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# Economic policy uncertainty and foreign direct investment: The role of social connectedness in Vietnam

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**Abstract**

**Purpose** — This study examines the association between home countries' economic policy uncertainty (EPU) and foreign direct investment (FDI) inflows into Vietnam. It also investigates how social connections between home countries and Vietnam, measured by the Social Connectedness Index, moderate the EPU—FDI relationship.

**Method —** Using data from 12 home countries from 2011 to 2022, this study analyzes the impact of EPU on FDI inflows through regression models, incorporating the social connectedness index to explore moderating effects.

**Findings —** The results show that higher EPU significantly leads to lower FDI inflows into Vietnam. Social connectedness mitigates the negative impact of EPU on FDI by reducing information friction and enhancing trust in uncertain policy environments. These results are robust for home countries that experience periods of high global uncertainty and geopolitical risk and are members of APEC.

**Implications** — The findings suggest that both the home and host countries should focus on stabilizing their policies and leveraging social connections to mitigate the negative impact of policy uncertainty, which could improve policymaking and investment strategies.

**Originality —** This research uniquely examines how EPU in home countries affects FDI in a specific emerging country, Vietnam. It introduces social connections as a moderating factor, offering new insights into the interplay between policy uncertainty and international investment behavior.

**Keywords** — Foreign Direct Investment, Economic Policy Uncertainty, Social Connectedness, Facebook, Vietnam

## Introduction

Since policy formulation in its initial stages is frequently not transparent, firms find it challenging to foresee the long-term consequences of forthcoming policies on their investments. At the same time, governments struggle to anticipate the policy's ultimate impact and its effects on the market once implemented. This economic policy uncertainty (EPU henceforth), particularly prevalent in the aftermath of the global financial crises, Brexit, and the current Russia – Ukraine war, underscores the importance of stabilizing policy environments for sustainable economic growth. The extent of literature on the effect of EPU on corporate behaviors in general and foreign direct investment (FDI) substantially discusses the uncertainty in the host countries or host cities.

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Foreign direct investment is crucial to the global competitive advantage of Multinational Enterprises (MNEs) and the development of host countries. FDI brings firms massive benefits, from harnessing the value of intangible assets, obtaining productivity gains, reducing production costs, and leveraging taxation advantages. For the host countries, FDI is an essential source of capital and represents a significant proportion of GDP. The decision, however, is costly and uncertain since it requires a large amount of capital commitment and faces various sources of risk, such as political risk. Therefore, compared with other corporate investment decisions, FDI is more sensitive to EPU.

FDI plays a critical role in developing economies, with various factors influencing inflows, including host countries' economic, geographical, and cultural attributes (Blonigen & Piger, 2014; Ly et al., 2018).MNEs are motivated by market access, tax advantages, and efficiency gains (Cheng & Kwan, 2000; Egger & Pfaffermayr, 2004; Haufler & Stähler, 2013). While uncertainty in host countries deters FDI (Büthe & Milner, 2008), home-country uncertainty can drive firms to invest abroad to diversify risks (Lensink et al., 2000). This study examines how home-country EPU influences FDI decisions.[1]

The effect of EPU in home countries on FDI in host countries may differ from other firms' investment decisions. For joint investment decisions, the "Wait-to-see" theory suggests that firms hold up their investment due to costly reversibility 11–13 when facing uncertainty in their domestic business environment. Since FDI typically involves substantial sums that are costly and difficult to reverse (Azzimonti, 2019; Rivoli & Salorio, 1996), the 'wait-to-see' effect is likely more pronounced in this type of investment."

Furthermore, firms may hesitate to invest abroad when facing instability in their home country's policy environment, increasing capital acquisition costs. However, the capital flight thesis argues that firms and individuals in countries with unstable political situations and volatile policies seek investment opportunities in foreign markets. These authors argue that local investors flee with their money, fearing that future government actions could somehow undermine the value of their holdings. However, the extent to which EPU in home nations affects businesses' decisions to expand internationally remains unclear.

Nevertheless, when firms decide to produce abroad, they incur new risks that are proportionately higher and more challenging to control than purely domestic investments. Risk comes from the differential treatment in law courts and the adverse market reactions to legal suit announcements. Arbitrary actions of foreign governments may hurt firms' performance, and operational risk emerges from their unfamiliarity with their foreign business environment.

Social networks are becoming essential determinants of global economic activity, influencing investment decisions by facilitating relationships, knowledge dissemination, and trust-building. Recent studies have demonstrated that in various economic contexts, social connectivity dramatically reduces information friction (Bailey, Cao, Kuchler, Stroebel, et al., 2018; Bailey et al., 2021). Previous studies show that social networks influence individual and household financial decisions, such as stock market participation and investment choices (Brown Jeffrey R. & Weisbenner, 2008; Ouimet & Tate, 2020). Another study area focuses on how social connectedness, such as through immigration networks, reduces information frictions and facilitates cross-border investments (Burchardi Konrad B. & Hassan, 2019; Wagner et al., 2002).

This study contributes to the current literature in two ways. First, this study adds to a substantial body of research on how businesses respond to uncertainty. The literature includes studies on cash holdings (Duong et al., 2020; Phan et al., 2019), cost of capital (Drobetz et al., 2018; Liu & Wang, 2022; Xu, 2020), investment behavior (Gulen & Ion, 2016; Julio & Yook, 2016; Kim & Kung, 2017b). While previous studies investigate the impact of political stability in host nations on FDI inflows, this study addresses whether government policy uncertainty of home countries encourages or discourages foreign investment by firms. Second, this study extends the literature on the economic impact of social networks. Existing literature documents the positive effect of social connections on actual economic activities by reducing information frictions.

[1] We are not trying to exhaust the literature, Paul & Feliciano-Cestero (2021) provides an excellent review for the FDI literature in the last 50 years.

This study investigates how domestic political unrest affects FDI in Vietnam. For two reasons, Vietnam is an ideal setting for studying the relationship between EPU and FDI. First, as a developing nation, Vietnam prioritizes attracting foreign direct investment as a central development strategy (Decision No. 667/QD-TTg). This strategy has proven effective, as Vietnam ranks 29th globally regarding FDI inflows. Secondly, Vietnam is recognized for its high political stability and is ranked 15th globally. The stability could explain the findings of this study and mitigate the argument of the host country's unstable business environment. This study analyzes a sample of FDI inflows into Vietnam from 12 home countries spanning 2011 to 2022, comprising 1,529 country-month observations. Utilizing EPU data from Baker et al. (2016), this study reveals a significant negative impact of EPU on FDI inflows. Specifically, the baseline findings indicate that one standard increase in EPU correlates with a 4.68% decrease in FDI inflows. Our subsample analyses show that the adverse effect of EPU persists in the subsamples of low world uncertainty and geopolitical risk indexes.

## Methods

### Sample Construction

The sample of this study intersects three primary data sources: (1) Foreign direct investment inflows into Vietnam from the General Statistics Office; (2) EPU Index obtained from the Economic Policy Uncertainty website;[2] and (3) Social connectedness index (SCI) between home countries and Vietnam from Facebook, a global online social networking service (Bailey, Cao, Kuchler, & Stroebel, 2018).Observations with insufficient information are eliminated for constructing the FDI measures, as well as those with missing social connectedness or control variables values. The final data set for the baseline regression contains 1529 country-months of 12 home countries investing in Vietnam over 12 years from 2011 to 2022.[3] The definitions and data sources of all the key variables used in the analysis are presented in Table 1.

**Table 1.** Description of variables

| Variables | Definition | Source |
|---|---|---|
| *FDI* | FDI from home country *i* to Vietnam | General Statistics Office (GSO), Vietnam Ministry of Planning and Investment (https://fia.mpi.gov.vn/) |
| *FDI_c* | FDI flow is scaled by the consumer price index (CPI) | General Statistics Office (GSO), Vietnam Ministry of Planning and Investment (https://fia.mpi.gov.vn/) and (https://worldbank.org/) |
| *SCI* | SCI between home country *i* and Vietnam Bailey et al.'s (2018) | Data for Good (https://dataforgood.facebook.com/) |
| *GDP* | The Gross Domestic Product (GDP) growth of Vietnam *i* | World Development Indicators (WDI) (https://worldbank.org/) |
| *PRICE* | The price differences are computed by dividing Vietnam's Consumer Price Index (CPI) by the CPI of the home (origin) country, and then further multiplying this ratio by the nominal bilateral exchange rate | World Development Indicators (WDI) (https://worldbank.org/) |
| *TARIFF* | The average tariffs measured by the import duties or taxes imposed on goods traded between the home country and Vietnam | World Development Indicators (WDI) (https://worldbank.org/) |

Based on prior literature (Bailey et al., 2021), this research includes many country-specific characteristics that are good predictors of foreign investment. At the country level, the control variables

[2] http://www.policyuncertainty.com.

[3] Our sample is derived from the intersection of three data sources: FDI, SCI, and EPU. After merging the data, 12 countries obtained with all complete data from 2011 to 2022. These countries are primarily major investors in Vietnam and maintain strong social connectedness.

are (1) the Gross Domestic Product (GDP) growth of Vietnam; (2) Price differences computed by dividing Vietnam's Consumer Price Index (CPI) by the CPI of the home (origin) country, and then further multiplying this ratio by the nominal bilateral exchange rate; (3) Average tariffs measured by the import duties or taxes imposed on goods traded between the home country and Vietnam. The descriptive statistics of these country-level control variables are presented in Table 2.

**Table 2.** Descriptive statistics

| Variable | N | Mean | SD | p25 | p50 | p75 |
|---|---|---|---|---|---|---|
| *FDI* | 1529 | 0.050 | 0.067 | 0.003 | 0.013 | 0.120 |
| *FDI_c* | 1529 | 0.093 | 0.129 | 0.006 | 0.023 | 0.182 |
| *EPU* | 1529 | 0.623 | 0.361 | 0.367 | 0.530 | 0.790 |
| *ln(SCI)* | 1529 | 7.195 | 1.502 | 5.549 | 7.333 | 8.659 |
| *GDP* | 1529 | 7.386 | 3.361 | 4.000 | 7.000 | 10.000 |
| *PRICE* | 1529 | 0.009 | 0.032 | 0.002 | 0.004 | 0.005 |
| *TARIFF* | 1529 | 0.080 | 0.110 | 0.010 | 0.050 | 0.100 |

Table 3 reports a matrix of Pearson correlation coefficients between the variables in the main tests. Moreover, significant negative correlation coefficients exist between EPU and FDI measures, suggesting that higher uncertainty in the home country will reduce foreign investment flows in Vietnam. None of the cross-correlations in the absolute values of independent variable pairs is sufficiently high to trigger concerns over multicollinearity.

**Table 3.** Correlation Matrix

| | *FDI* | *FDI_c* | *EPU* | *ln(SCI)* | *GDP* | *PRICE* | *TARIFF* |
|---|---|---|---|---|---|---|---|
| *FDI* | 1 | | | | | | |
| *FDI_c* | 0.986 | 1 | | | | | |
| *EPU* | -0.069 | -0.081 | 1 | | | | |
| *ln(SCI)* | 0.831 | 0.803 | 0.032 | 1 | | | |
| *GDP* | -0.020 | -0.038 | 0.199 | 0.006 | 1 | | |
| *PRICE* | 0.270 | 0.220 | -0.061 | 0.462 | 0.029 | 1 | |
| *TARIFF* | 0.046 | 0.014 | 0.143 | 0.014 | 0.149 | 0.014 | 1 |

### Model Regressions

The estimation for this research is to use an OLS model with year-fixed effects to control time-specific factors that might influence FDI across all countries, such as global economic trends or policy changes. This allows us to focus on the variations in FDI driven by country-specific factors, ensuring a more accurate estimation of the effects of EPU, SCI, and their interaction. As displayed in Eq. (1), using FDI as the dependent variable, the equation is thus specified as:

$$FDI_{i,t} = \beta_0 + \beta_1 EPU_{i,t} + \beta_2 \ln(SCI)_{i,t} + \beta_3 EPU_{i,t} x \ln(SCI)_{i,t} + \Psi G_{i,t} + \varepsilon_{i,t} \quad (1)$$

where $FDI_{i,t}$ is an alternative proxy of two measures: the amount of foreign development investment (reported in millions U.S.$) from home country *i* to Vietnam, and the FDI flow is scaled by the consumer price index (CPI), $EPU_i$ is the economic policy uncertainty index of home country *i*, and $ln(SCI_i)$ is the natural logarithm of *SCI* between home country *i* and Vietnam. Following previous studies in the FDI literature (Hsieh et al., 2019), this study includes the vector $G_i$, which reflects control variables.

## Results and Discussion

### The moderating effect of Social Connectedness on the relationship between Foreign Direct Investment and Economic Policy Uncertainty

The results of Eq. (1) are presented in Table 4. Columns (1) to (4) report the estimate of the EPU, and the coefficients of EPU are negative and significant, indicating that investors who are residents

of uncertain policy countries are reluctant to invest abroad. These findings are consistent with previous arguments that investors are discouraged from investing overseas due to instability in the economic policies of resident countries (Buchanan Bonnie G. & Weihrich, 2017; Phan et al., 2019; Xu, 2020).

Columns (5) to (8) show the results of the interaction term between EPU and SCI. The interaction term coefficients between EPU and SCI are significantly positive for both specifications. Specifically, for a 1% increase in social connectedness between home countries and Vietnam, the moderating role of social networks will reduce 4.68% the effect of EPU on FDI inflows into Vietnam. When considering GDP, price differences, and average tariffs, the influence of social connectedness remains statistically significant at the 1% level, consistent with previous findings (Hsieh et al., 2019).

**Table 4.** The Moderating Effect of Social Connectedness: Baseline Results

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Variables | *FDI* | *FDI* | *FDI_c* | *FDI _c* | *FDI* | *FDI* | *FDI _c* | *FDI _c* |
| *EPU* | -0.013*** | -0.010** | -0.029*** | -0.023** | -0.060*** | -0.061*** | -0.074** | -0.068** |
| | (-2.70) | (-2.19) | (-3.18) | (-2.52) | (-3.70) | (-3.73) | (-2.19) | (-2.01) |
| *ln(SCI)* | | | | | 0.034*** | 0.034*** | 0.066*** | 0.067*** |
| | | | | | (24.98) | (24.26) | (23.72) | (23.56) |
| *EPU** | | | | | | | | |
| *ln(SCI)* | | | | | 0.006*** | 0.006*** | 0.005 | 0.004 |
| | | | | | (2.65) | (2.65) | (1.07) | (0.89) |
| *GDP* | | -0.000 | | -0.001 | | -0.000 | | -0.001 |
| | | (-0.98) | | (-1.36) | | (-0.96) | | (-1.55) |
| | | 0.560** | | 0.879** | | | | |
| *PRICE* | | * | | * | | 0.047 | | -0.102 |
| | | (10.81) | | (8.69) | | (1.51) | | (-1.60) |
| *TARIFF* | | 0.033** | | 0.030 | | 0.030*** | | 0.025 |
| | | (2.16) | | (1.00) | | (3.47) | | (1.42) |
| Constant | 0.058*** | 0.052*** | 0.111*** | 0.107*** | -0.183*** | -0.182*** | -0.362*** | -0.363*** |
| | (17.11) | (11.51) | (17.01) | (12.03) | (-19.14) | (-18.37) | (-18.27) | (-17.74) |
| Obs | 1,529 | 1,529 | 1,529 | 1,529 | 1,529 | 1,529 | 1,529 | 1,529 |
| R-squared | 0.005 | 0.079 | 0.007 | 0.055 | 0.700 | 0.703 | 0.656 | 0.657 |

Note: ***, **, and * denote the statistical significance at 1%, 5%, and 10%, respectively. Obs is the number of observations.

