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Effect of Geopolitical Risk, Oil Price Shocks, and Banking Stability on Financial Stability in Selected Islamic Countries: Emphasizing Profitability and Trade Volume

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ABSTRACT

The present study employs a Bayesian Panel Vector Autoregression (BPVAR) approach to empirically investigate balance-sheet sustainability and financial stability in selected Developing Eight (D-8) countries, namely Iran, Türkiye, Pakistan, Bangladesh, Indonesia, Malaysia, Egypt, and Nigeria, over the 2013–2024 period. Financial stability is measured using the ratio of bank credit extended to the private sector to gross domestic product (GDP), while fluctuations in the price of Iranian Heavy Crude Oil are extracted using an asymmetric EGARCH specification. To more accurately control for and measure policy interventions in the financial structure, a composite and locally adapted Economic Policy Uncertainty (EPU) index is developed using the Hodrick–Prescott filter and Principal Component Analysis (PCA), based on monetary, fiscal, and exchange-rate variables as well as the macroeconomic variables of growth and inflation. The results indicate that the interest rate has the largest weight in the construction of this composite index. Examination of variable stationarity using the Levin–Lin–Chu test indicates that all variables are stationary at level, while the Kao panel cointegration test confirms the existence of a long-run equilibrium relationship among the variables. Model evaluation using the Limer test indicates that the panel-data structure is preferable to the pooled estimation method. After determining an optimal lag length of one, the dynamic relationships within the model are estimated. The findings obtained from estimation of the Panel VAR system show that structural oil-price shocks, geopolitical risks, and economic policy uncertainty exert negative and statistically significant effects on the financial stability index of the selected Islamic countries. Sudden capital outflows during periods of geopolitical tension, disruptions to international trade networks, cost-push inflation resulting from supply shocks, and the imposition of structural budget deficits on governments are among the most important transmission channels through which these fluctuations affect financial-system resilience, thereby intensifying credit and liquidity risks within the banking network. By contrast, improvements in the bank stability index, increases in return on assets as an indicator of profitability and internal efficiency within the banking sector, and expansion of foreign trade volume, representing greater economic openness, exert positive and statistically significant effects on financial stability in these countries. The estimated error-correction coefficient is -0.09, indicating a moderate speed of adjustment toward long-run equilibrium and the dynamic stability of the system; approximately 9% of short-run deviations are corrected each year. Analysis of impulse response functions further confirms that the response of financial stability to shocks originating from the explanatory variables is dynamic and that the effects of these shocks gradually dissipate over time. Finally, the structural stability test based on inverse characteristic roots shows that all roots lie inside the unit circle, confirming the required mathematical stability of the model.

Keywords: Financial stability, geopolitical risk, oil price shock, banking stability, selected Islamic countries



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Introduction

Financial stability has become one of the central concerns of contemporary macroeconomic and financial policy, particularly in economies that are simultaneously exposed to geopolitical tensions, commodity-price volatility, structural weaknesses in banking systems, and recurrent uncertainty in economic policymaking. A stable financial system is expected to maintain the continuous flow of credit, absorb macroeconomic and external shocks, preserve the soundness of financial intermediaries, and support investment and production without generating destabilizing feedback between the real and financial sectors. The importance of this issue is particularly pronounced in Islamic and emerging economies, where banking systems often play a dominant role in financial intermediation and where exposure to external shocks may be intensified by dependence on commodity exports, exchange-rate fluctuations, limited financial diversification, and constraints on cross-border capital flows. Financial instability may therefore emerge not only from endogenous banking-sector vulnerabilities but also from the interaction of international political tensions, oil-price disturbances, financial cycles, and domestic policy uncertainty. The cyclical behavior of public debt and its relationship with financial cycles further demonstrates that fiscal and financial dynamics can reinforce one another and thereby alter the resilience of the broader financial system (1).

In this context, geopolitical risk has increasingly been recognized as an important source of macro-financial instability. Geopolitical tensions may disrupt trade routes, restrict access to international financing, trigger capital flight, increase uncertainty regarding investment returns, alter exchange-rate expectations, and impose additional costs on firms and governments. These effects may be especially severe in economies located in politically sensitive regions or heavily dependent on international commodity and financial markets. Evidence concerning Iran, for example, suggests that geopolitical risk interacts with financial development and economic growth, indicating that geopolitical disturbances can affect the functioning of financial channels and the allocation of resources in the economy (2). Investor behavior may also change materially when geopolitical risks intensify, as investors reassess country risk, portfolio composition, and the relative attractiveness of domestic and foreign assets. Comparative evidence from Iran and the Caucasus region indicates that geopolitical conditions influence investor responses and risk perceptions, reinforcing the potential transmission of geopolitical shocks to asset markets and financial stability (3). More broadly, geopolitical uncertainty can become embedded in financial decision-making through expectations, liquidity preferences, and the repricing of risk.

The implications of geopolitical risk are not limited to conventional financial markets. Political instability, conflict, security threats, and terrorism may produce broader institutional and economic consequences that indirectly affect financial resilience. Research on terrorism and the institutional conditions associated with violent events highlights the importance of security-related risks in shaping the economic environment within which markets and financial intermediaries operate (4). Such risks may increase sovereign risk premiums, raise insurance and transaction costs, reduce investment, and divert public resources toward security-related expenditures. Banks can consequently face deterioration in borrower creditworthiness, declining collateral values, and greater liquidity pressures. In the aftermath of major financial or geopolitical crises, risk-management practices in banking therefore become especially important because banks must reassess credit exposures, liquidity buffers, capital adequacy, and contingency planning under highly uncertain conditions (5). The capacity of the banking system to absorb these shocks may ultimately determine whether geopolitical disturbances remain temporary or evolve into broader systemic instability.

Energy-market shocks represent another major channel through which external disturbances may affect financial stability. Oil prices are particularly important for Islamic countries because several of these economies are major oil producers, oil exporters, or energy-intensive importers. Oil-price changes can affect government revenues, current-account balances, exchange rates, inflation, investment, and aggregate demand. The consequences differ between oil-exporting and oil-importing economies because an increase in oil prices may improve fiscal and external balances in exporting countries while increasing production costs and inflationary pressures in importing economies (6). However, even oil exporters may experience adverse consequences when oil prices become highly volatile, because uncertainty regarding future revenues complicates fiscal planning, increases macroeconomic volatility, and may lead to procyclical public expenditure. The interaction between oil-price movements and exchange-rate behavior also suggests that energy shocks are transmitted through currency markets. Evidence regarding the relationship between the real effective U.S. dollar exchange rate and OPEC crude-oil prices demonstrates that these relationships may be nonlinear and asymmetric, emphasizing that positive and negative shocks need not produce identical economic consequences (7).

The macroeconomic consequences of oil-price volatility may further be transmitted through institutional, monetary, and financial channels. In oil-dependent economies, fluctuations in energy revenues can alter money creation, fiscal expenditure, bank deposits, credit conditions, and exchange-rate policy, thereby affecting financial-system performance (8). Oil and exchange-rate shocks may also spill over into asset markets. Evidence concerning housing prices in Iran indicates that oil-price and exchange-rate disturbances can affect major asset-market variables, demonstrating the broader transmission of commodity and currency shocks through household wealth, investment demand, and financial conditions (9). These relationships are particularly relevant for banking stability because real-estate assets often constitute an important component of bank collateral and household borrowing. A sharp deterioration in asset prices following external shocks can weaken bank balance sheets through higher non-performing loans and lower collateral values.

Recent research on commodity and electricity markets also reinforces the importance of modeling volatility as a dynamic and potentially asymmetric process. Geopolitical and climate risks have been shown to contribute to uncertainty in European electricity markets, suggesting that shocks originating outside the traditional financial sector can generate substantial price volatility and affect economic expectations (10). Similarly, evidence from Italy demonstrates that extreme weather events can be major drivers of electricity-price volatility when modeled using advanced GARCH-type specifications and machine-learning variable selection (11). Although these studies focus primarily on energy markets, their broader implication is directly relevant to financial stability: large external shocks can propagate through energy prices, production costs, inflation, firm profitability, and ultimately financial-sector balance sheets. Climate-related disturbances may additionally affect corporate innovation and investment decisions. Evidence from the Italian manufacturing sector shows that extreme climate events can alter incentives for green innovation, illustrating how external shocks can influence firm-level strategic behavior and financial needs (12). Environmental damages generated by overshooting climate targets may also impose significant social and economic costs, highlighting the growing importance of climate-related externalities in long-term economic and financial risk assessment (13).

Alongside geopolitical and commodity-market shocks, banking-sector stability is itself a fundamental determinant of broader financial stability. Banks perform the core functions of maturity transformation, liquidity provision, payment intermediation, and credit allocation. Weaknesses in bank capitalization, profitability, asset quality, or

liquidity management may therefore amplify external shocks rather than absorb them. This issue is especially important in fractional-reserve banking systems, where maturity mismatch and liquidity creation can generate intrinsic vulnerabilities under conditions of rapid withdrawals or declining confidence. Discussions of instability in fractional-reserve banking from an Islamic banking perspective emphasize the need to examine institutional mechanisms that can reduce systemic fragility and align financial intermediation with greater balance-sheet resilience (14). Empirical research on liquidity creation similarly indicates that excessive or poorly managed liquidity transformation may influence financial stability, while environmental, social, and governance disclosure can alter the relationship between bank behavior and financial resilience (15).

