literacy programs to ensure that individuals are well-equipped to make informed financial decisions can amplify the positive impacts of FIN. Such policies not only support sustained EG by enabling more inclusive participation in the economy but also assure that the gains of growth are more appropriately distributed across the population.

The strong positive *FIN-EG* linkage at upper quantiles of *EG* in the UAE, Qatar, and Saudi Arabia intimates that leveraging *FIN* can be a crucial strategy for sustaining and further stimulating *EG* in these nations. Policy recommendations should focus on enhancing the depth and breadth of FIN as part of a broader economic strategy. It could involve initiatives aimed at improving financial infrastructure, promoting fintech innovations to ease access to financial services, and tailoring financial products to confront the diverse requirements of the population, including small and medium enterprises. Additionally, policies should encourage financial education and literacy to empower individuals and businesses to use financial services effectively. By doing so, these countries can ensure that *FIN* acts as a catalyst for continued economic prosperity, benefiting a wider segment of their populations and fostering more equitable growth.

Given the unique dynamics in Iran, where the relationship between *FIN* and *EG* transitions from negative to positive at mid-quantiles of *EG*, policy recommendations should focus on strategies to navigate and expedite this transition. It could involve targeted interventions aimed at enhancing the efficiency and accessibility of financial services to support economic activities at all levels. Specifically, policies should prioritize improving financial infrastructure in underserved areas, fostering financial literacy to enable more informed financial decisions, and supporting small and medium-sized enterprises as they play a crucial part in moving the nation past the mid-quantile threshold. Additionally, regulatory frameworks should be adapted to encourage innovation in the financial sector, specifically in digital financial services, to broaden access and reduce disparities in *FIN*. Such approaches would help mitigate

the initial inverse influences of *FIN* on *EG* and maximize its positive benefits, ensuring a smoother transition to a more inclusive and prosperous economy.

There are some limitations to this work that would guide prospective investigations on this issue. In this study, the impact of *FIN* on the overall *EG* has been observed. Additional studies are required to ascertain the effect of *FIN* on the growth of particular sectors in chosen Middle Eastern nations, such as agriculture, manufacturing, and services. Moreover, future investigations are necessary to examine the individual effects of various elements of *FIN* (e.g., the number of commercial banks, ATMs, and depositors) on *EG*. The outcomes of the present research are restricted to top-10 financially inclusive Middle East economies; therefore, future research should consider other regions of the world like the European Union, Sub-Saharan Africa, and South Asia. Furthermore, detailed comparisons of developed and developing countries are also needed to take a broader picture of these findings in a bigger perspective.

Human and animal rights

No human or animals were harmed to do this research.

Availability of data

The dataset used during the current study is available from the corresponding author on reasonable request.

Ethics approval and consent to participate

N/A.

Consent for publication

N/A.

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CRediT authorship contribution statement

Xinyi Shen: Writing – original draft, Formal analysis. **Qian Huang:** Writing – original draft, Methodology. **Raima Nazar:** Writing – original draft, Data curation, Conceptualization. **Lee Chin:** Writing – original draft, Software.

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.

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