### The moderating effect of Social Connectedness in the World Uncertainty Environment

This section explores how global uncertainty affects the role of social connections in Vietnam's investment landscape. The World Uncertainty Index (WUI) by Ahir et al. (2019) is a proxy for global uncertainty, impacting investor behavior even in emerging markets like Vietnam. Nguyen and Lee (2021)emphasize that increasing global uncertainty significantly lowers FDI flows, especially in underdeveloped financial markets. Thus, high uncertainty is expected to overshadow the potential benefits of local social ties.

To investigate the impact of global uncertainty, the sample was split into two groups based on the median value of the WUI. WUI takes a value of one, which indicates countries with WUI above the median and zero for those below. In Table 5, the regression results highlight the impact of EPU and social connectedness (SCI) on FDI in Vietnam under varying levels of global uncertainty. In columns (1) to (4), EPU significantly negatively affects FDI regardless of global uncertainty levels. However, in high global uncertainty conditions (WUI=1), shown in columns (5) and (7), the positive and significant interaction coefficients between SCI and EPU, with 0.015 and 0.021, suggest that strong social connections help mitigate the negative effects of economic uncertainty on FDI. These findings align with previous research. The negative impact of EPU on FDI under low uncertainty is consistent with studies that highlight uncertainty as a deterrent to investment (Hsieh et al., 2019). Meanwhile, the positive role of SCI under high uncertainty supports the view that social ties enhance information flow and reduce investment risks (Büthe & Milner, 2008).

**Table 5.** The Moderating Effect of Social Connectedness in the World Uncertainty Environment

| | WUI=1 | WUI=0 | WUI=1 | WUI=0 | WUI=1 | WUI=0 | WUI=1 | WUI=0 |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| VARIABLES | *FDI* | *FDI* | *FDI_c* | *FDI _c* | *FDI* | *FDI* | *FDI _c* | *FDI _c* |
| *EPU* | 0.002 | -0.024*** | -0.001 | -0.048*** | -0.120*** | 0.007 | -0.186*** | 0.085* |
| | (0.33) | (-3.55) | (-0.06) | (-3.77) | (-5.13) | (0.33) | (-3.80) | (1.90) |
| *ln(SCI)* | | | | | 0.030*** | 0.037*** | 0.064*** | 0.073*** |
| | | | | | (14.89) | (19.95) | (14.92) | (19.70) |
| *EPU* ln(SCI)* | | | | | 0.015*** | -0.004 | 0.021*** | -0.018*** |
| | | | | | (4.48) | (-1.25) | (3.08) | (-2.86) |
| *GDP* | -0.000 | 0.000 | -0.001 | 0.001 | 0.000 | 0.001 | 0.000 | 0.002* |
| | (-0.25) | (0.44) | (-0.39) | (0.80) | (0.66) | (1.17) | (0.32) | (1.86) |
| *PRICE* | 0.548*** | 0.580*** | 0.877*** | 0.906*** | 0.039 | 0.069* | -0.131 | -0.038 |
| | (6.98) | (8.52) | (5.59) | (7.02) | (0.86) | (1.67) | (-1.38) | (-0.46) |
| *TARIFF* | 0.081** | 0.027 | 0.154** | 0.002 | 0.096*** | 0.012 | 0.182*** | -0.025 |
| | (2.29) | (1.51) | (2.18) | (0.05) | (4.91) | (1.16) | (4.45) | (-1.19) |
| Constant | 0.040*** | 0.053*** | 0.084*** | 0.098*** | -0.170*** | -0.211*** | -0.356*** | -0.425*** |
| | (4.91) | (7.79) | (5.12) | (7.65) | (-11.73) | (-15.27) | (-11.75) | (-15.32) |
| Obs | 762 | 767 | 762 | 767 | 762 | 767 | 762 | 767 |
| R-squared | 0.067 | 0.105 | 0.047 | 0.081 | 0.718 | 0.704 | 0.683 | 0.658 |

Note: ***, **, and * denote the statistical significance at 1%, 5%, and 10%, respectively. Obs is the number of observations.

### The moderating effect of Social Connectedness under Geopolitical Risk

Geopolitical risk is defined as "the risk associated with wars, terrorist acts, and tensions between states affecting the normal and peaceful course of international relations." Caldara and Iacoviello (Caldara & Iacoviello, 2022). Elevated GPR prompts investors to prioritize locations offering stability and resilience against geopolitical shocks (Khan & Akbar, 2013).Political instability exacerbated by GPR can deter investment by raising doubts about a government's ability to manage economic challenges effectively (Ismail, 2017). Transparent policies, robust institutions, and clear communication are critical in fostering investor confidence (Fania et al., 2020), underscoring the importance of comprehensive GPR information to help investors assess risk appetite. Therefore, investors from home countries with high GPR indices may seek alternative information channels before investing overseas.

**Table 6.** The Moderating Effect of Social Connectedness under Geopolitical Risk

| | GPR=1 | GPR=0 | GPR=1 | GPR=0 | GPR=1 | GPR=0 | GPR=1 | GPR=0 |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| VARIABLES | *FDI* | *FDI* | *FDI_c* | *FDI _c* | *FDI* | *FDI* | *FDI _c* | *FDI _c* |
| *EPU* | -0.003 | -0.016** | -0.008 | -0.029** | -0.141*** | -0.008 | -0.264*** | 0.069 |
| | (-0.43) | (-2.30) | (-0.58) | (-2.20) | (-5.61) | (-0.35) | (-5.04) | (1.57) |
| *ln(SCI)* | | | | | 0.029*** | 0.037*** | 0.056*** | 0.076*** |
| | | | | | (14.75) | (18.42) | (13.80) | (18.65) |
| *EPU* ln(SCI)* | | | | | 0.018*** | -0.002 | 0.033*** | -0.015** |
| | | | | | (5.02) | (-0.54) | (4.45) | (-2.41) |
| *GDP* | -0.000 | -0.001 | 0.001 | -0.004*** | 0.000 | -0.001 | 0.001 | -0.003*** |
| | (-0.00) | (-1.18) | (0.91) | (-2.89) | (0.08) | (-1.27) | (1.60) | (-4.10) |
| *PRICE* | 0.697*** | 0.491*** | 1.130*** | 0.778*** | 0.065 | 0.043 | -0.094 | -0.067 |
| | (7.94) | (7.67) | (6.49) | (6.36) | (1.25) | (1.11) | (-0.86) | (-0.87) |
| *TARIFF* | 0.008 | 0.050*** | -0.047 | 0.088** | 0.029* | 0.036*** | -0.005 | 0.064*** |
| | (0.27) | (2.71) | (-0.81) | (2.50) | (1.80) | (3.39) | (-0.14) | (3.01) |
| Constant | 0.046*** | 0.057*** | 0.083*** | 0.122*** | -0.153*** | -0.204*** | -0.305*** | -0.410*** |
| | (6.00) | (9.86) | (5.49) | (11.07) | (-10.96) | (-14.17) | (-10.48) | (-14.13) |
| Obs | 772 | 757 | 772 | 757 | 772 | 757 | 772 | 757 |
| R-squared | 0.078 | 0.090 | 0.055 | 0.076 | 0.709 | 0.705 | 0.668 | 0.667 |

Note: ***, **, and * denote the statistical significance at 1%, 5%, and 10%, respectively. Obs is the number of observations.

Accordingly, Table 6 presents the estimated regressions for subsample countries with high and low GPR indexes. GPR takes a value of one, indicating countries with GPR above the median and zero for those below. From columns (1) to (4), there is no moderating effect of SCI, and EPU significantly reduces FDI for countries with low GPR (GPR=0). In contrast, for high-GPR countries (GPR=1) in columns (5) and (7), the interaction coefficients between EPU and SCI are significant at 1%, 0.018, and 0.033, respectively. This finding indicates that strong social connections help mitigate the adverse effects of uncertainty, especially in times of heightened geopolitical risk. These findings align with previous research, showing that political instability deters investment (Ismail, 2017), while social connections and transparent communication reduce risk (Khan & Akbar, 2013). Social media likely plays a crucial role in enabling investors to access timely information and manage geopolitical risks effectively.

**The moderating effect of Social Connectedness under regional economic regions**

The analysis was expanded to include FDI inflows from 12 home countries to provide a more comprehensive examination. Although the dataset does not distinguish between M&A and greenfield FDI (Davies et al., 2018), explore whether the impact of policy uncertainty (EPU) on FDI inflows varies across home countries, dividing them into two subsamples: Asia-Pacific Economic Cooperation (APEC) members (APEC=1) and non-APEC countries (APEC=0). Arslan and Güzel (2018) highlight the significance of regional integration and economic cooperation in directing FDI flows. APEC membership strengthens economic ties and reduces uncertainty among member nations through trade agreements and cooperative projects. Similarly, Mishra a Jena (2019) provide evidence that regional integration is vital in attracting FDI, especially for emerging economies.

**Table 7.** The Moderating Effect of Social Connectedness: Regional Subsample Analysis

| | APEC=1 | APEC=0 | APEC=1 | APEC=0 |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| VARIABLES | *FDI* | *FDI* | *FDI_c* | *FDI _c* |
| *EPU* | -0.159*** | 0.013 | -0.231*** | 0.017 |
| | (-6.02) | (1.49) | (-4.08) | (0.96) |
| *ln(SCI)* | 0.036*** | 0.007*** | 0.073*** | 0.012*** |
| | (18.46) | (6.49) | (17.61) | (5.92) |
| *EPU* ln(SCI)* | 0.020*** | -0.003** | 0.027*** | -0.005* |
| | (5.72) | (-2.17) | (3.68) | (-1.71) |
| *GDP* | -0.001* | 0.000 | -0.002** | 0.000 |
| | (-1.82) | (1.30) | (-2.42) | (1.49) |
| *PRICE* | -0.007 | -1.924*** | -0.205*** | -3.787*** |
| | (-0.21) | (-9.53) | (-2.84) | (-9.22) |
| *TARIFF* | 0.033*** | 0.024*** | 0.029 | 0.035*** |
| | (3.23) | (4.33) | (1.33) | (3.14) |
| Constant | -0.204*** | -0.026*** | -0.415*** | -0.045*** |
| | (-13.44) | (-4.18) | (-12.77) | (-3.58) |
| Obs | 924 | 605 | 924 | 605 |
| R-squared | 0.713 | 0.244 | 0.655 | 0.233 |

Note: ***, **, and * denote the statistical significance at 1%, 5%, and 10%, respectively. Obs is the number of observations.

Since Vietnam is part of APEC, social connections are likely to mitigate the impact of policy uncertainty on FDI inflows. Table 7 shows that the coefficients of the interaction term (*EPU*ln(SCI)*) are significantly positive in the APEC sample (columns 1 and 3), at 0.020 and 0.027, respectively, indicating that social connectedness helps reduce the negative effect of EPU, thus encouraging investment. This finding aligns with Fania et al. (2020), who stress the importance of communication channels in fostering investor confidence during uncertain periods. In contrast, the coefficients for non-APEC countries (columns 2 and 4) show an insignificant EPU effect, with

positive values of 0.013 and 0.017. At the same time, the interaction term between EPU and SCI is negative (-0.003 and -0.005), suggesting that social connections do not effectively alleviate EPU's impact in these countries. This supports the view that the benefits of social ties are more pronounced in economically integrated regions, reinforcing Mishra and Jena's (2019) argument that regional integration is critical for attracting FDI, particularly in emerging markets like Vietnam.

## Conclusion

This research has investigated the dynamic relationship between the policy uncertainty of the economy and FDI inflows into Vietnam and under the moderating effect of social connectivity evaluated by Facebook. Our findings emphasize that online social networks are becoming more widely acknowledged for their significant impact on the development of economic activity in the globalized society. We now better grasp the factors influencing FDI, especially in developing countries like Vietnam.

The results of this study demonstrate that uncertain economic policies negatively influence FDI flows. This effect occurs when additional controls, such as trade dynamics and financial factors, are considered. Besides, the moderating role of social networks mitigates the negative impact of uncertainty in economic policies on FDI in the home countries with high world uncertainty index, high geopolitical index, and APEC countries, indicating the heightened economic and policy uncertainty environment that domestic nations encounter is likely to influence investment judgments.

This study contributes to the growing corpus of research on the factors influencing FDI and social connectedness's role in moderating the influence of policy uncertainty in the economy of home countries in foreign investments to Vietnam. The results might be helpful for policymakers and MNEs when considering how social networks affect economic globalization and navigate the dynamic landscape of foreign investment.

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### Appendix

| List of Home Countries | | |
|---|---|---|
| Australia | Italia | Singapore |
| Canada | Japan | Spain |
| Germany | South Korea | United Kingdom |
| India | Netherlands | United States |

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# Impact of financial inclusion and institutional quality on banking stability: Lessons from the Asia region

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**Abstract**

**Purpose** — This study examines the effects of financial inclusion and institutional quality on bank stability. It first examines the effects of banking on the whole Asian region and then the region according to income categories.

**Method** — We use aggregate data from 2013 to 2021 to investigate banking stability in 39 Asian countries and apply the generalized method of Moments (GMM), specifically the first difference GMM and system GMM. In addition, this research uses Principal Component Analysis (PCA) to measure the composite variables of the financial inclusion index and institutional quality index.

**Findings** — The findings demonstrate that overall financial inclusion has a favourable effect on Asian nations' banking systems. However, an examination based on income categories reveals some intriguing results: financial inclusion improves bank stability in lower- and upper-middle-income countries but does not affect high-income countries. In lower-middle-income countries, institutional quality has a detrimental effect on bank stability; in upper-middle-income and high-income countries, it has no effect.

**Implications** — The availability of financial services to households and small and medium-sized enterprises (SMEs) significantly impacts the stability of Asian banks. Several policy recommendations are feasible to implement, including the need for collaboration between banks and the government to broaden banking services to all communities, particularly in lower-middle-income nations.

**Originality** — Analyzing the differences in the impact of institutional quality and financial inclusion variables on banking stability in Asian countries according to income categories.

**Keywords** — bank stability, financial inclusion, institutional quality, Asia region

## Introduction

First introduced in 2005, financial inclusion stole the attention of many researchers and policymakers. Financial inclusion can be understood to mean that any economic operator can access and use formal financial services. In other words, financial inclusion means that every adult, including the poor and low-income community, has access to a range of affordable financial services (Kumar et al., 2021). In addition, financial inclusion is also marked by changes and technological advances in the financial sector, such as new service products and payment methods. The phase of financial inclusion can begin with having a deposit account, making and receiving

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payments, and making transactions with a bank or other financial service provider. The next stage, financial inclusion, includes access to credit from formal financial institutions (Demirgüç-Kunt et al., 2020). In addition to boosting economic growth (Claessens & Perotti, 2007; Allen et al., 2016), financial inclusion contributes to increased investment (Dupas & Robinson, 2013), helps macroeconomic stability (Mehrotra & Yetman, 2015), and reduces income inequality and poverty (Demirgüç-Kunt et al., 2020). A more financially inclusive country will have better financial stability and more effective monetary policy (Mehrotra & Yetman, 2015).