Bank profitability is another important component of financial resilience. Profitable banks are generally better able to accumulate capital internally, absorb unexpected losses, maintain lending during downturns, and invest in risk-management infrastructure. However, excessive pursuit of profitability may also encourage risk-taking if earnings are generated through highly leveraged or volatile activities. Therefore, the relationship between profitability and stability must be analyzed within the broader structure of banking risk. In Islamic banking systems, this issue is particularly relevant because financial contracts are theoretically structured around asset backing, risk sharing, and restrictions on interest-based transactions. Research examining the relationship between Islamic banking and financial-market stability suggests that Islamic banking principles may have implications for systemic resilience and the transmission of financial shocks (16). At the macroeconomic level, Islamic banking has also been associated with economic development through financial intermediation, investment mobilization, and the provision of financing structures compatible with Islamic principles (17).

Specific Islamic financial instruments may additionally contribute to firm-level and system-level stability. Sukuk, for example, provide an alternative mechanism for raising funds through asset-linked or asset-based structures and may affect corporate leverage, refinancing risk, and access to long-term capital. A systematic review of Islamic financial instruments indicates that sukuk may play a meaningful role in firms' financial stability, although their effects can depend on market structure, regulatory quality, and issuer characteristics (18). These considerations are important for Islamic countries seeking to strengthen financial resilience while expanding Shariah-compliant capital markets. At the same time, the effectiveness of Islamic finance depends not only on institutional design but also on users' understanding of financial products. Evidence from Muslim micro-entrepreneurs in Malaysia shows that Islamic financial literacy is interconnected with financial sustainability, implying that knowledge and effective use of Islamic financial services may improve financial decision-making and resilience (19).

Financial literacy and financial inclusion are increasingly considered complementary dimensions of banking-system resilience. Financial inclusion can broaden access to formal financial services, diversify the depositor and borrower base, and support economic participation, but rapid inclusion without adequate risk controls can also create new vulnerabilities. Evidence indicates that the relationship between financial stability and financial inclusion may be nonlinear, implying that inclusion can support stability up to a certain point while excessive or poorly managed credit expansion can potentially increase risk (20). The determinants of financial inclusion also differ across institutional and developmental contexts, as demonstrated by comparative evidence from Sub-Saharan African and OECD economies (21). Moreover, financial literacy and financial innovation may mitigate some of the adverse effects of corruption on banking-stability indicators by improving financial decision-making, access, and institutional effectiveness (22). Evidence from Montenegro similarly emphasizes the role of financial literacy in strengthening broader economic stability and resilience (23). These studies suggest that the stability of banks

cannot be separated from the quality, inclusiveness, and sophistication of the financial environment in which they operate.

Digitalization has added another dimension to this relationship. Digital financial inclusion can reduce transaction costs, broaden financial access, and improve the efficiency of payment and banking services, but its stabilizing effects may depend on the level of financial literacy and the structure of the banking system. Evidence from dual banking systems indicates that digital financial inclusion is significantly related to bank stability and that financial literacy can influence this relationship (24). For Islamic countries undergoing rapid financial digitalization, this suggests that technological expansion should be accompanied by adequate risk management, regulatory oversight, and financial education. The stability implications of banking development therefore arise from interactions among institutional structure, digitalization, liquidity creation, profitability, risk management, and depositor behavior rather than from a single balance-sheet variable.

Trade openness constitutes another important determinant of macro-financial resilience. Greater trade integration can facilitate access to larger markets, diversify sources of foreign exchange, increase productivity, and reduce dependence on domestic demand. For banks, higher trade volume may support corporate revenues, increase demand for financial services, and diversify economic activity. Nevertheless, openness may also increase exposure to global shocks, geopolitical disruptions, sanctions, and fluctuations in international demand. The net effect therefore depends on whether trade diversification and external integration strengthen economic resilience sufficiently to offset increased exposure to external volatility. In economies vulnerable to geopolitical restrictions, maintaining diversified trade relationships may be particularly important for sustaining liquidity, foreign-exchange availability, and banking-sector activity.

Economic policy uncertainty further complicates the relationship among geopolitical risk, energy shocks, banking conditions, and financial stability. Uncertainty regarding monetary, fiscal, exchange-rate, and macroeconomic policies can delay investment, alter portfolio allocation, increase precautionary liquidity demand, and raise risk premiums. Interest-rate uncertainty can directly affect bank funding costs and asset valuations; fiscal uncertainty can influence sovereign risk and private-sector expectations; exchange-rate uncertainty can alter foreign-currency exposures; and uncertainty regarding inflation and economic growth can impair credit-risk assessment. These dimensions are particularly relevant in developing Islamic economies where fiscal dependence on commodity revenues, exchange-rate pressures, and structural inflation may interact. The importance of robust risk-management systems after major financial crises illustrates the necessity of incorporating multiple dimensions of uncertainty into assessments of banking resilience (5).

The interaction of these factors creates a complex dynamic system. Geopolitical risk may intensify oil-price volatility; oil shocks may affect exchange rates and inflation; policy responses may generate additional uncertainty; banking profitability and capitalization may determine the capacity to absorb losses; and trade openness may either transmit or mitigate external shocks depending on the degree of diversification. Financial sustainability therefore requires an integrated analytical framework capable of capturing both immediate responses and longer-run adjustments. The relevance of such a framework is reinforced by growing recognition that banking stability, financial inclusion, Islamic finance, and broader macroeconomic resilience are closely interconnected rather than independent domains (20, 24). Furthermore, the interaction between financial cycles and public debt dynamics suggests that financial instability may persist or become amplified when macro-financial feedback mechanisms are not adequately managed (1).

Despite the expanding literature on geopolitical risk, oil-price volatility, Islamic banking, financial inclusion, and banking stability, these strands of research are frequently examined separately. Existing studies have analyzed geopolitical risk and financial development (2), investor responses to geopolitical shocks (3), oil-price transmission channels (8), oil and exchange-rate shocks (9), Islamic banking and financial stability (16), Islamic financial instruments (18), liquidity creation and bank stability (15), and the stabilizing roles of financial literacy and inclusion (19, 22). Other recent research has emphasized the broader consequences of environmental, climate, and market shocks for economic volatility and investment behavior (10-13). Nevertheless, a comprehensive empirical framework simultaneously incorporating geopolitical risk, oil-price shocks, economic policy uncertainty, banking stability, bank profitability, and trade openness remains particularly relevant for Islamic economies characterized by distinct financial institutions and heterogeneous exposure to external shocks.

Accordingly, the aim of this study is to investigate the effects of geopolitical risk, oil-price shocks, economic policy uncertainty, banking stability, bank profitability, and trade openness on financial stability in selected Islamic D-8 countries using a dynamic Bayesian Panel VAR framework over the 2013–2024 period.

Methods and Materials

Following the studies of Tanin et al. (2025), Suleiman and Al-Salami (2024), Talili et al. (2024), and Olaler et al. (2024), the present study investigates financial stability from the perspective of geopolitical risk, oil-price shocks, and banking variables in Islamic countries, while accounting for the role of economic policy uncertainty. For this purpose, a Bayesian Panel Vector Autoregression model is employed to assess financial stability in countries with Islamic banking systems in terms of geopolitical risk, oil-price shocks, banking variables, and economic policy uncertainty. The research model is specified as follows:

$$\begin{bmatrix}\varepsilon_{OILSH}\\ \varepsilon_{EMPU}\end{bmatrix} = [A(L)]\begin{bmatrix}U_{OILSH}\\ U_{EMPU}\end{bmatrix} \qquad (1)$$

The left-hand side of the above equation represents the first differences of the logarithms of the dependent variables. On the right-hand side, $A(L)$is a square matrix containing polynomials in the lag operator. For example, the element in row $i$and column $j$of the matrix $A(L)$, denoted by $a_{ij}(L)$, represents the response of the i-th variable to the j-th structural variable. The vector $E = [U_{ij}]$contains the structural disturbance terms.

FD: Financial Stability Index. The ratio of bank credit extended to the private sector to GDP, expressed as a percentage, is used as the financial stability indicator.

OIL: This variable represents shocks to the price of Iranian Heavy Crude Oil, calculated using the EGARCH model.

GE: Geopolitical Risk. This variable is measured using the Political Stability and Absence of Violence indicator. The index ranges from 0 to 100. The closer a country's ranking is to 100, the greater the level of political stability and absence of violence in the respective region.

Bank Stability (Z-score): Bank stability is assessed using the indicator introduced by Boyd and Graham, commonly referred to as the Z-score. Under this measure, banking stability and resilience are calculated as the sum of the capital adequacy ratio and return on assets divided by the standard deviation of return on assets. A higher value of this indicator implies a lower probability of bank instability or failure and, consequently, greater banking stability.

$$\text{Bank Stability} = \ln(Z\text{-score}) = \ln\left(\frac{ROA + \text{Capital Ratio}}{\sigma(ROA)}\right)$$

Bank Profitability (ROA): Return on assets is calculated as profit divided by total assets and is used as an indicator of banking-system performance.

$$ROA = \frac{\text{Profit}}{\text{Total Assets}}$$

OPEN: Trade openness is measured using trade volume.