With an emphasis on banks, several academics contend that account ownership via financial inclusion gives people access to a stable source of income, which boosts retail deposits at banks, lowers financing costs, and improves stability. However, opponents contend that financial inclusion would force banks to offer high-risk credit. According to Brunnermeier (2009). This may result in higher transaction costs, higher credit risk, and lower profitability. This reasoning is consistent with studies by Khan (2011) and Dupas et al. (2019) which discovered a negative link between bank stability and financial inclusion. However, according to Ahamed and Mallick (2019). There isn't any empirical data demonstrating a direct link between financial inclusion and bank stability. Therefore, questions remain regarding the contribution of financial inclusion to the economy and how it affects bank stability. These discrepancies in findings motivate scholars to conduct more research on the contribution that financial inclusion makes to the financial industry, particularly the banking industry.

In addition to financial inclusion, the quality of institutions is also seen to have an impact on improving bank stability (Bermpei et al., 2018). So far, research has focused only on the relationship between financial inclusion and bank stability. On the other hand, research that measures the correlation between financial inclusion, institutional quality, and bank stability (Ahamed & Mallick, 2019; Jungo et al., 2022). It is still quite limited. The study attempts to fill the gap by examining the influence of financial inclusion variables and institutional quality on the stability of banks in Asian countries. Good institutional quality indicates the proper implementation and formulation of policies, which can reduce the negative impact of economic shocks (Fazio et al., 2018). According to the literature on political economics, there is a positive correlation between institutional quality and economic development. Vigorous law enforcement and a corruption-free economy are some indicators of institutional quality that can guarantee accountability and stability in the financial sector. By implementing an adequate financial regulatory and supervisory framework, the quality of institutions can be ensured that the economic system can operate efficiently (Gazdar & Cherif, 2015; Uddin et al., 2020).

Research investigating the relationship between financial inclusion and financial stability is divided into two groups. The first type of research supports the notion that financial inclusion improves the banking sector's stability. In contrast, the second type of study endorses the idea that increased inclusion will disrupt banking stability. Feghali et al. (2021) researched various countries to determine the relationship between financial inclusion and bank stability. His study showed that financial inclusion positively impacted stability, including increased access to savings accounts and payments. On the contrary, financial inclusion in the form of extended access to credit could undermine stability if credit growth does not consider the ability of customers to repay. Studies conducted Vo et al. (2021), Elgharib (2024), Sethy and Goyari (2022), and Boachie et al. (2023) show empirical evidence that increased financial inclusion through access to banking facilities improves the banking sector's stability and resilience.

Based on previous literature, the positive impact of financial inclusion on bank stability can be explained by several reasons. First and foremost, financial inclusion can allocate resources optimally. One of the main features of financial inclusion is low cost, wide coverage, and sustainability. It shows that individuals, such as small and micro enterprises and rural residents, can access and use financial services, enabling communities to allocate resources optimally and contribute to economic growth and justice (Hannig & Jansen, 2010; Hua et al., 2023). Second, risk diversification increases with financial inclusion. Financial inclusion offers basic services such as account opening, deposits, withdrawals, and regular payments. Later, gradually, formal financial institutions started offering credit services like loans. For individuals, financial inclusion increases

the depository base and the prospect of borrowers (Mehrotra & Yetman, 2015), so increased savings make banks more resilient to risk (Hannig & Jansen, 2011). For small and micro-businesses, an increase in the number of borrowers can improve financial stability by reducing the ratio of problematic credit and the rate of failure to repay financial institutions (Morgan & Pontines, 2018). Most of the users of financial inclusion are small savers who usually keep their money during times of crisis. Therefore, countries with broader coverage of financial inclusion have more stable financial conditions due to reduced savings when the crisis is relatively small (Han & Melecky, 2013). Thirdly, financial inclusion reduces the dependence of capital seekers on informal financial institutions. Informal funding is essential in distributing funds to small and micro enterprises, rural populations, and other groups. However, without proper regulation and supervision, an increase in credit transactions in informal financial institutions can lead to systemic risk (Hua et al., 2023). In other words, financial inclusion reduces dependence on the expensive informal financial sector and improves the health of the small, the household sector, and even the corporate sector. Fourthly, financial inclusion helps people switch from cash transactions to supervised bank accounts. It contributes to preventing money laundering because banks can monitor and report suspicious transactions related to financial transactions in the economy (Khan, 2011).

On the other hand, several researchers have found several possible causes of the adverse effects of financial inclusion. First, financial inclusion allows financial institutions to innovate, such as digital finance backed by artificial intelligence. Fintech innovations not supported by proper regulation and supervision can jeopardize financial stability, especially if innovations are carried out with a bad motivation to pursue profits and ignore existing regulations (Financial Technology Board, 2017). Second, increased financial inclusion can lead to excessive credit expansion. Excessive credit is when the funds given to the borrower exceed their needs. The financial institution may have given loans to specific borrowers several times so that the client's rating matrix works better. Excessive credit to those who can't pay the loan will spoil the financial system and increase the risk of failure to pay (Jia et al., 2021). In addition, Drehmann et al. (2012) financial risks could spread from individual to industry if all financial institutions lowered the borrowing threshold, ultimately accumulating systemic risk and triggering a financial crisis. In addition to financial inclusion, institutional quality factors can affect bank stability. Malik et al. (2022) investigated how the quality of governance affects financial stability and increased financial inclusion. His research shows that the quality of institutions contributes negatively to financial inclusion but positively impacts bank stability. Nguyen et al. (2018) conducted a growing state study from 2002 to 2013, his research found that good institutional quality drives higher credit rates in banking. In this context, the quality of institutions reduces the problem of information asymmetry, which means that banks will give credit to qualified customers and tend not to engage in risky projects. Therefore, improved institutional quality can reduce the risk of moral hazard and improve bank stability (Ho et al., 2019).

Similar findings were reported by Jungo et al. (2022), who confirmed that the reduction of credit risk and bank stability was mainly attributed to the financial inclusion and strengthening of institutional variables, including corruption and the rule of law. The financial impact of inclusion is more pronounced in countries with strong governance, as stated by Saha and Dutta (2020). Focus on developing countries Wang and Luo (2022) They also conducted the same study and found that the relationship between financial inclusion and bank stability depends on business cycles, financial systems, governmental intensity, and policy environments. Sayılır et al. (2018) investigated the great benefits of institutional quality to the economic progress of a country. His research confirms that the quality of institutions impacts financial growth and economic growth, where effective governance accelerates progress in the banking sector (Law & Azman-Saini, 2012). However, Hoinaru et al. (2020) found the opposite result: low governance, like corruption, benefited the country's development.

This research is focused on Asian countries, as the banking sector plays an important role in driving economic development in these countries. Asia has become the most significant economic and trade area in the world. Between 2015 and 2021, Asia contributed 57% of global GDP growth. Besides, Asia has a relatively large banking system that can be seen from the bank

credit markets, reaching 61%, twice as much as the United States' 31% (Seong et al., 2023). Although Asian banking has excellent prospects for strong growth, policymakers face the challenge of ensuring that economic and financial development is fair and inclusive, where small incomes and UMKM have access to financial services (Le et al., 2019). Demirgüç-Kunt et al. (2022) pointed out that there are significant differences in the level of bank account ownership across Asian countries. For example, account ownership in low-income countries ranges between 6%, in low-middle-income countries 21%, in upper-middle-income countries 96%, and in high-income countries 100%.

## Research Method

### Data Description

The study uses aggregate data from 39 Asian countries from 2013 to 2021. The variables used in this study are presented in the Table 1.

**Table 1.** Research Variable

| Variables | Definition | Sources |
|---|---|---|
| Financial stability | Z-score= (ROA + EA)/(σ(ROA))<br>With:<br>EA is equity/total assets | World Governance Indicators |
| Financial Inclusion | Number of commercial bank branches per 100,000 adults | Financial Access Survey |
| Financial Inclusion | Institutions of Commercial Banks | Financial Access Survey |
| Financial Inclusion | Outstanding deposits with commercial banks (% of GDP) | Financial Access Survey |
| Financial Inclusion | Outstanding loans from commercial banks (% of GDP) | Financial Access Survey |
| Institutional quality | Government Effectiveness | World Governance Indicators |
| Institutional quality | Rule of Law | World Governance Indicators |
| Institutional quality | Control of Corruption | World Governance Indicators |
| Institutional quality | Voice and accountability | World Governance Indicators |
| Institutional quality | Regulatory quality | World Governance Indicators |
| Institutional quality | Government effectiveness | World Governance Indicators |
| Control Variable | | |
| Mobile Phone | Mobile cellular subscriptions (per 100 people) | Financial Access Survey |
| Inflation (CPI) | Inflation as measured by the consumer price index | World Governance Indicators |
| *Gross Domestic Product* (GDP) | Annual GDP Growth | World Governance Indicators |

### Principal Component Analysis (PCA)

Principal Component Analysis (PCA) reduces extensive data sets to be represented by smaller variables (Bartholomew, 2010; Dray & Josse, 2015). This technique helps convert data groups that have high correlations into non-correlated indicators (Asongu & Nnanna, 2019). By doing that, the PCA reduces the data size for analysis. In addition, the additional advantage of PCA lies in its ability to identify the similarities and differences between the various models made (Yoshino & Hesary, 2015). This study uses the PCA technique to extract financial inclusion and institutional quality data. The financial inclusion index is measured using four indicators, namely the number of ATMs per 100,000 adults, the number of bank branches per 100000 adults, Outstanding deposits with commercial banks (% of GDP), Outstanding loans from commercial Banks (%), and institutional quality data consisting of Political Stability, Rule of Law, Control of Corruption, Voice and accountability, Regulatory quality, Government effectiveness. Before performing the PCA, the procedure is to measure Kaiser Meyer Olkin (KMO) with the condition that the PCA technique is considered appropriate when it has a value of KMO more than 0.5. The test results show that the

indicator of financial inclusion has a value of CMO 0.589, and the institutional quality has a value of 0.86; the figure is more than 0.5, so it is generally considered appropriate.

The next test is a rotation solution for four financial inclusion indicators, with the results shown in Table 3. A component can be retained when the Eigenvalue exceeds 1.0 or represents a cumulative variance of more than 60 percent (Banda & Kumarasamy, 2020; Malik et al., 2022). The financial inclusion indicator has two Eigenvalue components worth more than 1.0 and represents variations of about 56.29 percent and 26.68 percent, with a cumulative variation of 82.98 percent. The weight extracted for each indicator is shown in Table 4 (Malik et al., 2022; Jima & Makoni, 2023; Seifelyazal et al., 2023).

$$Fin_{it} = \big((0.4513 * \text{ICB}) + (0.0849 * \text{NCB}) + (0.6347 * \text{OD}) + (0.6215 * \text{OL})\big) + \big((-0.3907 * \text{ICB}) + (0.9129 * \text{NCB}) + (0.0516 * \text{OD}) + (0.1064 * \text{OL})\big) \quad (1)$$

Fin is the financial inclusion index of country i in Asia in year t, ICB is the Institution of commercial banks, NCB is the Number of commercial bank branches, OD is the Outstanding deposits, and OL is the outstanding loans.

**Table 2.** KMO and Bartlett's Test of Financial Inclusion

| | |
|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | 0.589 |
| Bartlett test of sphericity | |
| Chi-square | 717.261 |
| df | 6 |
| p-value | 0.000 |

**Table 3.** Result of Principal Component Analysis (PCA) Financial Inclusion

| Component | Eigenvalue | Difference | Proportion | Cumulative |
|---|---|---|---|---|
| Comp1 | 2.251 | 1.184 | 0.562 | 0.562 |
| Comp2 | 1.067 | 0.475 | 0.266 | 0.829 |
| Comp3 | 0.591 | 0.501 | 0.147 | 0.977 |
| Comp4 | 0.089 | | 0.022 | 1 |

**Table 4.** Principal component analysis: Eigenvectors (loadings) Financial Inclusion

| Name | Comp1 | Comp2 | Comp3 | Comp4 | Unexplained |
|---|---|---|---|---|---|
| Institution of commercial banks | 0.451 | -0.390 | 0.799 | 0.068 | 0 |
| Number of commercial bank branches | 0.084 | 0.912 | 0.399 | -0.010 | 0 |
| Outstanding deposit | 0.634 | 0.051 | -0.271 | -0.721 | 0 |
| Outstanding loan | 0.621 | 0.106 | -0.357 | 0.688 | 0 |

Meanwhile, one component has an Eigenvalue of more than 1.0 for the Institutional Quality indicator with a cumulative value of 78.98 percent, as seen in Table 4. Next, build up the composite variable IQ that shows the institutional Quality Index with the weight given to the first component is 0.4390 for Government Effectiveness (GF), 0.3448 for Political Stability (PS), 0.4335 for Regulatory Quality (RQ), 0.4506 for Rule of Law (RL), 0.3182 for Voice and Accountability (VA), 0.4429 for Control of Corruption (CC).

$$IQ_{it} = (0.4390 * \text{GF}) + (0.3448 * \text{PS}) + (0.4335 * \text{RQ}) + (0.4506 * \text{RL}) + (0.3182 * \text{VA}) + (0.4429 * \text{CC}) \quad (2)$$

**Table 5**. KMO and Bartlett's Test of Institutional Quality

| | |
|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | 0.868 |
| Bartlett test of sphericity | |
| Chi-square | 2886.204 |
| df | 15 |
| p-value | 0.000 |

**Table 6.** Result of Principal Component Analysis (PCA) Institutional Quality

| Component | Eigenvalue | Difference | Proportion | Cumulative |
|---|---|---|---|---|
| Comp1 | 4.738 | 4.0463 | 0.789 | 0.789 |
| Comp2 | 0.692 | 0.328 | 0.115 | 0.905 |
| Comp3 | 0.363 | 0.243 | 0.060 | 0.965 |
| Comp4 | 0.120 | 0.070 | 0.020 | 0.986 |
| Comp5 | 0.050 | 0.016 | 0.008 | 0.994 |
| Comp6 | 0.033 | | 0.005 | 1 |

**Table 7.** Principal component analysis: Eigenvectors (loadings)

| Name | Comp1 | Comp2 | Comp3 | Comp4 | Comp5 | Comp6 | Unexplained |
|---|---|---|---|---|---|---|---|
| Government Effectiveness | 0.439 | -0.084 | -0.363 | 0.050 | 0.806 | 0.125 | 0 |
| Political Stability | 0.344 | -0.615 | 0.685 | 0.169 | 0.039 | 0.050 | 0 |
| Regulatory Quality | 0.433 | 0.072 | -0.313 | 0.705 | -0.436 | 0.143 | 0 |
| Rule of Law | 0.450 | -0.026 | -0.117 | -0.252 | -0.155 | -0.833 | 0 |
| Voice and Accountability | 0.318 | 0.779 | 0.520 | 0.031 | 0.134 | 0.039 | 0 |
| Control of Corruption | 0.442 | -0.041 | -0.121 | -0.637 | -0.340 | 0.514 | 0 |

**Generalized method of moments (GMM)**

A dynamic panel data model was required due to the panel data's bigger cross-section and smaller time dimension. When evaluating traditional estimators such as pooled OLS (fixed effect and random effect), increasing the cross-section does not remove the correlation issue, and the estimator is biased upwards. Additionally, due to the presence of correlation among the regressors, random effects are not suitable (Blundell & Bond, 1998; Harris et al., 2008; Law, 2009; Okui, 2009; Hayakawa, 2019; Farzana et al., 2024). The study adopted an Augmented Solow Growth Model conducted by (Mankiw et al., 1992) which was further developed by (Knowles & Owen, 1995) to measure the impact of financial inclusion and institutional quality on bank stability. The research model is as follows:

$$BS_{i,t} = \alpha_0 + \alpha_1 BS_{i,t-1} + \alpha_2 Fin_{it} + \alpha_3 IQ_{it} + \alpha_4 MP_{it} + \alpha_5 GDP_{it} + \alpha_6 Inf_{it} + \varepsilon_{i,t} \quad (3)$$

Where $BS_{i,t}$ denotes Bank Stability, $Fin_{it}$ is the Financial Inclusion Index, $IQ_{it}$ represents Institutional Quality. The variable $MP_{it}$ is a Mobile Phone, $GDP_{it}$ refers to Gross Domestic Product (GDP), and $Inf_{it}$ captures the inflation rate.