Given the prevailing economic conditions in Iran and other developing countries, where government budgetary requirements are frequently associated with exchange-rate fluctuations, growth in the money supply, inadequate economic growth, and increasing dependence on oil revenues that may reduce attention to tax revenues, it is necessary to construct an indicator specifically adapted to the economic characteristics of these countries in order to capture economic policy uncertainty. Accordingly, following Lavani et al. (2021), fluctuations in three groups of policy indicators—fiscal, monetary, and exchange-rate policies—are first calculated using the Hodrick–Prescott filter. Subsequently, a composite index based on fluctuations in these variables is estimated and introduced as an economic uncertainty index.

The procedure for measuring the uncertainty index is as follows. First, fluctuations in monetary-policy variables, including the monetary base and interest rate; fiscal-policy variables, including the budget deficit and taxation; and the exchange-rate policy variable, namely the exchange rate, as well as fluctuations in inflation and economic growth, are calculated using the Hodrick–Prescott filter. Principal Component Analysis (PCA) is then applied to construct the economic uncertainty index.

Principal Component Analysis reduces the dimensionality of observations by constructing a composite index and grouping similar observations. Under this method, correlated variables in a multidimensional space are transformed into a smaller set of uncorrelated components, each of which is a linear combination of the original variables. The resulting uncorrelated components are referred to as principal components (PCs) and are derived from the eigenvectors of the covariance matrix or correlation matrix of the original variables. Reducing the number of variables and identifying the underlying correlation structure among variables are among the most important applications of PCA. A major advantage of this method in econometric analysis is its ability to mitigate multicollinearity arising from the inclusion of a large number of explanatory variables in a model.

Table 1. Economic Policy Uncertainty Index

Policy	Abbreviation	Operational Definition
Monetary Policy: Monetary policy refers to the set of factors and mechanisms through which a central bank regulates the quantity of money in the economy to achieve price stability and sustainable economic growth. The principal monetary-policy instruments generally include open-market operations, changes in banks' required reserve ratios, and adjustments to the rediscount rate.	IR	Interest Rate: The interest rate is the cost of borrowing money that must be paid by the borrower. In other words, it represents the return that the lender could have earned by using the funds but forgoes by lending them to another party.
	M	Monetary Base: The monetary base refers to the total amount of money created by the central bank that possesses a high degree of liquidity. More specifically, it includes all currency in circulation, consisting of banknotes and coins held by the public, together with bank reserves and funds maintained by commercial banks at the central bank.

Fiscal Policy: Fiscal policy refers to the set of policies that alter government expenditures or revenues and thereby affect aggregate output. Fiscal policy was first systematically advanced by Keynes, and its principal instruments include government expenditure and tax rates.	BD	Budget Deficit: A budget deficit occurs when government expenditures exceed government revenues. Expansionary deficit policies are generally employed when the economy is experiencing a recession.
	TAX	Taxation: Taxation represents the transfer of part of society's income, or part of the profits generated through economic activities, to the government. Tax revenues are generally generated through two principal channels. The first is changes in tax rates, which governments may reduce during economic recessions and increase during periods of economic expansion. The second is expansion of the tax base, which refers to imposing taxes on goods or economic units that were not previously subject to taxation.
Exchange-Rate Policy: Exchange-rate policy refers to the mechanism through which the exchange rate is determined within an economy. Broadly, two dominant exchange-rate systems can be distinguished. Under a fixed exchange-rate regime, the central bank intervenes in the market to maintain the officially determined exchange rate. Under a floating exchange-rate regime, no predetermined official exchange rate is imposed, and the exchange rate is determined through market mechanisms.	ER	Exchange Rate: The exchange rate is the rate at which the value of the domestic currency is expressed relative to a foreign currency and at which currency exchange occurs. In other words, it indicates the amount of domestic currency required to obtain one unit of another country's currency.
Inflation Rate: Inflation refers to a sustained average increase in the general price level. Under this definition, a temporary increase in prices is not regarded as inflation.	INF	In calculating inflation, the price index of 386 goods in Iran is first calculated, and the average growth rate of the price index is identified as the inflation rate. In price-index terminology, the two principal measures are generally the Producer Price Index (PPI) and the Consumer Price Index (CPI).
Economic Growth: Economic growth refers to the growth of a country's gross domestic product over a specified period.	GDP	Gross Domestic Product: GDP is defined as the total monetary value of final goods and services produced by economic units resident in a country during a specified period, typically annually or quarterly. GDP is a flow variable whose value represents the monetary magnitude of the flow of goods and services produced in an economy over a specific period, generally one year.

Findings and Results

Principal Component Analysis (PCA) is widely used across different scientific disciplines. One of its important applications in economics is index construction. In the present study, PCA was employed to extract a composite Economic Policy Uncertainty (EMPU) index. In the analysis of many economic phenomena, several factors with different dimensions and originating from different domains may simultaneously contribute to the occurrence of a particular phenomenon. Incorporating all such factors directly into econometric models may not only generate technical problems such as multicollinearity but may also increase model complexity and the likelihood of statistical error. Consequently, dimensionality-reduction techniques such as PCA provide an effective means of reducing these problems and obtaining more parsimonious and statistically reliable results.

Multivariate data analysis plays a fundamental role in empirical information processing. A multivariate dataset contains numerous states or variables for each observation. When a dataset contains $n$variables, each observation can be represented in a multidimensional space. Because interpretation and visualization become increasingly difficult as dimensionality increases, PCA reduces the dimensionality of the observations through a composite index while preserving the maximum possible amount of information and grouping observations with similar characteristics. PCA is one of the most useful applications of linear algebra and has been extensively applied in areas ranging from neural networks to computer graphics because it represents a nonparametric approach to extracting relevant information from complex datasets.

Under PCA, correlated variables in a multidimensional space are transformed into a set of mutually uncorrelated components, each of which is a linear combination of the original variables. These uncorrelated components are referred to as principal components (PCs) and are derived from the eigenvectors of the covariance or correlation matrix of the original variables. The major applications of PCA therefore include reducing the number of variables and identifying the underlying dependence structure among them. In econometric applications, one of its principal advantages is the mitigation of multicollinearity caused by the simultaneous inclusion of a large number of influential variables.

Seven variables were used to construct the composite Economic Policy Uncertainty index: the interest rate (IR), monetary base (M), budget deficit (BD), taxation (TAX), exchange rate (ER), inflation (INF), and gross domestic product (GDP). Conceptually, the direction of maximum dispersion among observations can be represented by an ellipse. The first principal component, PC_1, corresponds to the direction along which the largest proportion of total variability in the original variables is observed. The second principal component, PC_2, is orthogonal to $PC_1$and explains the largest possible proportion of the remaining variability. The subsequent principal components are constructed according to the same principle and are mutually orthogonal. Thus, the seven original variables can be represented as linear combinations of seven principal components:

$$X_i = a_{i1}PC_1 + a_{i2}PC_2 + a_{i3}PC_3 + a_{i4}PC_4 + a_{i5}PC_5 + a_{i6}PC_6 + a_{i7}PC_7$$

The values of the principal components can, in turn, be calculated from the original variables as follows:

$$PC_1 = W_1X_1 + W_2X_2 + W_3X_3 + W_4X_4 + W_5X_5 + W_6X_6 + W_7X_7$$
$$PC_2 = W_8X_8 + W_9X_9 + W_{10}X_{10} + W_{11}X_{11} + W_{12}X_{12} + W_{13}X_{13} + W_{14}X_{14}$$
$$\vdots$$
$$PC_7 = W_{43}X_{43} + W_{44}X_{44} + W_{45}X_{45} + W_{46}X_{46} + W_{47}X_{47} + W_{48}X_{48} + W_{49}X_{49}$$

where $W_i$represents the regression coefficient or weight of the corresponding variable in the principal-component solution.

Principal components can be calculated directly from the original dataset or, where the original observations are unavailable, from the covariance or correlation matrix. The correlation matrix is generally preferred when the variables have different units of measurement or markedly different variances. Using a correlation matrix is equivalent to performing PCA on standardized variables with a mean of zero and a standard deviation of one.

The first extracted principal component captures the maximum possible variation in the complete dataset and is therefore correlated with at least some of the original variables. The second component has two important properties. First, it explains the largest proportion of the variance that is not explained by the first component. Second, it is uncorrelated with the first component. These properties also apply sequentially to the remaining extracted components.

The number of principal components initially extracted is equal to the number of variables included in the analysis. Nevertheless, only a subset of these components normally needs to be retained. In many applications, the first two or three components account for a substantial proportion of total variation. Several criteria can be used to determine the appropriate number of retained components. The first is the scree criterion, under which the eigenvalues are plotted against their corresponding principal components and components are retained up to the point at which the decline in eigenvalues becomes substantially flatter. The second is the eigenvalue criterion,

according to which components with eigenvalues greater than one are generally retained. The third is the explained-variance criterion, under which components explaining sufficiently large proportions of total variance are retained, with the first component ordinarily explaining the largest share.