This study uses the Generalized Method of Moments (GMM) for some reason that appears in the estimates. Levine and Renelt (2016) criticized cross-sectional regression methods because they were susceptible to the independent variables included. In other words, the estimated parameter changes significantly when one or more variables are inserted or removed from the model. There are two commonly used GMM estimation models: the first difference GMM and the GMM system. Some model specification tests must be performed in GMM analysis to get a valid and consistent result. The first test assesses the validity of a model by looking at the results of the values of AR (1) and AR (2), which are the p-values for first and second-order autocorrelated disturbance. The test for AR (1) usually rejects the null hypothesis, but the vital indicator is indicated by the value of AR (2). The next test is the Sargant Test or Hansen Test against overidentifying restriction, which tests the validity of the instrument variable used by testing samples analogous to the control moment used. The null hypothesis of this test is a valid instrument variable used and distributed according to the chi-square. The validity of the research model is when the value of the probability of the Chi-square has a degree of significance greater than 0.1, 0.5, or 0.01 and then rejects H0, or, in other words, the variable of the instrument used is valid.

## Results and Discussion

### Descriptive statistics

Preliminary analysis explains the characteristics of the data by performing descriptive analysis to determine whether the data condition is valid and can produce the best conclusions. Table 8 shows the data conditions of average values, standard deviations, and minimum and maximum values for all variables used.

**Table 8.** Descriptive statistics

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Government effectiveness (x1) | 351 | 0.231 | 0.881 | -1.320 | 2.285 |
| Political Stability (x2) | 351 | -0.178 | 0.945 | -2.609 | 1.599 |
| Regulatory quality (x3) | 351 | 0.182 | 0.929 | -1.730 | 2.252 |
| Rule of Law (x4) | 351 | 0.053 | 0.903 | -1.801 | 2.004 |
| Voice and accountability (x5) | 351 | -0.466 | 0.865 | -1.966 | 1.606 |
| Control of Corruption (x6) | 351 | -0.009 | 0.993 | -1.462 | 2.334 |
| Institution of commercial banks (x7) | 351 | 50.331 | 44.288 | 5 | 204 |
| Number of ATMs (x8) | 351 | 63.740 | 60.598 | 1.012 | 314.31 |
| Number of commercial bank branches (x10) | 351 | 16.742 | 12.511 | 2.694 | 71.917 |
| Outstanding deposit (x11) | 351 | 85.558 | 80.550 | 8.89 | 541.283 |
| Outstanding loan (x12) | 351 | 75.998 | 59.874 | 8.189 | 390.093 |
| Bank Z-score (x13) | 351 | 19.378 | 10.69 | 1.472 | 62.437 |
| GDP growth (x14) | 351 | 3.227 | 5.322 | -54.336 | 23.536 |
| Inflation (x15) | 351 | 4.292 | 9.781 | -3.749 | 154.756 |
| Mobile cellular (x16) | 351 | 11200000 | 290000000 | 544337 | 1750000000 |

The main variable average is bank stability, measured using a Z-score of 19,377 with a maximum of 62,437 and a minimum of 1,472. The Z-score value has a relatively large range of 60.965 (62.437-1.472), indicating that banks' stability in Asian countries is variable. The financial inclusion variables, consisting of the Institution of commercial banks, Number of ATMs, number of commercial bank branches, Outstanding deposits, and Outstanding loans, have averages of 50.3305, 63.7403, 16.7419, 85.5584, and 75.9975. Meanwhile, the institutional quality variables in each category have almost the same standard deviation. From the macroeconomic sector, average GDP growth and inflation in Asian countries have values of 3.227% and 4.2922%, respectively. The correlation matrix between variables is displayed in Table 9, which reveals that a few variables have relatively high correlation values, more than 0.9. The following variables have strong correlations: number of commercial bank branches and outstanding deposits, government efficacy and regulatory quality, government effectiveness and the rule of law, and the rule of law and control of corruption. If noticed, the variables with strong correlation are institutional quality and financial inclusion indicators. The Principal Component Analysis (PCA) approach must be used to address the possibility of multicollinearity between these variables.

**Table 9.** Correlation Matrix

| | X1 | X2 | X3 | X4 | X5 | X6 | X7 | X8 | X9 | X10 | X11 | X12 | X13 | X14 | X15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **X1** | 1 | | | | | | | | | | | | | | |
| **X2** | 0.671 | 1 | | | | | | | | | | | | | |
| **X3** | 0.926 | 0.617 | 1 | | | | | | | | | | | | |
| **X4** | 0.945 | 0.713 | 0.917 | 1 | | | | | | | | | | | |
| **X5** | 0.563 | 0.318 | 0.642 | 0.643 | 1 | | | | | | | | | | |
| **X6** | 0.925 | 0.703 | 0.878 | 0.960 | 0.626 | 1 | | | | | | | | | |
| **X7** | 0.340 | 0.069 | 0.244 | 0.240 | 0.18 | 0.220 | 1 | | | | | | | | |
| **X8** | 0.550 | 0.379 | 0.595 | 0.529 | 0.407 | 0.439 | 0.031 | 1 | | | | | | | |
| **X9** | 0.205 | 0.314 | 0.276 | 0.258 | 0.459 | 0.261 | -0.098 | 0.334 | 1 | | | | | | |
| **X10** | 0.512 | 0.297 | 0.515 | 0.503 | 0.235 | 0.464 | 0.487 | 0.181 | 0.115 | 1 | | | | | |
| **X11** | 0.683 | 0.527 | 0.691 | 0.699 | 0.331 | 0.660 | 0.417 | 0.279 | 0.147 | 0.906 | 1 | | | | |
| **X12** | 0.214 | 0.231 | 0.234 | 0.292 | 0.214 | 0.311 | -0.041 | -0.096 | 0.146 | 0.243 | 0.263 | 1 | | | |
| **X13** | -0.125 | -0.084 | -0.184 | -0.159 | -0.087 | -0.134 | 0.045 | -0.216 | -0.105 | -0.215 | -0.202 | -0.017 | 1 | | |
| **X14** | -0.263 | -0.189 | -0.230 | -0.231 | -0.086 | -0.217 | -0.062 | -0.105 | 0.087 | -0.095 | -0.179 | -0.095 | -0.133 | 1 | |
| **X15** | 0.005 | -0.163 | -0.139 | -0.081 | -0.055 | -0.097 | 0.701 | -0.041 | -0.132 | 0.047 | -0.026 | -0.044 | 0.138 | -0.026 | 1 |


**Figure 1.** Bank Stability and Financial Inclusion in the Asian Region

This study analyzed Asian countries based on high-income, upper-middle-income, and lower-middle-income countries. The high financial inclusion index in high-income countries indicates that the development of national banking services is progressing faster than in developing countries. As is well known, financial inclusion indicates the extent to which the state provides banking services to all population levels. Improved access to banking, ease of use, and banking services that reach most people can drive financial inclusiveness in a country. Interestingly, high financial inclusion in high-income countries is also followed by high bank stability. The link between the two is also visible in upper-middle-income countries with a higher financial inclusion index and bank stability than in lower-income countries. The condition reinforces the initial hypothesis that the inclusion of financial variables significantly influences bank stability.

## Dynamic aspects of the bank stability model

In economics and finance, the value of the dependent variable lag can usually describe the values of the running year and is used as an instrumental variable. A variable's lag value can produce better estimates (Arellano & Bond, 1991), so this study uses a dynamic panel model to estimate the bank's stability. The dynamic model means that another influences one variable in the present time and another in the past. In this study, the z-score bank lag value significantly influenced the bank's stability in the running year. There are two commonly used GMM estimation models: GMM's first difference and the GMM system. Model specification tests for GMM and GMM systems show that AR2 values have a higher probability value than alpha 5 percent, so it can be concluded that there is no autocorrelation series in the model. The next test is the Sargant Test or Hansen Test against overidentifying restriction, which tests the validity of the instrument variable used by testing samples that are analogous to the control moment used. The validity test of instruments using the Hansen Test shows that the one-step difference GMM and one-step system GMM models have a probability value smaller than the alpha 5 percent, so it is concluded that the instrument is not valid. Based on the model validity test, the model interpreted is a model that does not exhibit serial autocorrelation in errors and has valid instruments, namely the GMM two-step difference model and the two-step system GMM. The study chose the two-step GMM model, proposed by Blundell and Bond (2023) compared to other models because it reduces the strict exogeneity assumption for explanatory variables and helps insert the dependent variable lag into the model.

The estimates of the two-stage model of the GMM system show that the financial inclusion variable positively impacts the stability of banks in Asian countries. These results show that higher levels of financial inclusion can drive banks to become more stable, which means lower bankruptcy

rates. The results of this study reinforce previous findings Ahamed and Mallick (2019), Le et al. (2019), Vo et al. (2021), and Malik et al. (2022). Financial inclusion can improve the stability of the financial system for four reasons (Cull et al., 2012) First, financial inclusion attracts small savers. Given that the small number of subscribers is large enough, financial inclusion increases savings for individuals and households, strengthening banks' stability. Second, financial inclusions reach the healthier household and small business sectors so that they can drive macroeconomic stability. Third, financial inclusion can produce a more effective financial intermediation system. Good intermediation functions can generate large domestic savings and strengthen the savings cycle, as well as healthy domestic investment to enhance stability.

**Table 10.** Dynamic Model All Countries Using Difference GMM and System GMM

| Variable | Diff GMM One Step | Diff GMM Two Step | Sys GMM One Step | Sys GMM Two Step |
|---|---|---|---|---|
| Lagged Bank Z-score | -0.079 | -0.059*** | 0.947*** | 0.951*** |
| | (0.144) | (0.019) | (0.021) | (0.004) |
| Financial Inclusion (Fin) | -1.075** | -0.987*** | 0.036 | 0.096*** |
| | (0.464) | (0.113) | (0.106) | (0.024) |
| Institutional quality (IQ) | 0.103 | 0.002 | 0.045 | 0.011 |
| | (0.835) | (0.175) | (0.076) | (0.015) |
| GDP growth | 0.018 | 0.019** | 0.036 | 0.049*** |
| | (0.022) | (0.008) | (0.024) | (0.007) |
| Inflation | 0.017 | 0.013*** | 0.032** | 0.031*** |
| | (0.017) | (0.005) | (0.0129) | (0.001) |
| Mobile cellular | 0.001 | 0.000*** | 0.000 | 0.000* |
| | 0.001 | 0.000 | (0.000) | (0.000) |
| Constant | | | 0.753* | 0.521*** |
| | | | (0.445) | (0.103) |
| Hansen | 84.62 | 26.68 | 98.14 | 31.08 |
| Hansen P-Value | 0.000 | 0.481 | 0.000 | 0.612 |
| AR1 | -0.624 | -1.023 | -5.082 | -3.514 |
| AR1 P-Value | 0.533 | 0.307 | 0.000 | 0.001 |
| AR2 | -1.197 | -0.889 | 0.638 | 0.824 |
| AR2 P-Value | 0.231 | 0.374 | 0.523 | 0.41 |

Notes: The models are regressed using the system GMM two-step method; *, **, and *** represent statistical significance levels of 10%, 5%, and 1%, respectively.

Fourthly, the diversification of customer service related to financial inclusion is expected to result in a more resilient economy. Reducing income disparities through financial inclusion will result in better social and political stability, which in turn can contribute to the financial system's stability. Yangdol and Sarma (2019) explain that the availability of financial services that are accessible to the public throughout the region can help individuals conduct financial transactions and manage risk, which can ultimately create opportunities to generate income. Le et al. (2019) reinforces the argument that a positive relationship exists between financial inclusion and bank stability. The positive impact of financial inclusion on the financial system is the diversification of assets that can reduce credit pressure and the possibility of default, and improve the stability of the public's savings base, thereby reducing the risk of liquidity and enhancing the transmission of monetary policy. Policies, regulations, and the performance of public institutions also affect the financial sector, including banks. Therefore, governance quality is another variable that influences bank stability. Unlike the initial hypothesis, the estimates show that governance Quality has no direct impact on the stability of banks across Asian countries. The study also uses macroeconomic conditions such as GDP and inflation as control variables, as economic development generally improves financial inclusion and bank stability. The results show that GDP has a positive impact on bank stability. According to a study conducted by Damrah et al. (2023), which revealed that growth in GDP supports financial stability by improving the quality of assets, lowering risk rates,

and reducing default. More specifically, Athanasoglou et al. (2008) it shows evidence that GDP growth can increase bank profitability, ultimately driving stability.

In the meantime, the impact of inflation on bank stability can be positive and negative, depending on the extent to which banks can divert increased operating costs due to rising inflation towards customers. Increased inflation will affect banks' cost-to-income ratio, so banks need to anticipate by adjusting interest rates (Bourke, 1989; Perry, 1992). In addition to macroeconomic conditions, the study included mobile subscription variables as control variables. Developments in the field of communication have prompted the use of mobile phone technology in the community, almost replacing the landline telephone. Besides, as the digital economy grows alongside mobile money-based activities, some researchers are studying the relationship between mobile cellular subscriptions and financial inclusion. Abor et al. (2018) and Alabi and Olaoye (2022) found evidence that cellular use promotes increased financial inclusion. The positive relationship between mobile cellular subscriptions and financial inclusion is also supposed to improve bank stability.

### Dynamic model-based income group of countries

Asia has considerable diversity, especially in GDP, population, cultures, and languages, which vary widely across countries. Wang and Luo (2022) viewed that there was a considerable gap between financial inclusion in developing and developed countries; further, they argued that financial inclusion was seen as more of a problem in the developing world. The further analysis in this study looks at the influence of financial inclusion and governance quality in Asian countries classified by income, namely high-income, upper-middle-income, and lower-middle-income countries. After conducting a two-step model specification test, the GMM System obtained a probability value of AR2 and the Sargant test greater than alpha 5%, so it was concluded that the instrument did not exhibit autocorrelation series and the two-step difference GMM model was valid.