Before extracting the composite index, the correlations among the seven constituent indicators were examined. The interest rate was negatively correlated with the monetary base ($r = -0.066561$), budget deficit ($r = -0.157517$), and taxation ($r = -0.344988$), while it was positively correlated with the exchange rate ($r = 0.432166$), inflation ($r = 0.011065$), and GDP ($r = 0.021601$). The monetary base was positively associated with the budget deficit ($r = 0.199898$), taxation ($r = 0.205616$), exchange rate ($r = 0.060198$), inflation ($r = 0.121488$), and GDP ($r = 0.051334$). The budget deficit was positively correlated with taxation ($r = 0.312675$) but negatively correlated with the exchange rate ($r = -0.282109$), inflation ($r = -0.009326$), and GDP ($r = -0.189983$). Taxation was negatively correlated with the exchange rate ($r = -0.663387$), inflation ($r = -0.225045$), and GDP ($r = -0.263352$). The exchange rate was positively correlated with inflation ($r = 0.176880$) and GDP ($r = 0.383599$), while inflation and GDP were positively correlated ($r = 0.283143$). These relationships indicated sufficient interdependence among the constituent indicators to justify dimensionality reduction through PCA.

Table 2. Principal Component Analysis Results for the Economic Policy Uncertainty Index

Panel A. Eigenvalues

Component	Eigenvalue	Difference	Proportion	Cumulative Value	Cumulative Proportion
PC1	2.396286	1.085454	0.3423	2.396286	0.3423
PC2	1.310833	0.303116	0.1873	3.707119	0.5296
PC3	1.007717	0.206004	0.1440	4.714836	0.6735
PC4	0.801713	0.139636	0.1145	5.516549	0.7881
PC5	0.662077	0.096797	0.0946	6.178625	0.8827
PC6	0.565279	0.309184	0.0808	6.743905	0.9634
PC7	0.256095	—	0.0366	7.000000	1.0000

Panel B. Eigenvectors (Loadings)

Variable	PC1	PC2	PC3	PC4	PC5	PC6	PC7
IR	0.351392	-0.253062	0.605601	0.131235	-0.123174	0.625273	-0.149568
M	-0.087394	0.610223	0.477813	-0.479860	-0.262111	-0.176898	-0.247838
BD	-0.331760	0.301830	0.389201	0.506716	0.622904	-0.050419	0.006613
TAX	-0.536287	0.104042	-0.009941	-0.223811	-0.111877	0.522700	0.604689
ER	0.549868	0.071204	0.243049	-0.128570	0.180626	-0.283190	0.710035
INF	0.223425	0.547003	-0.220610	0.586852	-0.477044	0.121988	0.123909
GDP	0.344883	0.396711	-0.381608	-0.291090	0.505374	0.454870	-0.176093

As shown in Table 2, the first principal component had the largest eigenvalue, 2.396286, and explained 34.23% of the total variation. The second and third components had eigenvalues of $1.310833$and 1.007717, respectively, and together the first three components accounted for approximately 67.35% of total variability. The eigenvalue criterion therefore also indicated that the first three components contained a substantial amount of the common information embedded in the original variables.

The relationship between the observed variables and the principal components can be represented through factor loadings, while factor scores can be used to estimate the principal-component values. Based on the first-component loadings, the estimated PC_1equation was:

$$PC_1 = 0.35IR - 0.08M - 0.33BD - 0.53TAX + 0.54ER + 0.22INF + 0.34GDP$$

Accordingly, the above linear combination represents the first principal component employed in constructing the Economic Policy Uncertainty index.

Table 3. Relative Importance of Variables in the Composite Economic Policy Uncertainty Index

Variable	Relative Importance
Interest rate	0.3423
Monetary base	0.1873
Budget deficit	0.1439
Taxation	0.1146
Exchange rate	0.0946
Inflation	0.0807
Gross domestic product	0.0366
Total	1.0000

Table 3 reports the relative contribution of the constituent variables to the composite Economic Policy Uncertainty index. The interest rate had the greatest relative importance, with a weight of 0.3423, followed by the monetary base at 0.1873 and the budget deficit at 0.1439. Taxation contributed 0.1146, the exchange rate 0.0946, inflation 0.0807, and GDP 0.0366. Thus, interest-rate developments represented the dominant component of the composite policy-uncertainty measure. The resulting PCA-based composite index was subsequently extracted and used as the EMPU variable in the final empirical model.

To quantify oil-price shocks, the oil-price series was first modeled using an autoregressive moving-average specification, consistent with the standard methodology for volatility modeling. The Box–Jenkins approach was employed to identify the appropriate autoregressive and moving-average structure. The resulting ARMA specification included one autoregressive and one moving-average term. The coefficient of $AR(1)$was 1.014930, with a standard error of 0.011936, a z-statistic of 85.03441, and $p < .001$. The coefficient of $MA(1)$was -0.275550, with a standard error of 0.037883, a z-statistic of -7.273665, and $p < .001$. Therefore, the current oil price was significantly associated both with its own first lag and with the first lag of the disturbance term.

The presence of conditional heteroskedasticity was subsequently assessed through the ARCH test. The resulting F-statistic was 2.214044, with $p = .0364$, while the Obs*R^2 statistic was 2.218810, with a chi-square probability of $p = .0363$. Because both probabilities were below .05, the null hypothesis of no conditional heteroskedasticity was rejected. Accordingly, the oil-price series exhibited statistically significant ARCH effects and required a conditional variance specification.

Oil-price shocks were therefore extracted using the Exponential Generalized Autoregressive Conditional Heteroskedasticity model developed by Nelson (1991). An important limitation of conventional ARCH and GARCH specifications is their symmetry assumption, according to which positive and negative shocks of identical magnitude exert equal effects on volatility. Oil prices, however, may respond differently to positive and negative information. An asymmetric specification such as EGARCH is therefore more appropriate for capturing such behavior (Verbeek, 2005).

The EGARCH variance equation was specified as:

$$\ln \sigma_t^2 = \alpha_0 + \alpha_1 \frac{| u_{t-1} |}{\sqrt{\sigma_{t-1}^2}} + \beta \ln \sigma_{t-1}^2 + \gamma \frac{u_{t-1}}{\sqrt{\sigma_{t-1}^2}}$$

where:

$$\alpha_0 = \omega - \alpha\sqrt{\frac{2}{\pi}},\ \alpha_1 = \alpha$$

The EGARCH formulation has several advantages. First, because the dependent conditional-variance term is expressed logarithmically, coefficients on the right-hand side may be either positive or negative while σ_t^2remains positive. Therefore, non-negativity restrictions on the parameters are unnecessary. Second, asymmetric responses to positive and negative shocks can explicitly be modeled. The coefficient γcaptures shock asymmetry because u_{t-1}may take either a positive or negative value, whereas $\alpha$is associated with the absolute magnitude $|\ u_{t-1}\ |$. When $\gamma = 0$, the response is symmetric; when $\gamma \neq 0$, the effect is asymmetric. The effect of a positive shock is $\alpha + \gamma$, whereas the effect of a negative shock is $\alpha - \gamma$. A negative γindicates that negative shocks have a stronger effect than positive shocks, and the reverse holds when $\gamma$is positive.

Table 4. Oil Price Modeling and EGARCH Estimation Results

Component	Statistic/Variable	Coefficient/Statistic	Std. Error	z-Statistic	p
Mean equation	AR(1)	1.014930	0.011936	85.03441	<.001
Mean equation	MA(1)	-0.275550	0.037883	-7.273665	<.001
ARCH test	$F(1, 80)$	2.214044	—	—	.0364
ARCH test	Obs*R^2	2.218810	—	—	.0363
Variance equation	$C(3)$	-1.460988	0.302531	-4.829211	<.001
Variance equation	$C(4)$	-0.557479	0.164041	-3.398404	.0007
Variance equation	$C(5)$	0.118678	0.138461	0.857123	.3914
Variance equation	$C(6)$	-0.842610	0.171831	-4.903725	<.001

The EGARCH estimates indicate that $C(3)$, $C(4)$, and $C(6)$were statistically significant, whereas $C(5)$, which captured the asymmetric shock component, was not statistically significant at the .05 level. After estimation of the conditional-variance equation, the resulting conditional variance series was extracted and used as the oil-price shock variable ($OILSH$) in the principal Panel VAR specification.

A large proportion of economic time series are nonstationary, and regressions estimated between nonstationary series may be spurious (Granger & Newbold, 1974). Conventional time-series tests, including the Dickey–Fuller (DF), Augmented Dickey–Fuller (ADF), and Phillips–Perron (PP) procedures, have traditionally been used to identify unit roots. Because panel datasets incorporate both cross-sectional and temporal dimensions, panel unit-root tests generally provide greater power than conventional individual time-series tests (Levin & Lin, 1992).

In comparison with conventional time-series unit-root procedures, which may have complicated limiting distributions, panel unit-root tests provide statistics with asymptotically normal distributions (Baltagi, 2005). Among the available procedures, the Levin–Lin–Chu (LLC) test introduced by Levin et al. (2002) and the Im–Pesaran–Shin (IPS) test introduced by Im et al. (2003) are among the most widely used. Both are based on augmented Dickey–Fuller specifications.

The LLC specification can be expressed as:

$$\Delta y_{it} = \alpha y_{it-1} + \sum_{j=1}^{p_i} \beta_{ij}\, \Delta y_{it-j} + X_{it}'\delta + \varepsilon_{it}$$

where $i$denotes the cross-sectional unit, $t$denotes time, $p_i$is the selected number of lags in the ADF specification, and X'_{it}denotes the vector of exogenous variables. LLC assumes a common autoregressive coefficient αacross all cross-sectional units. Its hypotheses are:

$$H_0: \alpha = 0$$

indicating the presence of a unit root, and

$$H_1: \alpha < 0$$

indicating stationarity.

The LLC procedure is based on residuals derived from two auxiliary regressions:

$$\Delta y_{it} = \sum_{j=1}^{p_i} \beta_{ij}\, \Delta y_{it-j} + X'_{it}\delta + e_{it}$$

and

$$y_{it-1} = \sum_{j=1}^{p_i} \beta_{ij}\, \Delta y_{it-j} + X'_{it}\delta + V_{it}$$

The corresponding residuals, $\hat{e}_{it}$and $\hat{V}_{it}$, are standardized using the estimated ADF standard deviation S_i:

$$\tilde{e}_i = \frac{\hat{e}_{it}}{S_i}$$

$$\tilde{V}_i = \frac{\hat{V}_{it}}{S_i}$$

The indicator equation is subsequently expressed as:

$$\tilde{e}_{it} = \alpha \tilde{V}_{it} + \eta_{it}$$

and the adjusted LLC statistic is given by:

$$t^*_\alpha = \frac{t_\alpha - \left(N\tilde{T}\right) S_N^{\tilde{\sigma}^{-2}} se(\hat{\alpha}) \mu^*_{m\tilde{T}}}{\sigma^*_{m\tilde{T}}} \rightarrow N(0, 1)$$

with:

$$\hat{S}_N = \frac{1}{N} \sum_{i=1}^{N} \frac{\hat{\sigma}_{yi}}{\hat{\sigma}_{\varepsilon i}}$$

where $\hat{\sigma}_{\varepsilon i}$represents an estimate of the long-run standard deviation of cross-section i, while $\mu^*_{m\tilde{T}}$and $\sigma^*_{m\tilde{T}}$are the mean and standard-deviation adjustment terms.

The IPS test, by contrast, is based on the following regression:

$$\Delta y_{it} = \alpha_i y_{it-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{it-j} + \mu_{it}$$

Unlike LLC, IPS allows the autoregressive coefficient $\alpha_i$to vary freely across cross-sectional units. The corresponding test statistic is based on the average of the individual cross-sectional ADF statistics:

$$\bar{t}_{NT} = \frac{1}{N} \sum_{i=1}^{N} t_{iT} \, (p_i, \alpha_i)$$

For the empirical analysis, stationarity was assessed primarily through the LLC test. A probability below .05 was interpreted as evidence against the null hypothesis of a unit root.

Table 5. Results of the Levin–Lin–Chu Panel Unit-Root Test

Variable	Method	Statistic	p	Integration Order
EMPU	Levin–Lin–Chu t	-5.73181	<.001	$I(0)$
FD	Levin–Lin–Chu t	-4.10335	<.001	$I(0)$
GE	Levin–Lin–Chu t	-1.89142	.0293	$I(0)$
OILSH	Levin–Lin–Chu t	-1.89914	.0288	$I(0)$
OPEN	Levin–Lin–Chu t	-2.05813	.0197	$I(0)$
ROA	Levin–Lin–Chu t	-2.92571	.0017	$I(0)$
ZSCORE	Levin–Lin–Chu t	-3.24090	.0006	$I(0)$

The hypotheses underlying the LLC test were:

H_0:The variable is nonstationary

H_1:The variable is stationary

As shown in Table 5, the probability associated with every variable was below .05. The null hypothesis of nonstationarity was therefore rejected for EMPU, FD, GE, OILSH, OPEN, ROA, and ZSCORE. All variables were consequently stationary at level, $I(0)$. This indicates that their statistical properties were sufficiently stable over time for subsequent dynamic panel modeling.

Economic theories frequently formulate long-run relationships among variables in level form. Establishing such relationships requires either that the variables be stationary or, if nonstationary, that they share an appropriate order of integration. Cointegration analysis is therefore employed to determine whether a stable long-run equilibrium relationship exists among a set of variables. If the residuals generated from the estimated long-run regression are stationary, $I(0)$, the existence of a long-run equilibrium relationship can be inferred.

The Kao panel cointegration test was initially employed. The ADF statistic from this procedure was -10.59921, with $p < .001$. The null hypothesis under the Kao procedure was the absence of cointegration, whereas the alternative hypothesis specified the existence of cointegration among the variables. Because the probability was below .05, the null hypothesis was rejected, confirming a statistically significant long-run equilibrium relationship.

Before estimation of the Panel VAR model, the optimal lag length was also determined. The selection procedure considered the likelihood-ratio statistic, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SC), and Hannan–Quinn Criterion (HQ). At lag zero, LogL was 253.3847, FPE was 1.07×10^{-12}, AIC was -7.699522, SC was -7.463394, and HQ was -7.606499. At lag one, LogL increased to 367.7004,

the LR statistic was 200.0524, FPE declined to 1.40×10^{-13}, AIC to -9.740636, SC to -7.851614, and HQ to -8.996455. At lag two, the corresponding values were 399.4764, 48.65704, 2.53×10^{-13}, -9.202387, -5.660469, and -7.807047. At lag three, the values were 462.1300, 82.23287, 1.90×10^{-13}, -9.629062, -4.434250, and -7.582563. Finally, at lag four, LogL was 526.3649, the LR statistic was 70.25687, FPE was 1.58×10^{-13}, AIC was -9.105152, SC was -3.257444, and HQ was -7.407494. FPE, AIC, SC, and HQ selected one lag, whereas the LR criterion selected four lags. Because the majority of criteria, including the Schwarz Bayesian Criterion, supported one lag, the optimal lag length was set equal to one.

Long-run relationships were additionally examined using the Johansen cointegration framework. Two principal approaches are commonly used for cointegration analysis: the Engle–Granger procedure and the Johansen approach. The Engle–Granger method generally examines one long-run relationship and becomes restrictive when the system includes more than two variables because only a single residual process is incorporated. In addition, differencing may result in the loss of some long-run information. The Johansen approach avoids these limitations by estimating cointegrating vectors within a VAR framework and preserving long-run equilibrium information through an error-correction representation.

Within the Johansen framework, the number of cointegrating vectors was evaluated using the trace and maximum-eigenvalue statistics. Under the trace test, the null hypothesis of no cointegration was rejected. Specifically, for $r = 0$, the eigenvalue was 0.468254, the trace statistic was 152.2358, the 5% critical value was 125.6154, and $p = .0004$. For $r \leq 1$, the eigenvalue was 0.371333, the trace statistic was 101.7086, the critical value was 95.75366, and $p = .0183$. For $r \leq 2$, the eigenvalue was 0.327742, the statistic was 64.57627, the critical value was 69.81889, and $p = .1220$. Subsequent trace statistics were 32.80727 ($p = .5675$), 18.95956 ($p = .4958$), 9.132727 ($p = .3532$), and 0.766784 ($p = .3812$) for the remaining hypotheses. The trace test therefore indicated two cointegrating equations at the 5% level.

Under the maximum-eigenvalue test, the null hypothesis of no cointegration was likewise rejected. For $r = 0$, the maximum-eigenvalue statistic was 50.52722, compared with a 5% critical value of 46.23142, with $p = .0164$. For $r \leq 1$, the statistic was 37.13231 and the critical value was 40.07757 ($p = .1035$). The remaining statistics were 31.76900 ($p = .0874$), 13.84771 ($p = .8330$), 9.826832 ($p = .7607$), 8.365943 ($p = .3427$), and 0.766784 ($p = .3812$). Hence, the maximum-eigenvalue procedure indicated one cointegrating equation at the 5% level. Taken together, both Johansen tests confirmed the existence of at least one long-run cointegrating relationship among the variables.

A diagnostic test was also conducted to determine whether the pooled or panel specification was appropriate. For a general panel regression,

$$Y_{it} = \alpha_i + \beta_1 X_{1it} + \beta_2 X_{2it} + \cdots + \beta_k X_{kit} + e_{it},$$

Y_{it}represents the dependent variable for cross-sectional unit $i$in period t, while X_{jit}represents explanatory variable $j$for the same unit and period. Differences among cross-sectional units are represented by α_i. The null hypothesis assumes that the intercept is identical across all cross-sectional units, whereas the alternative states that at least one cross-sectional intercept differs.

The Limer/Chow test produced statistics of 4.557851 ($p = .0024$) and 21.986342 ($p = .0010$). Both probability values were below .05. Thus, the null hypothesis supporting pooled-data estimation was rejected, and the panel-data specification was selected.