**Table 11.** Dynamic model classified by income group of countries using Sys GMM Two Step

| Variables | High Income | Upper Middle Income | Lower Middle Income |
|---|---|---|---|
| Lagged Bank Z-Score | 0.772*** | 0.776*** | 1.009*** |
| | -0.238 | -0.116 | -0.0667 |
| Financial Inclusion (Fin) | -0.305 | 6.809** | 1.133*** |
| | -0.398 | -3.378 | -0.346 |
| Institutional quality (Iq) | 0.411 | 0.155 | -0.449* |
| | -0.556 | -1.025 | -0.237 |
| GDP Growth | 0.137*** | 0.183*** | 0.0363** |
| | -0.0347 | -0.0539 | -0.017 |
| Mobile cellular | -2.08E-08 | -1.33e-08* | 3.30e-09*** |
| | -2.29E-08 | -7.21E-09 | -1.14E-09 |
| Inflation | -0.127 | 0.103* | -0.0974* |
| | -0.15 | -0.0528 | -0.0546 |
| Constant | 5.737 | 4.629* | -0.365 |
| | -6.552 | -2.365 | -1.579 |
| Sargant Test | 38.93 | 89.48 | 48.6 |
| Sargant P-Value | 0.258 | 0.7 | 0.05 |
| AR 1 | -2.268 | -0.607 | -2.703 |
| AR1 P-Value | 0.0233 | 0.544 | 0.00688 |
| AR 2 | 1.493 | -1.578 | 1.234 |
| AR 2 P-Value | 0.136 | 0.115 | 0.217 |

Notes: The models are regressed using the system GMM two-step method; *, **, and *** represent statistical significance levels of 10%, 5%, and 1%, respectively.

The estimates show an exciting finding that financial inclusion has a significant positive impact on bank stability in upper-middle-income and lower-middle-income countries. In contrast, variable financial inclusion does not contribute to stability in a high-income country. This result supports the research by Ahamed and Mallick (2019), who contend that inclusive finance is more

beneficial in low-income nations. Furthermore, the World Economic Forum discovered that upper-middle-income and lower-middle-income countries had stronger correlations between financial stability and inclusivity. This can be explained by the fact that some high-income countries with broad financial access face greater instability due to a lack of incentives to monitor risks. In contrast, banks in low-income countries have a higher ratio of capital to assets to meet regulatory requirements and caution given their requirements and less sophisticated capital structure. The phenomenon suggests that upper-middle-income and lower-middle-income countries respond to the regulatory framework more proactively and cautiously in responding to the crisis than high-income countries (Čihák et al., 2013). Sahay et al. (2015) and Saha and Dutta (2020) reveal that the relationship between financial inclusion and financial stability in high-income countries becomes more complex, worse, and ambiguous when there are conditions of financial crisis. This is in line with the findings of Han and Melecky (2013), which state that financial inclusion increases stability in upper- and middle-income countries. This is because increased financial inclusion can increase deposits in public banks, thus strengthening the resilience of the banking sector's reserve base in times of crisis. Meanwhile, Hannig and Jansen (2011) state that low-income societies that gained access to finance tended to be immune to economic cycle changes, thereby improving the stability of the savings and lending base. Furthermore, they found that financial institutions that serve lower-class societies could cope with the crisis and contribute to the resilience of local economies.

The group of high-income countries has the most extensive financial inclusion index due to greater bank penetration, lower information asymmetry, and better governance than middle-income countries. Countries with high GDP levels have a greater capacity to provide financial services and credit, as demonstrated by the higher number of commercial bank institutions, ATMs, outstanding deposits, and outstanding loans compared to upper-middle-income and lower-middle-income countries. This is why sufficiently mature financial inclusion in high-income countries has no significant influence on bank stability. On the contrary, developing countries are more dependent on public banks (Laeven & Valencia, 2013). Therefore, for countries heavily dependent on banking, the impact of financial accessibility on bank stability is more significant. Low-income countries face a situation where most citizens do not have access to banking services due to limited ATM and branch networks, and high savings and credit services costs (Morgan & Pontines, 2018). Kawai and Prasad (2011) pointed out that limited access to finance for small, labour-intensive enterprises harmed employment and could implicitly jeopardize financial and macroeconomic stability.

Furthermore, the institutional quality variable at alpha 10% was found to harm bank stability in lower-middle-income countries. This result is surprising because it differs from literature and theory studies, most of which show a positive relationship between institutional quality and bank stability (Bermpei et al., 2018; Saha & Dutta, 2020; Uddin et al., 2020; Ha & Nguyen, 2023). However, this research aligns with the findings of Canh et al. (2021), which shows that better institutional quality causes increased credit risk in lower-middle-income and low-income countries, thus endangering bank stability. Good institutional quality encourages increased economic activity in various sectors, which can increase the banking system's exposure to new risks. This is because the banking system for low-income and middle-class individuals is not yet mature regarding processes, regulations, bank diversification, and default risk as part of financial development. Hoinaru et al. (2020) stated the same thing, and the results of their research show that low governance increases economic development. Corruption is a way to circumvent the law to obtain greater economic benefits, increasing business growth. In addition, Williams and Kedir (2016) found that governance, such as easing regulations, is considered to increase business growth and productivity, and can increase company profitability (Jiang & Nie, 2014). On the other hand, the estimation results show that institutional quality in high-income and upper-middle-income countries positively impacts bank stability, but it is not significant. Thus, these findings indicate that the relationship between institutions and bank stability directly depends on the country's income level.

Additionally, the estimation findings demonstrate that while the mobile cellular variable hurts bank stability in upper-middle-income countries, it has a favourable effect on bank stability in lower-middle-income nations. The rise in mobile device users indicates the expansion of digital

services, particularly financial services, and is considered a measure of digital financial inclusion. Consumers accustomed to technology prefer digital financial services to conventional banking services (Ong et al., 2023). Antwi and Kong (2023) argue that the application of digital finance in the banking sector, especially in developing countries, raises the question of whether this can be a solution to achieving banking stability, because both can have a good or bad impact on financial stability. Digital finance expands the financial sector and creates opportunities for systematic harm. If digital financial technology changes, it could negatively impact banking risks. The widespread use of telecommunications technology and e-banking capabilities can change banks' overall risk levels. Various risks, including strategic, operational, legal, and reputational, have become more severe following the spread of e-banking activities (Buchak et al., 2018; Tang, 2019).

Several fairly extensive empirical studies try to explain why financial digitalization or financial technology harms bank stability (Claessens et al., 2018; Merton & Thakor, 2019; Murinde et al., 2022; Khan et al., 2023). First, implementing fintech causes new operational issues and disturbs traditional banking procedures. As a result, the bank's personnel, protocols, and infrastructure must be significantly altered. Second, credit risk management may be impacted by fintech use. Fintech loan processing has become more accessible and user-friendly, which has the potential for a relaxation of credit requirements, which could raise non-performing loan (NPL) percentages. A rise in non-performing loans could jeopardize bank stability and financial health. Third, fintech innovations frequently defy regulations. Fintech-using banks sometimes struggle with managing the risks involved, maintaining compliance, and navigating laws. Regulation violations may place you at risk for legal trouble, damage to your reputation, and increased credit risk. Fourth, strong security procedures are necessary to gather, keep, and use customer data since fintech presents new risks to data security and privacy. Data or privacy breaches can lead to increased non-performing loans (NPL) ratios and less stable banks by undermining client confidence, harming a company's brand, and raising the risk of loan default. Fifth, there are significant differences in the technology infrastructure and connectivity across upper-middle-income nations. Fintech integration and performance might be hampered by inadequate infrastructure and connection. A bank's efficiency, credit risk management, and overall financial health can be negatively impacted by systemic operational issues resulting from technological constraints, as demonstrated by a lower Z score and a larger NPL ratio.

The macroeconomic aspect is that GDP growth as a variable significantly impacts bank stability in high-income, upper-middle-income, and lower-middle-income countries. As previous research has shown, economic performance affects financial performance. In addition, rapid economic growth increases public confidence in banks, which generates greater liquidity due to abundant deposits (Boachie et al., 2023). Meanwhile, inflation positively impacts upper-middle-income countries but contributes negatively to the stability of banks in lower-middle-income countries. This suggests that lower-middle-income countries have not been able to anticipate inflation by adjusting the interest rates on loans charged to their customers. On the other hand, banks in upper-middle-income countries can predict inflation and adjust prices accurately, so rising inflation is positively linked to financial stability. The impact of inflation varies depending on how mature a country's economy is, so it can predict future inflation and how banks manage their operating costs. The extent to which inflation affects bank performance depends on whether inflation expectations are entirely predictable. The inflation rate fully anticipated by bank management implies that banks can adjust interest rates appropriately to raise income faster than costs, thus earning higher economic gains. Given the circumstances, it is logical that bank stability and inflation positively correlate in the upper-middle-income country because its economic conditions are stronger than those of the lower-middle-income country.

## Conclusion

This research uses the GMM analysis tool to measure the influence of financial inclusion and institutional quality on bank stability in 39 Asian countries. The main finding of this research is that the financial inclusion variable positively influences bank stability. The results of this research strengthen previous findings that financial inclusion that reaches small entrepreneurs and low-

income communities can increase the stability of the deposit base, thereby reducing liquidity risk and increasing bank stability. The estimation results show that financial inclusion provides greater benefits for upper-middle-income and lower-middle-income countries. In contrast, high-income countries with broad financial access face greater instability due to reduced bank prudence.

Meanwhile, the direct impact of institutional quality on bank stability depends on the state income level. Lower-middle-income countries experience increased stability due to the low quality of governance. Better institutional quality directly causes higher credit risk in lower-middle-income countries because increased economic activity in various sectors causes banks to face new risk exposures. This fact cannot be separated from the fact that the economies of lower-middle-income countries are not yet mature in terms of processes, regulations, bank diversification, and default risk. Macroeconomic conditions as a control variable show that the GDP variable positively affects bank stability in all country classifications: high-income, upper-middle income, and lower-middle income. Interesting findings can be seen in the inflation variable, where increasing inflation positively affects bank stability in upper-middle-income countries but contributes negatively to bank stability in lower-middle-income countries. This finding implies that lower-middle-income countries cannot anticipate rising inflation by adjusting interest costs, as in upper-middle-income countries. Finally, the mobile cellular variable as an indicator of digital financial inclusion negatively impacts upper-middle-income countries because digital financial innovation creates new risks for banks, such as legal risks, bad reputation risks, and higher credit risks.

The results of this study imply that household and SME access to financial services greatly influences banking stability in Asian countries. Several policy recommendations can be implemented: banks and the government must work together to expand banking services to all communities, especially in lower-middle-income countries. Policies that can be implemented include expansionary monetary policy and creating a better investment environment. Policymakers must ensure that appropriate macroeconomic policies accompany efforts to encourage financial inclusion and bank stability. The government can realize financial exclusion by identifying the obstacles individuals and small businesses face in obtaining financial services. Then, the government can make appropriate policies to overcome these obstacles. Steps that can be taken include increasing financial literacy, improving financial infrastructure that reaches small areas, and encouraging financial inclusion for marginalized groups such as women and the poor. In addition, increasing financial literacy can help small communities make the right decisions about financial products and services, thereby reducing problem loans and moral hazards detrimental to banks. The government can encourage financial inclusion in stages, starting with basic financial products and services and then progressing to more complex financial products and services as consumers' knowledge of finance increases. The government must also implement more effective governance, such as comprehensive law enforcement and establishing friendly regulations, so that institutional quality contributes positively to bank stability. No less critical, macroeconomic policies also need to be directed at encouraging GDP growth and controlling inflation to maintain people's purchasing power, especially in lower-middle-income countries. The government must ensure consumer and investor protection through comprehensive regulations and supervision as digital financial innovation develops. In addition, developing countries should review their digital financial laws so that mobile phone use can support secure financial services and thus strengthen bank stability.

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# Bank efficiency and shareholder value in Vietnam Banking

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**Abstract**

**Purpose** — This paper investigates the impact of bank efficiency on shareholder value in the context of Vietnamese commercial banks.

**Methods** — Bank technical efficiency is measured using the DEA input cost minimization method. We employ fixed effects model (FEM), random effects model (REM), and two-step difference generalized method of moments (GMM) to regress the research models.

**Findings** — The findings indicate that bank efficiency positively impacts shareholder value. Additionally, the study reveals that specific bank characteristics, such as return on equity, bank size, market risk, liquidity risk, and macroeconomic factors, such as GDP growth rate, inflation rate, and credit to the private sector, also affect shareholder value.

**Implications** — We recommend that bank managers implement policies to enhance technical efficiency, creating greater shareholder value.

**Originality** — This study is the first to explore the role of technical efficiency in predicting shareholder value, specifically within the context of Vietnamese banks.

**Keyword** — bank efficiency; shareholder value; Vietnam banking

## Introduction

Like other countries worldwide, the banking sector in Vietnam plays a crucial role in developing the economy. Since Vietnam joined the WTO in 2007, the economy has experienced significant breakthroughs, with high economic growth rates leading to a substantial increase in capital demand. This growth has resulted in uncontrolled expansion within the banking system, and many poorly performing banks have begun to emerge, significantly impacting the national financial system. A series of bank restructuring solutions issued by the government during the 2013–2015 period helped bring the situation under control and resulted in a healthier financial system. Since 2016, the Vietnamese banking system has been more actively managed and controlled to ensure the smooth and efficient operation of capital flows within the economy.

From an academic perspective, as the banking system faced risks and was subsequently stabilized, many scholars began to question and focus on how effectively Vietnamese commercial banks were operating. This interest has attracted numerous studies measuring the technical efficiency of Vietnamese commercial banks (Kontesa et al., 2020; Lan et al., 2024; Le et al., 2022; Le et al., 2021; Thanh Ngo & Tripe, 2017; Nguyen & Simioni, 2015; Nguyen & Pham, 2020; Nguyen et al., 2016; Stewart et al., 2016; Vo & Nguyen, 2018; Dinh et al., 2019).

However, more importantly, the impact of technical efficiency on shareholder value has not yet been thoroughly explored. Therefore, this study does not focus on the detailed estimation of technical efficiency; instead, we analyze the impact of technical efficiency on the shareholder value of Vietnamese commercial banks. In other words, we ask whether banks with higher technical efficiency contribute to increased bank value.

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The concept of technical efficiency was first defined and clarified by Farrell (1957). Technical efficiency measures the extent to which a production unit utilizes available input resources to produce the maximum possible output. Technical efficiency is applied across all industries to evaluate the efficiency of a company, bank, or even a country. Coelli et al. (2005) further developed the theory of technical efficiency in the banking sector, suggesting that a bank is considered technically efficient when it minimizes input resources to produce a given output level. A production unit is considered technically efficient if it cannot reduce the input without reducing the corresponding output. Hughes and Mester (2012) expanded on technical efficiency, suggesting that efficiency should be considered from three perspectives: cost minimization, profit maximization, and managerial utility maximization. Managerial utility maximization refers to goals reflecting the priorities of managers, which may include cost, profit, market share, growth, and other strategic objectives.

Calculating technical efficiency is relatively complex and is often approached using nonparametric and parametric estimation methods. Data Envelopment Analysis (DEA) is a nonparametric method that uses linear programming to estimate the technical efficiency of decision-making units (DMUs). Stochastic Frontier Analysis (SFA) is a parametric method in which a frontier production function is estimated through regression techniques. This production function includes a random component to capture factors beyond the DMU's control and an inefficiency error component. In the banking sector, many studies apply the DEA or SFA method, and some even apply both methods simultaneously to calculate technical efficiency. For example, Wanke et al. (2020) conducted research on banks in OECD countries, Liu (2019) studied banks in the US and Canada, Dar et al. (2021) researched banks in India, and Nguyen and Pham (2020) and Nguyen et al. (2016) focused on Vietnamese banks, among many other studies (Dong et al. (2014); Silva et al. 2017); Thoraneenitiyan & Avkiran (2009)). However, the DEA method is more commonly used in empirical studies to evaluate banking efficiency because it does not require assumptions about the form of the production function, is easy to apply to organizations using multiple inputs to generate multiple outputs, and is adaptable to various situations, especially in service industries (Liu et al., 2013).