Table 6. Long-Run, Lag-Selection, Cointegration, and Model-Specification Diagnostics

Diagnostic	Statistic/Result	Critical Value / p	Decision
Kao panel cointegration ADF	-10.59921	$p < .001$	Cointegration confirmed
Optimal lag: FPE	1.40×10^{-13}at lag 1	Minimum	Lag 1 selected
Optimal lag: AIC	-9.740636 at lag 1	Minimum	Lag 1 selected
Optimal lag: SC	-7.851614 at lag 1	Minimum	Lag 1 selected
Optimal lag: HQ	-8.996455 at lag 1	Minimum	Lag 1 selected
Johansen trace, $r = 0$	152.2358	Critical = 125.6154; $p = .0004$	Reject $r = 0$
Johansen trace, $r \leq 1$	101.7086	Critical = 95.75366; $p = .0183$	Reject $r \leq 1$
Johansen trace conclusion	2 cointegrating equations	5% level	Long-run relationship
Max-eigen, $r = 0$	50.52722	Critical = 46.23142; $p = .0164$	Reject $r = 0$
Max-eigen conclusion	1 cointegrating equation	5% level	Long-run relationship
Limer/Chow test	4.557851	$p = .0024$	Panel data selected
Additional Limer statistic	21.986342	$p = .0010$	Panel data selected

After establishing the optimal lag order, selecting the panel-data structure, and confirming the existence of a long-run equilibrium relationship, the principal model was estimated using the Panel VAR approach. Statistical significance was evaluated using the ratio of each estimated coefficient to its standard error. At the 95% confidence level, an absolute test statistic greater than approximately 1.96 was treated as evidence that the corresponding coefficient was statistically different from zero.

Table 7. Panel VAR Estimation Results for Financial Stability

Explanatory Variable	Response Variable	Coefficient	Std. Error	Test Statistic
OILSH	Financial stability	-0.326912	0.11156	-2.930369
EMPU	Financial stability	-0.261852	0.10288	-2.545218
GE	Financial stability	-0.067273	0.02806	-2.397469
ZSCORE	Financial stability	0.625156	0.15312	4.082785
ROA	Financial stability	0.363486	0.12838	2.831329
OPEN	Financial stability	0.256156	0.10226	2.504952

As shown in Table 7, all explanatory variables had test statistics whose absolute values exceeded 1.96, indicating statistical significance at the 95% confidence level. Oil-price shocks exerted a negative and statistically significant effect on financial stability, with an estimated coefficient of -0.326912. Economic policy uncertainty likewise had a negative coefficient of -0.261852, while geopolitical risk had a negative coefficient of -0.067273. In contrast, banking stability had the largest positive estimated coefficient, 0.625156. Bank profitability, measured by ROA, had a positive coefficient of 0.363486, and trade openness had a positive coefficient of 0.256156.

Accordingly, the empirical results indicate that geopolitical risk, economic policy uncertainty, and oil-price shocks adversely affect financial stability in the selected Islamic countries, whereas bank stability, bank profitability, and trade volume contribute positively to financial stability.

The negative relationship between geopolitical risk and financial stability can operate through several transmission channels. One mechanism is the interaction between supply shocks and inflation. Geopolitical tensions, particularly in regions that supply energy or essential commodities, can disrupt supply chains and generate cost-push inflation. This may lead central banks to raise interest rates, which can reduce asset valuations and weaken financial conditions.

A second transmission mechanism operates through capital flows. During periods of geopolitical tension, investors tend to shift their portfolios toward conventional safe-haven assets, such as gold, the U.S. dollar, or sovereign securities perceived as relatively secure. Sudden capital outflows from emerging or higher-risk markets may consequently produce substantial exchange-rate volatility and balance-sheet instability.

A third mechanism involves disruptions to international trade and payments. Sanctions, restrictions on access to international payment infrastructures such as SWIFT, and tariff barriers may interrupt liquidity flows and increase default risk among firms involved in international trade.

A fourth mechanism operates through fiscal and monetary policies. Governments responding to geopolitical and security pressures may increase defense and security expenditures, contributing to larger fiscal deficits and potentially weakening sovereign debt sustainability.

Financial stability is also closely dependent on the soundness of the banking system. Geopolitical risk may affect banks through two principal channels. The first is credit risk. Lower corporate profitability caused by geopolitical disruption may impair borrowers' ability to service bank debt, increasing non-performing exposures and weakening bank asset quality. The second is liquidity risk. Under severe stress, banks may face rapid deposit withdrawals or reduced access to interbank and wholesale funding markets, increasing their vulnerability to liquidity shortages.

Given the confirmed long-run equilibrium relationship, short-run dynamics were examined using an Error-Correction Model (ECM). The ECM provides information on short-run fluctuations and indicates the speed at which disequilibrium is corrected toward the long-run equilibrium path.

Table 8. Estimated Error-Correction Coefficient

Model	$ECM(-1)$	Std. Error	Test Statistic
Financial stability model	-0.097247	0.03558	-2.73325

The principal parameter in an error-correction specification is the coefficient of $ECM(-1)$, which measures the speed at which short-run disequilibrium is corrected. As reported in Table 8, the estimated error-correction coefficient was $-0.097247$and was statistically significant. The negative sign and absolute value below one indicate convergence toward the long-run equilibrium rather than divergence from it. Because the observations in the present study are annual, the coefficient implies that approximately 9.7% of short-run disequilibrium is corrected in each year. The adjustment process is therefore relatively gradual, but it is directionally stable and convergent.

In a VAR framework, interpretation of estimated coefficients alone does not provide sufficient information regarding the complete dynamic interactions among variables. Impulse Response Functions (IRFs) are therefore used to investigate how a dynamic system responds to random innovations equivalent to a one-standard-deviation disturbance in a particular equation. Sims (1980) proposed impulse-response analysis and variance decomposition as tools for obtaining economically meaningful interpretations from VAR models.

Consider a two-variable $VAR(1)$system:

$$\begin{bmatrix} x_{1t} \\ x_{2t} \end{bmatrix} = \begin{bmatrix} x_{11} & x_{12} \\ x_{21} & x_{22} \end{bmatrix} \begin{bmatrix} x_{1,t-1} \\ x_{2,t-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix}$$

A disturbance to e_{1t}has an immediate direct effect on x_{1t}. In period $t+1$, this disturbance propagates through the lag structure of the system and affects both variables. The same process continues into $t+2$and subsequent periods. Consequently, a random shock to one variable in a VAR model generates a chain of dynamic responses across the variables in the system. An impulse response function traces these responses over time.

A conventional IRF is subject to the identification problem that contemporaneous disturbances may be correlated across equations. One common solution is to orthogonalize the disturbances, thereby transforming them into pairwise uncorrelated innovations with unit variances. In the present application, the impulse responses indicate how financial stability changes when each explanatory variable is subjected to an unexpected one-standard-deviation innovation.