Most previous empirical studies, whether at the national level or across economic regions, suggest that banks with higher technical efficiency tend to positively impact stock market prices, thereby enhancing shareholder value. For instance, Sufian and Majid (2009) were the first to investigate the relationship between China banks' efficiency and share price performance. Their study, covering the period from 1997 to 2006, used the DEA estimation method to estimate technical efficiency with two input factors: Total deposits and fixed assets, and two output factors: Total loans and investments. The fixed-effect estimation method was used to regress the research models. The results indicated that larger banks generally exhibited better technical efficiency than smaller banks, and technical efficiency positively correlated with stock returns. Pasiouras et al. (2008) investigated the relationship between the efficiency of Greek banks and their share price performance. Based on data collected from 2001 to 2005, the study found a positive and statistically significant relationship between technical efficiency and stock returns. Kale et al. (2020) examined the impact of changes in bank efficiency on the stock returns of banks listed in the Turkish market from 2002 to 2017. The study showed that improvements in bank efficiency were a significant factor in explaining positive changes in stock returns.

Alsharif (2021) evaluated the impact of bank efficiency on the profitability performance of stock prices for 12 listed commercial banks in Saudi Arabia from 2006 to 2018. The DEA method was used to calculate technical efficiency parameters through input cost minimization. The estimation model included three input factors: Personnel expenses, fixed assets, and deposits, and two output factors: Loans and other earning assets. The study found that banks with better technical efficiency experienced growth in stock prices. Sharma (2018) investigated the relationship between bank efficiency and stock performance in a developing country, India. The study included 22 listed banks from 2002 to 2012. The DEA method was used to estimate technical efficiency, considering both variable returns to scale (VRS) and constant returns to scale (CRS) efficiency with the same input and output factors. Four input factors included deposits, interest expenses, non-

interest expenses, and personnel expenses, while three output factors included loans, interest income, and non-interest income. The results indicated that efficient banks created more value for their investors. Hoang et al. (2020) investigated the influences of efficiency, concentration, and market power on the shareholder value of 73 Australian banks from 2000 to 2015. Tobin's Q ratio was used as a representative indicator of shareholder value, while bank efficiency was calculated using the SFA method with three input factors: Fund, physical capital, and labour, and two output factors from the main and off-balance sheet activities in banking. The study found that technical efficiency had a positive impact on shareholder value.

From a broader perspective, Fu et al. (2014) used the GMM estimation method to analyze the relationship between shareholder value and bank efficiency for a large sample of listed banks across 14 Asia-Pacific economies from 2003 to 2010. Technical efficiency, represented by profit and cost efficiency, was measured using the SFA method. The estimation model included three output factors: Total net loans, other earning assets, and non-interest income, and two input factors: Price of purchased funds, measured by the ratio of interest expenses to deposits and short-term funding, and price of physical capital, measured by the ratio of non-interest expenses to total fixed assets. The study indicated that cost and profit efficiency improvements positively correlated with stock price changes. Bank size, credit losses, and market risk also influenced stock prices. Fiordelisi and Molyneux (2010) investigated the factors affecting shareholder value for banks in the European region from 1998 to 2005. Bank efficiency was one of the explanatory variables considered in the regression models and was measured using the SFA method. The estimation model for bank efficiency was based on three input factors: Labour, physical capital, and financial capital, and three output factors: Deposits, total loans, and other earning assets. The study found that technical efficiency positively affected shareholder value.

However, the relationship between bank technical efficiency and shareholder value is unclear. Aftab et al. (2011) analyzed the impact of bank efficiency on share performance for banks listed on the Karachi Stock Exchange in Pakistan from 2003 to 2007. The DEA estimation method was used to estimate both VRS and CRS technical efficiency. The results showed that VRS technical efficiency had a demonstrable impact on stock prices, whereas CRS technical efficiency did not clearly impact stock prices. Siauwijaya (2020) studied the effect of bank efficiency, earnings per share, and price-earnings ratio on the stock returns of 33 banks in Indonesia from 2012 to 2016. The DEA method was also used to estimate bank efficiency. The findings indicated that bank efficiency did not significantly affect stock prices, while earnings per share and the price-earnings ratio positively influenced stock prices. Liadaki and Gaganis (2010) examined the impact of technical efficiency on the stock prices of 171 listed banks across 15 EU markets from 2002 to 2006. The SFA method was used to estimate profit efficiency and cost efficiency. The study found that changes in profit efficiency had a positive and significant effect on stock prices, while no relationship was found between changes in cost efficiency and stock returns. Thus, most previous studies, national or multinational, suggest that bank technical efficiency positively impacts shareholder value. Therefore, in the case of Vietnam, we also expect a positive relationship between bank efficiency and shareholder value.

## Methods

### The Model

Based on the studies by Fu et al. (2014), Fiordelisi and Molyneux (2010) and Hoang et al. (2020). The authors propose a model to analyze the impact of bank efficiency on shareholder value for banks in Vietnam as follows:

$$\textit{Shareholder value} = f(\textit{Bank efficiency; Bank characteristics; Macroeconomic factors})$$

where,

1) Shareholder value is measured by Tobin's Q. Similar to Fu et al. (2014) and Saif-Alyousfi 2020) Tobin's Q is calculated as the market value of equity plus the book value of debt, divided by the book value of assets.

2) Bank efficiency is represented by constant returns to scale technical efficiency (CRSTE)and variable returns to scale technical efficiency (VRSTE), estimated using the DEA method based on input cost minimization. The estimation model includes three input factors: total assets, deposits, and personnel expenses, similar to the input factors used in previous studies (Alsharif, 2021; Abdulahi et al., 2023; Boubaker et al., 2023; Fukuyama et al., 2023; Gržeta et al., 2023; Henriques et al., 2018;Kamarudin et al., 2017; Kamarudin et al., 2015;Kamarudin et al., 2016; Řepková, 2014; Svitalkova, 2014). The three output factors include total loans, income, and profit before tax, similar to the output factors used in previous studies (Abdulahi et al., 2023; Boubaker et al., 2023; Kamarudin et al., 2016; Řepková, 2014; Wanke et al., 2016). We use the Vietnamese DEA add-in for Excel, developed by Ngo (2015) to estimate CRSTE and VRSTE.
3) Bank characteristics
   - Return on Equity
     Return on equity (ROE) measures the bank's performance by comparing business profits with equity capital. A higher ROE generally reflects better operational performance, contributing to increased firm value and shareholder value. Most previous studies support the positive relationship between ROE and shareholder value (Arshad, 2021; Pennacchi & Santos, 2021; Widjaja & Ariefianto, 2022). Therefore, we expect a positive relationship between ROE and shareholder value in this study.
   - Credit risk
     Credit risk is measured by the ratio of loan loss provisions to total loans. High loan loss provisions can reduce the bank's accounting profit and are expected to decrease shareholder value (Athanasoglou et al., 2008). However, Fiordelisi and Molyneux (2010) found that higher credit risk provisions have a positive relationship with shareholder value and serve as a tool for smoothing bank profits, which can build shareholder confidence in the bank's stability. On the other hand, Hoang et al. (2020) indicated that credit risk might reduce net interest margin and ROE but found no evidence of its impact on shareholder value. Similarly, other studies have found no evidence of credit risk affecting shareholder value (Fu et al., 2014; Widjaja & Ariefianto, 2022). Therefore, the relationship between credit risk and shareholder value is complex, and we have no clear expectations regarding their relationship.
   - Market risk
     Market risk is typically measured by the ratio of total security investments to total assets Fu et al., 2014). However, we measure market risk by the ratio of provisions for trading and investment securities to total assets for greater clarity. Empirical studies have shown inconsistent results regarding the relationship between market risk and shareholder value. Fu et al. (2014) found a positive relationship, Fiordelisi and Molyneux (2010) found a negative relationship, while Saif-Alyousfi (2020) We found no evidence of a relationship between market risk and shareholder value, so we do not have a clear expectation of such a relationship.
   - Liquidity risk
     Liquidity risk is measured by the ratio of total loans to total deposits. The relationship between liquidity risk and shareholder value is also debated. Hoang et al. (2020) argue that a higher loan-to-deposit ratio can lead to higher bank risk and lower shareholder value. However, Fiordelisi and Molyneux (2010) suggest that maintaining a high loan ratio and loan growth rate can benefit shareholder value. Meanwhile, some studies have found no evidence of a relationship between liquidity risk and shareholder value (Fu et al., 2014; Widjaja & Ariefianto, 2022). Therefore, we do not have a clear expectation of the relationship between liquidity risk and shareholder value.
   - Bank size
     Bank size is the natural logarithm of total assets. Bank size is often one of the crucial factors influencing bank efficiency. Some studies suggest that larger banks often have better product advantages and diversification, which reduces credit risk. Additionally, larger banks can benefit from economies of scale, leading to higher shareholder value (Fiordelisi

& Molyneux, 2010; Fu et al., 2014). However, other studies argue that smaller banks create more shareholder value (Hoang et al., 2020; Saif-Alyousfi, 2020). They believe that smaller banks can focus better on managing a limited number of loans, thereby better controlling risks and creating more benefits and shareholder value. In the context of Vietnamese commercial banks, larger banks tend to have better reputations, and their customers are usually of higher quality. Therefore, we expect a positive relationship between bank size and shareholder value.

4) Macroeconomic factors:

- GDP growth rate
  Economic growth plays a vital role in the economy's supply and demand for credit. A rapidly growing economy typically leads to significant credit expansion, increased competition among banks, and a loosening of risk controls, which can result in reduced bank profitability and Tobin's Q (Saif-Alyousfi, 2020). Some other studies also support the inverse relationship between economic growth and shareholder value (Fiordelisi & Molyneux, 2010; Hoang et al., 2020). In the context of Vietnam, the banking system has also faced risk issues during periods of high economic growth. Therefore, we expect an inverse relationship between economic growth and shareholder value.
- Inflation rate
  Inflation is also one of the key macroeconomic variables affecting bank performance. High inflation usually represents a more risky economic environment. Some studies suggest that the impact of inflation on bank performance depends on the bank's ability to predict inflation and adjust interest rates accordingly (Apergis, 2014; Dietrich & Wanzenried, 2014; Saif-Alyousfi, 2020). Incorrect inflation forecasts can lead to inappropriate interest rates and increasing costs. Saif-Alyousfi (2020) found evidence of an inverse relationship between inflation and shareholder value. However, other studies have shown that inflation is not a factor influencing shareholder value (represented by Tobin's Q) (Hoang et al., 2020). In the context of Vietnam, we also believe that inflation challenges the economy and negatively affects bank performance, thereby reducing shareholder value. We expect an inverse relationship between inflation and shareholder value.
- Credit to the private sector
  Credit to the private sector is represented by domestic credit to the private sector (% of GDP). Saif-Alyousfi (2020) found strong evidence of a negative impact of credit to the private sector on shareholder value (represented by Tobin's Q). Saif-Alyousfi (2020) argues that developing credit to the private sector can lead immature banks to bypass ethical barriers by lending to riskier projects and providing more funding to lower-quality clients. However, Naceur and Omran (2011) found evidence of a positive relationship between credit to the private sector and bank performance. In the context of Vietnam, we agree with Saif-Alyousfi (2020). We also expect an inverse relationship between credit in the private sector and shareholder value.

The variables used in the research model are summarized in Table 1.

**Table 1.** Summary of variables used in the research model

| Variables | Definition | Symbol | Expected sign |
|---|---|---|---|
| Dependent variable | | | |
| Shareholder value, represented by Tobin's Q | Market value of equity plus book value of debt divided by book value of assets | Tobin's Q | |
| Independent variables | | | |
| *Bank efficiency* | | | |
| Constant returns to scale technical efficiency | Estimated using the DEA method | CRSTE | + |
| Variable returns to scale technical efficiency | Estimated using the DEA method | VRSTE | + |

| Variables | Definition | Symbol | Expected sign |
|---|---|---|---|
| *Bank characteristics* | | | |
| Return on equity | Net profit after tax divided by equity | ROE | + |
| Credit risk | Credit risk is measured by the ratio of loan loss provisions to total loans | CRER | +/- |
| Market risk | Market risk is measured by the ratio of provisions for trading and investment securities to total assets | MAKR | +/- |
| Liquidity risk | Liquidity risk is measured by the total loans to total deposits ratio | LIQR | +/- |
| Bank size | Bank size is defined as the natural logarithm of total assets | SIZE | + |
| *Macroeconomic factors* | | | |
| GDP growth rate | Annual growth rate of GDP (annual% %) | GDP | - |
| Inflation rate | Inflation, consumer prices (annual% %) | INF | - |
| Credit to the private sector | Domestic credit to private sector (% of GDP) | CREPRI | - |

Source: The authors compiled.

## Data Sources

The dataset includes 23 Vietnamese joint-stock commercial banks from 2006 to 2022. The sample does not include 100% state-owned banks, foreign banks, or branches of foreign banks operating in Vietnam. Additionally, banks involved in mergers and acquisitions during the study period were excluded to limit the impact of abnormal changes in asset structure on the research results. Data related to bank characteristics were calculated using information from the banks' financial reports. Data on macroeconomic factors, including GDP growth rate, inflation rate, and credit to the private sector, were collected from the World Bank. Stock price data used to calculate Tobin's Q for the banks were collected from the Ho Chi Minh City Stock Exchange (HOSE) and the Hanoi Stock Exchange (HNX).

**Table 2.** Average Technical Efficiency of Vietnam Banks based on CRSTE

| Year | No. of banks | No. of efficient banks | Average efficiency | Standard deviation | Minimum Efficiency |
|---|---|---|---|---|---|
| 2006 | 23 | 4 | 0.84 | 0.15 | 0.57 |
| 2007 | 23 | 5 | 0.80 | 0.16 | 0.61 |
| 2008 | 23 | 5 | 0.85 | 0.12 | 0.67 |
| 2009 | 23 | 7 | 0.89 | 0.11 | 0.69 |
| 2010 | 23 | 7 | 0.84 | 0.15 | 0.52 |
| 2011 | 23 | 7 | 0.82 | 0.17 | 0.37 |
| 2012 | 23 | 6 | 0.84 | 0.17 | 0.47 |
| 2013 | 23 | 6 | 0.85 | 0.15 | 0.54 |
| 2014 | 23 | 6 | 0.87 | 0.11 | 0.62 |
| 2015 | 23 | 3 | 0.86 | 0.12 | 0.55 |
| 2016 | 23 | 6 | 0.90 | 0.15 | 0.44 |
| 2017 | 23 | 7 | 0.91 | 0.10 | 0.65 |
| 2018 | 23 | 9 | 0.94 | 0.07 | 0.72 |
| 2019 | 23 | 8 | 0.94 | 0.08 | 0.75 |
| 2020 | 23 | 6 | 0.90 | 0.10 | 0.68 |
| 2021 | 23 | 8 | 0.92 | 0.10 | 0.68 |
| 2022 | 23 | 12 | 0.93 | 0.09 | 0.75 |

Notes: Constant returns to scale technical efficiency (CRSTE) were calculated using the DEA method and the Vietnamese DEA add-in for Excel developed by Ngo (2015). Source: Compiled from the author's calculations.

Table 2 and Table 3 present the summary results of constant returns to scale technical efficiency (CRSTE) and variable returns to scale technical efficiency (VRSTE) using the DEA method for Vietnamese commercial banks from 2006 to 2022. Banks with an efficiency score of 1 are considered efficient. The results in Tables 2 and 3 indicate an increasing trend in the number

of efficient banks and an improvement in average efficiency. Overall, this suggests that Vietnamese commercial banks are performing better over time.