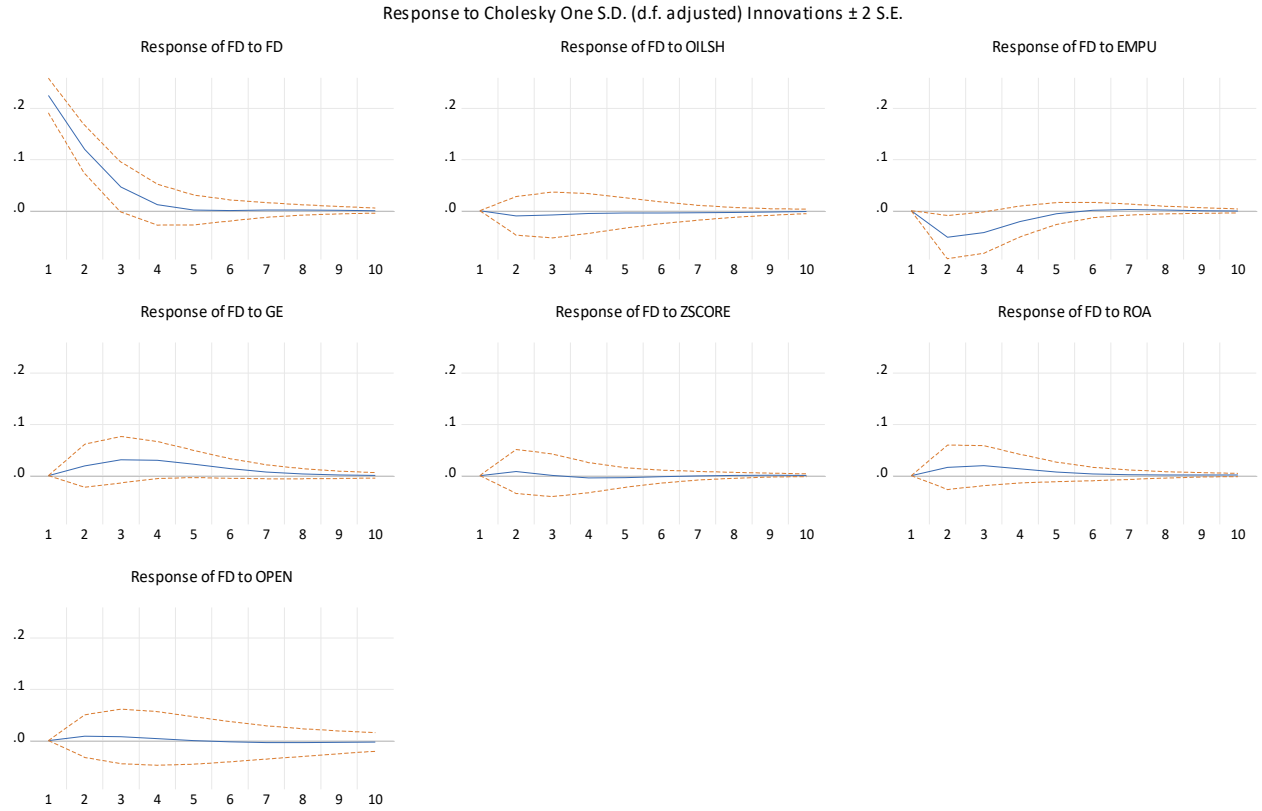


Figure 1. Impulse Response Functions of Financial Stability to Structural Shocks

The impulse-response results indicate that the response of financial stability in the selected Islamic countries to shocks in the explanatory variables is dynamic rather than permanent. A one-standard-deviation innovation produces an observable response in financial stability, but the magnitude of the response declines progressively over subsequent periods. Thus, the effects of the shocks gradually dissipate over time, which is consistent with the convergent dynamics indicated by the estimated error-correction coefficient.

Finally, the structural stability of the estimated Panel VAR model was examined using the inverse roots of the characteristic autoregressive polynomial. This diagnostic is essential because the results of an unstable Panel VAR process cannot be considered reliable.

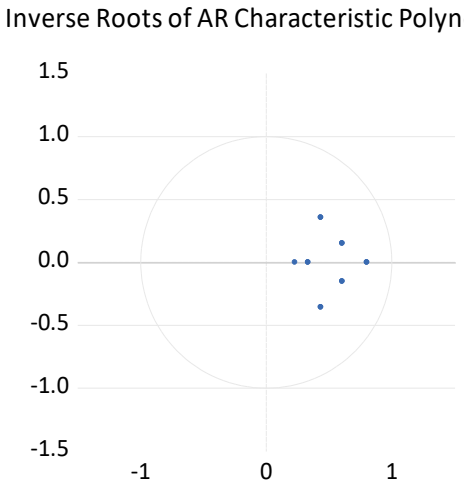


Figure 2. AR Roots Stability Test for the Estimated Panel VAR Model

The AR-root diagram presents the inverse roots of the characteristic polynomial of the estimated autoregressive system. The stability condition requires the absolute value of every inverse root to be less than one, such that all roots lie inside the unit circle. The results show that all inverse characteristic roots of the estimated Panel VAR system were located within the unit circle. Consequently, the estimated model satisfies the required mathematical stability condition. This result indicates that shocks to the system do not generate explosive dynamics and that their effects diminish over time, supporting the reliability of the estimated dynamic relationships.

Discussion and Conclusion

The present study investigated the effects of geopolitical risk, oil-price shocks, economic policy uncertainty, banking stability, bank profitability, and trade openness on financial stability in selected Islamic D-8 countries over the 2013–2024 period. The empirical findings showed that oil-price shocks, economic policy uncertainty, and geopolitical risk had negative and statistically significant effects on financial stability, whereas bank stability, bank profitability, and trade openness exerted positive and statistically significant effects. The results of the Kao and Johansen cointegration tests further confirmed the existence of a long-run equilibrium relationship among the variables, while the estimated error-correction coefficient was negative and statistically significant, indicating convergence toward long-run equilibrium. The impulse-response analysis also demonstrated that shocks to the explanatory variables generated dynamic responses in financial stability but that the effects gradually dissipated over time. Finally, the inverse-root stability test confirmed the structural stability of the estimated Panel VAR system. Taken together, these findings indicate that financial stability in Islamic economies is determined by the interaction between external geopolitical and commodity-market shocks and the internal resilience, profitability, and international connectedness of their banking and economic systems.

One of the principal findings was the negative and statistically significant effect of oil-price shocks on financial stability. This result suggests that greater volatility in international oil markets can weaken the stability of financial systems in the selected Islamic economies. The estimated negative coefficient implies that oil-price disturbances are not merely sector-specific shocks but can propagate through fiscal, monetary, exchange-rate, and banking channels. This finding is consistent with Tavakolian, who emphasized that oil-price shocks affect both oil-exporting and oil-importing economies, although the direction and magnitude of the effects differ according to their position in the global energy market (6). In oil-exporting economies, declining or highly volatile oil prices can reduce

government revenues, weaken foreign-exchange inflows, and constrain public expenditure, whereas in oil-importing economies, upward oil-price shocks may raise production costs and inflation. In both cases, financial institutions may face deterioration in borrowers' repayment capacity, shifts in liquidity conditions, and greater uncertainty in asset valuation.

The adverse financial consequences of oil-price shocks are also supported by evidence concerning the transmission of oil volatility through monetary and financial variables. Khavari et al. showed that oil-price volatility affects economic growth through institutional, monetary, and financial channels, which provides a mechanism through which oil-market instability may ultimately influence financial stability (8). The present findings are also compatible with Khanbabaei and Shahbazi's evidence of a nonlinear and asymmetric relationship between oil prices and the real effective exchange rate, suggesting that oil shocks may be transmitted through currency-market adjustments and need not affect the economy symmetrically (7). Similarly, the evidence reported by Kanganinejad et al. regarding the effects of oil- and exchange-rate shocks on housing prices indicates that energy-market disturbances may spill over into important asset markets (9). Because real estate commonly serves as collateral within banking systems, deterioration in housing-market conditions may increase credit risk and weaken bank balance sheets. The use of an EGARCH specification in the present study was therefore appropriate because it permitted explicit modeling of volatility and asymmetric responses to shocks.

The finding that oil-price instability weakens financial stability can also be interpreted in a broader energy-market context. Cincinelli and Pellini found that geopolitical and climate risks contribute to uncertainty in European electricity markets, emphasizing that energy-price uncertainty can be driven by multiple external risk sources (10). Guerzoni et al. likewise demonstrated that extreme weather conditions can become major drivers of electricity-price volatility, reinforcing the view that energy markets are highly sensitive to external shocks and that such shocks can generate persistent economic uncertainty (11). Although those studies focused on electricity rather than crude oil, their findings support the broader mechanism identified in the present study: instability in strategically important energy markets can be transmitted to production costs, inflation, expectations, and ultimately financial conditions. The economic consequences of climate-related externalities documented by Rodés-Bachs et al. further highlight the growing relevance of environmental and energy-related risk in macroeconomic and financial assessments (13). Moreover, Agostino and Rondinella showed that extreme events can alter firms' innovation behavior, demonstrating that external shocks may reshape investment and corporate decision-making in ways that eventually affect financing demand and financial resilience (12).

The second major finding was that geopolitical risk exerted a negative and statistically significant effect on financial stability. This result indicates that heightened geopolitical tensions weaken the capacity of financial systems to maintain stable credit intermediation and balance-sheet resilience. Several mechanisms may explain this relationship. Geopolitical tensions can induce capital outflows, increase exchange-rate volatility, reduce investor confidence, disrupt trade and payment networks, and increase sovereign and corporate risk premiums. The present finding is aligned with Javaheri et al., who reported meaningful relationships among geopolitical risk, financial development, and economic growth in Iran, indicating that geopolitical instability can influence both real and financial dimensions of economic performance (2). It is also consistent with Mirmohammadi and Khani Keshmarzi, who examined investor behavior under geopolitical risk and showed that investors modify their decisions when political and security risks intensify (3). Such portfolio adjustments can create sudden shifts in liquidity and capital flows that place pressure on exchange rates, banks, and domestic asset markets.

The negative effect of geopolitical risk may be especially relevant for banking systems because geopolitical instability can increase both credit and liquidity risks. Firms affected by sanctions, disrupted supply chains, higher transportation costs, or restricted access to foreign markets may experience declining revenues and weaker debt-servicing capacity. At the same time, greater uncertainty can encourage depositors and investors to shift toward safer or more liquid assets. Moradipour's review of banking risk management in the aftermath of financial and geopolitical crises emphasizes precisely this need for stronger credit, liquidity, and operational risk-management frameworks under conditions of heightened uncertainty (5). Broader evidence concerning security-related risks also supports the proposition that political violence and terrorism can alter the institutional and economic environment within which financial institutions operate (4). The present results therefore confirm that geopolitical risk should not be viewed as an exclusively political phenomenon; rather, it constitutes an economically consequential source of systemic financial risk.