Table 4 presents descriptive statistics for the variables used in the research model. The data is an unbalanced panel. Notably, the number of Tobin's Q observations is fewer than other variables because Vietnamese commercial banks were listed and traded on the stock exchanges at different times. The variable constant returns to scale technical efficiency (CRSTE) has a minimum value of 0.37, a maximum of 1.0, and an average of 0.88. In contrast, the variable returns to scale technical efficiency (VRSTE) has a minimum value of 0.52, a maximum of 1.0, and an average of 0.94. A small note on the variable market risk (MAKR): Table 4 displays only two decimal places, and the values of MAKR are very small, so some of the MAKR indicators are nearly zero (except for the maximum value). The mean and median values show no significant differences, indicating that the data is approximately normally distributed and meets the conditions for inclusion in the regression models.

**Table 3.** Average Technical Efficiency of Vietnam Banks based on VRSTE

| Year | No. of banks | No. of efficient banks | Average efficiency | Standard deviation | Minimum Efficiency |
|---|---|---|---|---|---|
| 2006 | 23 | 11 | 0.95 | 0.09 | 0.71 |
| 2007 | 23 | 9 | 0.94 | 0.10 | 0.65 |
| 2008 | 23 | 12 | 0.95 | 0.09 | 0.70 |
| 2009 | 23 | 13 | 0.94 | 0.10 | 0.69 |
| 2010 | 23 | 11 | 0.92 | 0.14 | 0.52 |
| 2011 | 23 | 13 | 0.93 | 0.12 | 0.56 |
| 2012 | 23 | 11 | 0.93 | 0.10 | 0.72 |
| 2013 | 23 | 9 | 0.90 | 0.12 | 0.62 |
| 2014 | 23 | 11 | 0.92 | 0.11 | 0.70 |
| 2015 | 23 | 8 | 0.89 | 0.12 | 0.57 |
| 2016 | 23 | 11 | 0.94 | 0.11 | 0.58 |
| 2017 | 23 | 9 | 0.93 | 0.09 | 0.65 |
| 2018 | 23 | 10 | 0.94 | 0.07 | 0.72 |
| 2019 | 23 | 14 | 0.96 | 0.07 | 0.77 |
| 2020 | 23 | 9 | 0.94 | 0.09 | 0.74 |
| 2021 | 23 | 13 | 0.96 | 0.07 | 0.75 |
| 2022 | 23 | 14 | 0.96 | 0.08 | 0.76 |

Notes: Variable returns to scale technical efficiency (VRSTE) was calculated using the DEA method and the Vietnamese DEA add-in for Excel developed by Ngo (2015). Source: Compiled from the author's calculations.

**Table 4.** Descriptive statistics

| Variable | Obs | Mean | S.D. | Min | Median | Max |
|---|---|---|---|---|---|---|
| Tobin's Q | 142 | 0.98 | 0.06 | 0.83 | 0.98 | 1.15 |
| CRSTE | 359 | 0.88 | 0.13 | 0.37 | 0.92 | 1.00 |
| VRSTE | 359 | 0.94 | 0.10 | 0.52 | 1.00 | 1.00 |
| ROE | 413 | 0.11 | 0.09 | -0.56 | 0.10 | 0.44 |
| CRER | 350 | 0.01 | 0.01 | 0.00 | 0.01 | 0.04 |
| MAKR | 354 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| LIQR | 355 | 0.91 | 0.24 | 0.23 | 0.89 | 2.51 |
| SIZE | 376 | 17.92 | 1.53 | 11.88 | 18.09 | 21.32 |
| GDP | 413 | 0.06 | 0.01 | 0.03 | 0.06 | 0.08 |
| INF | 413 | 0.07 | 0.06 | 0.01 | 0.04 | 0.23 |
| CREPRI | 413 | 0.93 | 0.18 | 0.60 | 0.90 | 1.26 |

Source: Calculations by the author based on the dataset and using Stata software.

Table 5 describes the correlation matrix among the variables used in the research model. All correlation coefficients are below 0.8, suggesting that the estimation models are unlikely to encounter severe multicollinearity (Gujarati & Porter, 2009).

**Table 5.** Correlation matrix of variables

| | Tobin's Q | CRSTE | VRSTE | ROE | CRER | MAKR | LIQR | SIZE | GDP | INF | CREPRI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tobin's Q | 1.000 | | | | | | | | | | |
| CRSTE | 0.283 | 1.000 | | | | | | | | | |
| VRSTE | 0.063 | 0.679 | 1.000 | | | | | | | | |
| ROE | 0.000 | 0.153 | 0.345 | 1.000 | | | | | | | |
| CRER | 0.059 | -0.043 | 0.074 | 0.062 | 1.000 | | | | | | |
| MAKR | -0.259 | -0.092 | -0.121 | -0.375 | 0.022 | 1.000 | | | | | |
| LIQR | 0.094 | 0.476 | 0.277 | 0.108 | -0.243 | 0.052 | 1.000 | | | | |
| SIZE | 0.148 | 0.108 | 0.191 | 0.315 | 0.472 | -0.108 | -0.206 | 1.000 | | | |
| GDP | -0.305 | -0.012 | -0.019 | -0.022 | -0.104 | 0.004 | 0.056 | -0.152 | 1.000 | | |
| INF | -0.541 | -0.193 | 0.008 | -0.012 | -0.027 | 0.210 | 0.095 | -0.364 | 0.010 | 1.000 | |
| CREPRI | 0.664 | 0.268 | 0.089 | 0.158 | 0.066 | -0.104 | 0.066 | 0.529 | -0.305 | -0.485 | 1.000 |

Source: Calculations by the author based on the dataset and using Stata software.

### Estimation Methods

The study employs panel data estimation methods, including the fixed effects model (FEM) and the random effects model (REM). The Hausman test is then conducted to choose the appropriate estimation model. We also apply tests to check for heteroscedasticity and autocorrelation. We will use more suitable estimation methods if these issues are present. Additionally, Saif-Alyousfi (2020) suggests that factors affecting bank shareholder value may be biased due to endogeneity and omitted variables. Therefore, Saif-Alyousfi (2020) recommends using the generalized method of moments (GMM) to ensure more reliable estimation results, as this method effectively addresses endogeneity and heteroscedasticity issues. In this case, the lagged values of the independent variables are used as instruments. The GMM method is also used in other studies (Fiordelisi & Molyneux, 2010; Fu et al., 2014). Therefore, we will use the GMM estimation method with instruments that are all independent variables that lag by 1 to 2 years. Moreover, our dataset includes 23 banks (N) over 17 years (T) (from 2006 to 2022). Given the small sample size (N) and the not-too-long period (T), we prioritize the difference GMM method as it is more effective than the system GMM method (Roodman, 2009). The difference GMM method is also one of the choices for estimating the regression model in Saif-Alyousfi (2020).

## Results and Discussion

Table 6 presents the results of the impact of bank efficiency on shareholder value using the FEM and REM estimation methods in panel data. The Hausman test indicates that REM is more appropriate than FEM. However, the Breusch and Pagan test results suggest that the estimation models in Table 6 face heteroscedasticity issues, leading to unreliable estimation results.

Table 7 presents the estimation results of the impact of bank efficiency on shareholder value using the two-step difference GMM estimation method. The AB test AR(1) has a p-value of less than 0.05, and the AB test AR(2) has a p-value greater than 0.1 in models 3 and 4. This indicates no second-order autocorrelation. Additionally, the Hansen test has a p-value greater than 0.1, indicating that the instruments used in the model are appropriate. Thus, the estimation results using the two-step difference GMM method in Table 7 are reliable. We will use the results in Table 7 to discuss the research findings.

The estimated coefficients for the CRSTE and VRSTE variables are positive and statistically significant in models 3 and 4 in Table 7. This indicates that constant returns to scale technical efficiency and variable returns to scale technical efficiency are positively related to shareholder value. In other words, bank technical efficiency positively impacts shareholder value. This result aligns with our expectations and with most previous studies (Alsharif, 2021; Fiordelisi & Molyneux, 2010; Fu et al., 2014; Hoang et al., 2020; Sufian & Majid, 2009). The findings of this study suggest that in the context of Vietnam, any improvement in technical efficiency in banking operations plays a crucial role in increasing shareholder value.

**Table 6.** Impact of bank efficiency on shareholder value using FEM and REM estimation methods

| | Model 1 | | | | Model 2 | | | |
|---|---|---|---|---|---|---|---|---|
| | FEM | | REM | | FEM | | REM | |
| | Coef. | P -value | Coef. | P -value | Coef. | P -value | Coef. | P -value |
| CRSTE | 0.149*** | 0.001 | 0.135*** | 0.001 | | | | |
| VRSTE | | | | | 0.138** | 0.021 | 0.124** | 0.023 |
| ROE | 0.054 | 0.471 | 0.027 | 0.697 | 0.066 | 0.390 | 0.035 | 0.627 |
| CRER | -1.145 | 0.204 | -1.158 | 0.168 | -0.935 | 0.308 | -0.988 | 0.247 |
| MAKR | -21.652 | 0.155 | -23.918* | 0.090 | -28.656* | 0.064 | -30.233** | 0.034 |
| LIQR | -0.097*** | 0.003 | -0.080*** | 0.007 | -0.070** | 0.023 | -0.056** | 0.047 |
| SIZE | 0.016 | 0.172 | 0.010 | 0.212 | 0.016 | 0.189 | 0.010 | 0.219 |
| GDP | -0.538*** | 0.000 | -0.542*** | 0.000 | -0.520*** | 0.000 | -0.524*** | 0.000 |
| INF | -0.171 | 0.152 | -0.170 | 0.135 | -0.351*** | 0.003 | -0.330*** | 0.003 |
| CREPRI | 0.156*** | 0.000 | 0.177*** | 0.000 | 0.153*** | 0.000 | 0.174*** | 0.000 |
| _cons | 0.519** | 0.013 | 0.617*** | 0.000 | 0.507** | 0.022 | 0.606*** | 0.000 |
| Sample period | 2006 - 2022 | | 2006 - 2022 | | 2006 - 2022 | | 2006 - 2022 | |
| Observations | 142 | | 142 | | 142 | | 142 | |
| R_Square | 0.664 | | 0.662 | | 0.648 | | 0.645 | |
| F stat | 24.420 | | 230.290 | | 22.660 | | 216.890 | |
| Prob | 0.000 | | 0.000 | | 0.000 | | 0.000 | |
| Hausman Test | | | 0.910 | | | | 0.960 | |
| Breusch and Pagan test (p value) | | | 0.000 | | | | 0.000 | |
| Wooldridge test (p value) | | | 0.833 | | | | 0.691 | |

Notes: The dependent variable is Tobin's Q. The estimation methods used are fixed effects (FEM) and random effects (REM). *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Source: Calculations by the author based on the dataset and using Stata software.

**Table 7.** Impact of bank efficiency on shareholder value using the difference GMM method

| | Model 3 | | Model 4 | |
|---|---|---|---|---|
| | Coef. | P -value | Coef. | P -value |
| CRSTE | 0.052* | 0.098 | | |
| VRSTE | | | 0.146** | 0.013 |
| ROE | 0.331*** | 0.000 | 0.242*** | 0.000 |
| CRER | 0.420 | 0.470 | -0.409 | 0.369 |
| MAKR | -13.530** | 0.019 | -8.831 | 0.174 |
| LIQR | -0.058** | 0.025 | -0.071** | 0.012 |
| SIZE | 0.014* | 0.053 | 0.026*** | 0.001 |
| GDP | -0.578*** | 0.000 | -0.587*** | 0.000 |
| INF | -0.428*** | 0.000 | -0.422*** | 0.000 |
| CREPRI | 0.102*** | 0.000 | 0.107*** | 0.000 |
| Sample period: | 2006 - 2022 | | 2006 - 2022 | |
| Number of banks | 23 | | 23 | |
| Observations: | 120 | | 120 | |
| AB test AR(1) p value | 0.045 | | 0.040 | |
| AB test AR(2) p value | 0.778 | | 0.666 | |
| Hansen test (2nd step; p-value) | 0.312 | | 0.253 | |

Notes: The dependent variable is Tobin's Q. The estimation method used is the two-step difference GMM. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Source: Calculations by the author based on the dataset and using Stata software.

The results in models 3 and 4 in Table 7 show that bank characteristics impact shareholder value differently. The regression coefficient for ROE is positive and statistically significant in all models, indicating that a higher return on equity reflects better performance and positively affects shareholder value. This result aligns with our expectations and is consistent with some previous studies (Pennacchi & Santos, 2021; Widjaja & Ariefianto, 2022). The regression coefficient for CRER is not statistically significant in any of the models, indicating no evidence that credit risk affects shareholder value in the context of Vietnamese commercial banks. This finding is similar to previous studies (Fu et al., 2014; Widjaja & Ariefianto, 2022). The regression coefficient for

MAKR is negative and statistically significant in model 3 and insignificant in model 4, indicating that market risk from investing in financial assets causes substantial losses to shareholder value. This result is consistent with Fiordelisi and Molyneux (2010). The regression coefficient for LIQR is negative and statistically significant in all models in Table 7. This supports the view of Hoang et al. (2020)Increasing the loan-to-deposit ratio can lead to higher bank risk and lower shareholder value. The regression coefficient for SIZE is positive and statistically significant, indicating that in the case of Vietnam, larger banks can better leverage economies of scale, achieving more benefits in terms of profits and risks, thus increasing shareholder value. These results are like previous studies (Fiordelisi & Molyneux, 2010; Fu et al., 2014).

The estimation results in Table 7 also show that macroeconomic factors have distinct impacts on shareholder value. Specifically, the regression coefficient for GDP is negative and statistically significant in all models in Table 7, indicating that high economic growth rates tend to negatively affect bank shareholder value. This finding is consistent with our expectations and with the results of some previous studies (Fiordelisi & Molyneux, 2010; Hoang et al., 2020). The regression coefficient for INF is negative and statistically significant in all models in Table 7. In other words, inflation represents economic challenges and negatively impacts shareholder value. This finding is consistent with some previous studies (Dietrich & Wanzenried, 2014; Saif-Alyousfi, 2020). Finally, the regression coefficient for CREPRI is positive and statistically significant in all models in Table 7. This result contrasts with our expectation that credit to the private sector negatively impacts shareholder value. Instead, credit to the private sector has increased shareholder value, consistent with Naceur and Omran (2011). This can be explained by the fact that increased credit to the private sector may allow banks to expand their reach and attract more customers, thereby creating more benefits and increasing shareholder value.

### Robustness Checks

To test the robustness and reliability of the impact of bank efficiency on shareholder value, we use the market-to-book ratio (MB) as an alternative dependent variable for Tobin's Q to represent shareholder value, like the approach of Fu et al. (2014). The regression results of the impact of bank efficiency on shareholder value using the market-to-book ratio (MB) are presented in Table 8. The results in Table 8 are almost entirely consistent with those in Table 7. Thus, the findings on the positive impact of bank efficiency on shareholder value are robust and reliable.