Economic policy uncertainty was likewise found to have a negative and significant effect on financial stability. This result is particularly important because the study constructed a composite uncertainty index from monetary, fiscal, exchange-rate, inflation, and economic-growth variables rather than relying on a single dimension of uncertainty. The PCA results indicated that the interest rate had the greatest relative weight in the composite indicator, followed by the monetary base and budget deficit. This suggests that uncertainty surrounding monetary conditions and financing costs plays a particularly important role in the selected economies. Greater policy uncertainty can delay investment, raise precautionary liquidity holdings, increase risk premiums, weaken credit demand and supply, and make bank risk assessment more difficult. It can also increase the volatility of asset prices and exchange rates and weaken the predictability of government financing conditions. These mechanisms are consistent with the broader literature emphasizing interactions between macro-financial cycles and fiscal conditions. Zhou et al. demonstrated that financial cycles have a non-negligible effect on public-debt cycles, indicating that instability in financial conditions can interact with fiscal dynamics and amplify macroeconomic vulnerability (1).

Another major finding was the positive and statistically significant impact of bank stability, measured using the Z-score, on financial stability. Among the positive explanatory variables, bank stability exhibited the largest coefficient, indicating that the soundness of the banking system is a central determinant of broader financial-system resilience. This result is theoretically plausible because banks serve as the primary channel of financial intermediation in many Islamic and emerging economies. A bank with stronger capitalization, higher profitability, and lower volatility of returns is better positioned to absorb losses, withstand deposit withdrawals, and maintain lending during adverse economic conditions. The finding is consistent with the literature on the inherent vulnerabilities of fractional-reserve banking and the importance of institutional mechanisms that strengthen banking resilience. Khosravi's assessment of instability in fractional-reserve banking within an Islamic banking framework emphasizes the structural importance of liquidity and balance-sheet management in preventing financial fragility (14).

The positive role of bank stability also accords with research on Islamic banking and broader financial-market resilience. Eskandari reported that Islamic banking can influence financial-market stability, suggesting that institutional features of Islamic financial intermediation may affect systemic risk and the transmission of shocks (16). Bozorgmehr and Sadeghi similarly linked Islamic banking to economic development, implying that a sound Islamic banking system can support productive financing and broader economic resilience (17). Moreover, Mahalleh and Kazemi's review of sukuk and firms' financial stability highlights the potential contribution of Islamic financial

instruments to funding diversification and financial resilience (18). These findings collectively support the present result that improvements in banking stability can strengthen the overall financial system, particularly where banks remain the dominant providers of financing.

Bank profitability, measured by return on assets, also exerted a positive and significant effect on financial stability. This suggests that more profitable banks possess greater internal capacity to absorb losses, accumulate capital, and maintain operations during periods of stress. Higher profitability may provide an important buffer against deteriorating credit quality and liquidity pressures, thereby reducing the probability that institution-specific difficulties develop into systemic instability. The result is compatible with Baharvandi's analysis of liquidity creation and bank financial stability, which emphasizes that the internal financial condition and behavior of banks influence their resilience (15). However, profitability should not be interpreted independently of risk. Sustainable profitability generated through efficient intermediation is likely to promote stability, whereas profitability based on excessive leverage or speculative risk-taking may have different consequences. The positive coefficient obtained in the present study therefore reflects the stabilizing role of profitability within the empirical structure and period analyzed.

The findings concerning banking resilience can also be interpreted in relation to financial inclusion, financial literacy, and institutional quality. Banna showed that digital financial inclusion is associated with bank stability in dual banking systems and that financial literacy influences this relationship (24). Kebede et al. identified a nonlinear relationship between financial inclusion and financial stability, indicating that inclusion can contribute to resilience but may produce different outcomes depending on its scale and institutional context (20). Eshun and Kočenda further demonstrated that financial inclusion is shaped by a range of economic and institutional factors in both Sub-Saharan African and OECD economies (21). These findings suggest that stable and profitable banks can support financial inclusion, but the resulting benefits for systemic stability depend on responsible intermediation and appropriate regulatory oversight.

Financial literacy may strengthen these positive effects by improving borrowing, saving, and investment decisions. Jungo et al. found that financial literacy, financial innovation, and financial inclusion can mitigate the adverse effect of corruption on banking-stability indicators (22). Katnic et al. similarly demonstrated the importance of financial literacy for economic stability and resilience (23). In an explicitly Islamic-finance context, Nik Azman et al. found an interconnection between Islamic financial literacy and financial sustainability among Muslim micro-entrepreneurs (19). Together with the present results, these studies suggest that financial-system resilience is strengthened not only by bank-level financial indicators but also by the quality of financial participation and the ability of economic agents to use financial products effectively.

Trade openness also had a positive and statistically significant impact on financial stability. This finding suggests that greater trade volume may strengthen resilience by diversifying sources of income and foreign exchange, expanding market access, and increasing economic activity. For the selected Islamic economies, wider international trade networks may reduce dependence on individual domestic markets and support firms' revenues, thereby improving borrowers' repayment capacity and strengthening banks' asset quality. Trade integration can also support foreign-exchange availability and facilitate access to inputs and technology. The positive finding is particularly relevant given the negative effect of geopolitical risk: economies with diversified trade links may be better positioned to reallocate trade when particular routes or partners are disrupted. Nevertheless, the benefits of trade openness depend on diversification and institutional resilience because excessive concentration in particular commodities or trading partners may create new vulnerabilities.

Finally, the significant negative error-correction coefficient confirms that deviations from long-run financial equilibrium are progressively corrected. The estimated coefficient of approximately -0.097indicates that close to 9.7% of short-run disequilibrium is eliminated annually. Although this adjustment speed is relatively modest, its negative and statistically significant sign confirms convergence toward long-run equilibrium. The impulse-response findings complement this result by showing that the effects of shocks on financial stability gradually dissipate rather than persist indefinitely. This dynamic behavior is consistent with the broader interpretation that financial systems can absorb disturbances over time when banking structures remain sufficiently resilient. The fact that all inverse characteristic roots were located inside the unit circle further confirms that the estimated system is dynamically stable. Overall, the findings indicate that strengthening bank stability and profitability and maintaining diversified external economic relations can enhance resilience, whereas geopolitical tensions, energy-price volatility, and policy uncertainty remain important sources of financial vulnerability.

The present study is subject to several limitations. First, the analysis was restricted to selected D-8 Islamic countries over the 2013–2024 period, and the findings may therefore not be directly generalizable to all Islamic, emerging, or developing economies. Second, the countries included in the analysis differ substantially in terms of financial structure, dependence on oil revenues, exchange-rate regimes, regulatory quality, banking-system composition, and degree of trade openness, and these structural differences may generate heterogeneous responses that are not fully captured by a common panel specification. Third, the financial stability measure was based on bank credit to the private sector relative to GDP and therefore captures an important but not exhaustive dimension of financial stability. Alternative indicators based on non-performing loans, capital adequacy, liquidity, market volatility, or composite systemic-risk measures could produce complementary evidence. Fourth, geopolitical risk was operationalized through available political-stability and violence-related indicators, which may not capture all dimensions of geopolitical tension, including sanctions intensity, military escalation, diplomatic conflict, and trade restrictions. Fifth, although the constructed economic policy uncertainty index combines several important macroeconomic variables, it remains dependent on the selected indicators, their transformations, and the PCA weighting procedure. Finally, annual data restrict the ability to identify high-frequency transmission mechanisms and short-lived responses to geopolitical or oil-market events.

Future studies could extend the analysis in several directions. Comparative research could include a larger group of Islamic and non-Islamic economies to determine whether the estimated relationships differ systematically according to banking structure, institutional quality, energy dependence, or level of financial development. Researchers could also employ heterogeneous panel estimators, panel threshold models, quantile regressions, or regime-switching approaches to investigate whether geopolitical risk and oil-price shocks have nonlinear effects across different levels of financial stress. Using quarterly or monthly data would allow more precise identification of short-run responses and improve the analysis of rapid geopolitical and commodity-market shocks. Future studies could construct multidimensional financial-stability indices incorporating bank capitalization, liquidity, asset quality, market risk, and systemic interconnectedness rather than relying on a single proxy. Additional research could also distinguish positive and negative oil-price shocks, examine sanction-related risk separately from military and political risk, and evaluate whether Islamic and conventional banks respond differently to common shocks. Finally, incorporating climate risk, digital financialization, institutional quality, sovereign debt, and capital-flow volatility into an integrated dynamic model could provide a more comprehensive explanation of financial resilience.

The findings have several practical implications for monetary authorities, fiscal policymakers, financial regulators, and banking institutions in Islamic economies. Policymakers should reduce the vulnerability of public finances and banking systems to oil-price fluctuations by diversifying fiscal revenue sources, developing stabilization funds, and limiting procyclical expenditure during periods of high commodity prices. Central banks and financial regulators should strengthen macroprudential surveillance of banks' liquidity, foreign-exchange exposures, sectoral credit concentration, and sensitivity to geopolitical events. Banks should maintain adequate capital and liquid-asset buffers, conduct regular stress tests involving geopolitical and energy-price scenarios, and diversify funding and asset portfolios. Because profitability and bank stability were positively associated with financial stability, regulatory policy should encourage sustainable earnings models rather than short-term risk taking. Governments should also promote diversified international trade relationships and alternative payment channels to reduce vulnerability to disruptions in specific markets or networks. Finally, greater coordination among monetary, fiscal, trade, and financial authorities is necessary to reduce policy uncertainty and ensure that responses to external shocks do not generate additional instability within the banking and financial system.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adheried in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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