**Table 8.** Impact of bank efficiency on shareholder value using the market-to-book ratio (MB) as the dependent variable, estimated using the difference GMM method

| | Model 5 | | Model 6 | |
|---|---|---|---|---|
| | Coef. | P -value | Coef. | P -value |
| CRSTE | 0.418** | 0.048 | | |
| VRSTE | | | 1.658*** | 0.000 |
| ROE | 4.341*** | 0.000 | 3.193*** | 0.000 |
| CRER | 6.598 | 0.498 | -1.576 | 0.879 |
| MAKR | -287.704*** | 0.000 | -227.202*** | 0.000 |
| LIQR | -0.147 | 0.315 | -0.395* | 0.055 |
| SIZE | 0.089* | 0.098 | 0.240*** | 0.003 |
| GDP | -8.118*** | 0.000 | -7.353*** | 0.000 |
| INF | -4.088*** | 0.000 | -3.605*** | 0.000 |
| CREPRI | 1.028*** | 0.000 | 1.089*** | 0.000 |
| Sample period: | 2006 - 2022 | | 2006 - 2022 | |
| Number of banks | 23 | | 23 | |
| Observations: | 120 | | 120 | |
| AB test AR(1) p value | 0.016 | | 0.009 | |
| AB test AR(2) p value | 0.160 | | 0.352 | |
| Hansen test (2nd step; p-value) | 0.381 | | 0.239 | |

Notes: The dependent variable is the market-to-book ratio (MB). The estimation method used is the two-step difference GMM. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Source: Calculations by the author based on the dataset and using Stata software.

## Conclusion

This study evaluates the impact of bank efficiency on shareholder value in the context of Vietnamese commercial banks. The sample includes 23 banks, with data collected from 2006 to 2022. Technical efficiency was measured using the DEA input cost minimization method, with three input factors: total assets, deposits, and personnel expenses, and three output factors: total loans, income, and profit before tax. We use panel data estimation techniques, including the fixed effects model (FEM), random effects model (REM), and two-step difference generalized method of moments (GMM) to regress the research models. Our results indicate that bank efficiency positively impacts shareholder value.

Furthermore, bank characteristics have distinct impacts on shareholder value; for instance, return on equity and bank size positively affect shareholder value, while market risk and liquidity risk negatively impact shareholder value, and credit risk shows no evidence of impact on shareholder value. Similarly, macroeconomic factors have different impacts on shareholder value, with GDP growth rate and inflation rate negatively affecting shareholder value, while credit to the private sector positively impacts shareholder value. Based on the findings, we recommend that Vietnamese bank managers focus on improving the technical efficiency of their banks. An effective operational policy, minimizing costs, and maximizing the utilization of resources to increase output products and services will create more value for bank shareholders.

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# Bank-specific determinants of explicit deposit insurance adoption: A global analysis

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**Abstract**

**Purpose** — The adoption of explicit deposit insurance has increased significantly over the past two decades, yet there is limited evidence on how bank-specific factors influence this decision. This study addresses this gap by investigating the determinants of explicit deposit insurance adoption.

**Method** — This study uses 25 years of unbalanced data from 107 countries and a probit model to identify the key factors influencing the adoption of the financial safety net.

**Findings** — The analysis reveals that bank-specific factors significantly influence the decision to implement explicit deposit insurance. However, bank capitalization does not significantly impact the decision. Additionally, regulatory quality, economic growth, and financial crises are critical determinants of the adoption decision. The likelihood of adopting explicit deposit insurance also varies considerably across different income groups in countries.

**Implications** — The study provides valuable insights for policymakers on the factors to consider when implementing this financial safety net.

**Originality** — This study contributes to the existing literature by highlighting the previously overlooked role of bank-specific factors in adopting explicit deposit insurance.

**Keywords** — Explicit Deposit Insurance; bank-specific factors; regulatory quality; global banking; probit

## Introduction

Deposit insurance is a safeguard mechanism established by governments or specialized institutions to protect depositors' funds in case of a bank failure (Dubey, 2018). It ensures that depositors do not lose their money up to a predefined limit, thereby sustaining public confidence in the banking system. Explicit deposit insurance schemes (EDI) are those where the terms, limits, and conditions are clearly defined and publicly communicated, as opposed to implicit schemes where the government's backing is assumed but not explicitly guaranteed. Explicit deposit insurance schemes are implemented to promote financial stability (Anginer & Demirguc-Kunt, 2018). Over the past 25 years, a notable global trend has been toward adopting explicit deposit insurance schemes (Van Roosebeke & Defina, 2022). This period has been marked by several significant financial crises, including the global financial crisis 2008, the European sovereign debt crisis, and the Asian financial crisis of the late 1990s. Over two-thirds of countries have experienced one or more banking crises

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in recent years (Barth, Nguyen, & Xu, 2021). These events profoundly influenced the adoption and design of deposit insurance systems worldwide. However, despite these advancements, many countries still do not have explicit deposit insurance. According to the latest data, approximately 50 countries have yet to implement such schemes, leaving their banking sectors and depositors more vulnerable to financial instability. Deposit insurance is crucial for maintaining financial stability, preventing bank runs, and protecting depositors' savings. During periods of financial distress, such as the global financial crisis 2008, deposit insurance schemes were pivotal in restoring confidence in the banking system. Understanding the determinants of explicit deposit insurance adoption is essential to developing effective financial policies and regulatory frameworks.

In an era of globalization and global banking, the bank sector's contagions and cross-country instability spillovers are evident; understanding what factors countries investigate before taking the explicit deposit insurance scheme leap is essential. Although significant literature is available on deposit insurance, its focus has been on understanding how such schemes help improve stability in the banking sector amidst the debate on moral hazard and market discipline. There is a dearth of literature on what factors matter for its adoption. The limited empirical evidence focuses on macroeconomic factors, and little work has been done on micro foundations (Cull, Senbet, & Sorge, 2002; Demirgüç-Kunt, Kane, & Laeven, 2008; Qian, Zhang, & Zheng, 2017). Previous studies indicate that various factors influence the adoption and design of explicit deposit insurance schemes. Economic development, crisis pressures, and political institutions play significant roles (Demirgüç-Kunt et al., 2008). Deposit insurance is more common in democratic systems, although it may be poorly designed, particularly in times of crisis or when copying other nations (Demirgüç-Kunt et al., 2008). While deposit insurance may increase confidence in the financial sector, it can also facilitate risk-taking, potentially negatively impacting financial system health (Cull et al., 2002). The adoption of deposit insurance is more likely when it is publicly administered, privately funded, has non-risk-rated premiums, and compulsory membership. Other factors include a larger deposit market, diverse banking groups, lower government ownership of banks, and higher economic freedom (Chu, 2021). Empirical literature has overlooked the role of the banking sector as an economic agent in the decision to adopt explicit deposit insurance schemes. This study addresses this gap by analyzing global banking data from the past 25 years. We answer the question of what bank-specific, economic, regulatory, political, and institutional factors influence the adoption of explicit deposit insurance schemes.

Research suggests that explicit deposit insurance (EDI) schemes can positively and negatively affect banking stability during financial crises. While EDI adoption may increase moral hazard and risk-taking (Prabha & Wihlborg, 2008). It can also stabilize bank lending and mitigate the impact of a crisis (Hasan, Liu, Saunders, & Zhang, 2022). The effectiveness of EDI depends on factors such as the level of financial liberalization and the design of the insurance scheme (Demirgüç-Kunt et al., 2008; Maysami & Sakellariou, 2008). Countries with democratic systems are more likely to adopt EDI but may design it poorly, primarily when implemented during crises or due to external pressures. The relationship between EDI coverage and risk-taking is U-shaped, suggesting that an optimal level of coverage exists (Prabha & Wihlborg, 2008). While EDI can be beneficial, its implementation requires careful consideration of institutional factors and design elements to maximize its effectiveness in crisis mitigation. We test for institutional factors that matter when it comes to EDI adoption. There is a difference in regional adoption of EDI. Finally, we test whether income classifications matter when adopting explicit deposit insurance.

The main goal of this study is to determine and examine the factors that influence the adoption of explicit deposit insurance across different countries over the past 25 years. What bank-specific, economic, political, and institutional factors influence the adoption of explicit deposit insurance schemes? How do financial crises affect the likelihood of adopting explicit deposit insurance? Since data suggests that DI adoption varies across countries of different income classifications, with the high-income group countries having the highest percentage of EDI adoption while the lower-income group having the lowest adoption percentage, we finally test if income matters in the adoption decision of explicit deposit insurance.

The current research utilizes a comprehensive global banking dataset that includes information on deposit insurance schemes, banking sector performance, and macroeconomic indicators for over 107 countries from 1999 to 2023, enabling an examination of the long-term trends and impact of major financial events. This study employs a probit regression model to investigate the key determinants of explicit deposit insurance adoption. The probit model is particularly suited for this analysis, as it allows for modeling binary dependent variables, in this case, the presence or absence of explicit deposit insurance. This study also uses an event study methodology to assess the impact of financial crises on the likelihood of adoption.

This study contributes to the theoretical understanding of financial stability and regulation by providing empirical evidence of the factors driving the adoption of explicit deposit insurance schemes. We extend the existing literature by incorporating various banking, economic, political, and institutional variables. This study's findings have significant implications for policymakers and regulators. Identifying the key determinants of deposit insurance adoption provides insights into how countries make this decision.

Deposit insurance has been a subject of considerable debate in the literature. Its effectiveness in ensuring bank stability regarding moral hazard and market discipline has been extensively studied. Some studies suggest that the introduction of deposit insurance reduces risk-taking. Gropp and Vesala (2004) argue that deposit insurance mitigates moral hazard by setting safety net limits, thereby reducing risk-taking. Similarly, Lopez-Quiles and Petricek (2018) demonstrate that increased insurance does not lead to higher risk-taking or reduced market discipline, as evidenced by the lack of impact on banks' deposit rates. Mumtaz and Jadoon (2018) provide evidence from an analysis of 2,196 banks across 125 countries, indicating that deposit insurance is associated with reduced risk-taking. Chiaramonte, Girardone, Migliavacca, and Poli (2020) also find that deposit insurance schemes do not increase risk-taking in banks, and moral hazards can be countered using temporary blanket guarantees.

Contrarily, other studies highlight the potential for deposit insurance to incentivize risk-taking. Keeley (1990) suggests that explicit deposit insurance encourages moral hazard without stringent regulations and increases risk-taking. Lé (2013) finds that deposit insurance increases insolvency risk by promoting higher leverage and reducing capital, with larger banks being less responsive to the safety net. Demirgüç-Kunt and Huizinga (2004) It also suggests that explicit deposit insurance reduces market discipline. Karas, Pyle, and Schoors (2021) observed that introducing deposit insurance led to increased risk-taking due to a decline in market discipline. Kim and Rezende (2023) also argue that insurance premiums impact bank margins and balance sheets, inducing a "search for yield." Additionally, Qian, Zhang, Zheng, and Ashraf (2019) suggest that competition induces risk-taking in banks, and explicit deposit insurance becomes ineffective under excessive scenarios.

Prabha and Wihlborg (2008) propose that the relationship between risk and insurance is U-shaped when analyzed in the context of insurance coverage, with institutional characteristics acting as essential moderators. Other factors also influence the relationship between deposit insurance and risk. Qian et al. (2019) noted that risk premiums are higher in uninsured countries. During the COVID-19 pandemic, systemic risk was aggravated in many countries (Yan, Jeon, & Wu, 2023), with central bank interventions potentially exacerbating moral hazard behavior. The pandemic negatively impacted global bank profitability and stability, with significant variations in response based on the type of banking system (Elnahass, Trinh, & Li, 2021; Xiazi & Shabir, 2022). High leverage, loan ratios, and undercapitalization made banks more vulnerable during the crisis, and insurance was found to moderate these relationships (Ben-Ammar, 2024a; Duan, El Ghoul, Guedhami, Li, & Li, 2021). Banks with explicit deposit insurance experienced faster recovery and smaller increases in bank spreads (Hasan et al., 2022).

Research indicates that stringent capital regulation generally reduces bank default risk, an effect strengthened by explicit deposit insurance during crises (Ashraf, Zheng, Jiang, & Qian, 2020). Bank risk-taking is positively associated with shareholder power within corporate governance structures, and the impact of regulations on risk varies with ownership concentration. Increased competition in banking can lead to higher default risk through increased asset risk and reduced

capital (Keeley, 1990). While generous deposit insurance schemes increase bank risk during stable periods, they contribute to lower bank risk and better systemic stability during crises. Adequate bank supervision can mitigate the unintended consequences of deposit insurance on systemic risk during stable periods (Anginer, Demirguc-Kunt, & Zhu, 2014).

Islamic banking presents unique challenges and considerations regarding deposit insurance. Hamisu and Hassan (2017) suggest that Islamic banking is generally compatible with traditional deposit insurance, and some propose integrating takaful principles with traditional systems (Fendi, 2020). However, Islamic banks are advised to have a higher potential for moral hazard (Oktarina, Fahmi, & Beik, 2019). Mili and Abid (2017) find that Islamic banks with low franchise values are more prone to risk-taking. Kabir et al. (2022) analyze Islamic and conventional banks in Bangladesh, finding similar credit risk behaviors. Grassa et al. (2022) compare Islamic and conventional banks. It is noted that government support in improving capitalization and market discipline is less effective for Islamic banks due to their risk-sharing characteristics. Political stability, proxied by government stability, the absence of internal conflicts, and democratic rights, can moderate the risk-deposit insurance relationship (Anginer et al., 2014). Politics also influences banks' lobbying for increased insurance coverage (Laeven, 2004).

Previous studies suggest that capital regulation and deposit insurance are essential in moderating bank risk and capital ratios. Bank default risk is decreased by strict capital regulations, especially in nations where deposit insurance is explicitly provided during times of crisis (Ashraf et al., 2020). However, the relationship between capital requirements and risk behavior differs between conventional and Islamic banks. Conventional banks show a negative link between increased capitalization and credit risk only for banks with high market power, while Islamic banks are less sensitive to market competition. The introduction of deposit insurance influences the relationship between bank capital and liquidity creation, especially for banks with high household deposit ratios, reducing the impact of capital on liquidity creation.

Research has also focused on factors needed for making deposit insurance schemes effective and identified factors like legislation, depositor confidence, and risk-adjusted premiums as essential factors (Chen & Shen, 2023; Tofan, 2022). The EDI can become manipulated by larger influential banks (Suljić Nikolaj, Olgić Draženović, & Buterin, 2022).

Empirical evidence on the determinants of the adoption of deposit insurance is limited. Chu (2021) developed a model of deposit insurance that suggests that administration, funding sources, risk premiums, banking sector ownership, and economic and political freedom would influence deposit insurance adoption. Their model does not focus specifically on the role of bank-specific factors either. Democracy, risk, financial crisis, and external pressures are suggested to improve the probability of deposit insurance adoption (Demirgüç-Kunt et al., 2008). Stable economies, financial crises, strong legal systems, real per capita GDP, and regional adoption of EDI also impact the decision to adopt the system (Cull et al., 2002). Greater government effectiveness, less privatization, and lower financial liberalization also increase the likelihood of EDI adoption (Ji, Bian, & Huang, 2018).

There is limited evidence on how bank-specific factors impact the adoption decision. The size of the bank plays a critical role; larger banks with more extensive deposit bases are more likely to support the adoption of deposit insurance to protect their extensive customer bases (Demirgüç-Kunt et al., 2008). Second, higher bank capitalization is predicted to increase the likelihood of DI adoption (Demirgüç-Kunt et al., 2008). How profitability, risk-taking, liquidity management, and operations impact the adoption decision is unclear. This paper tries to answer this question.

## Methods

We extend (Demirgüç-Kunt et al., 2008) and use a probit model for the analysis. The choice of probit as the estimation technique is grounded on its ability to analyze discrete choice data and estimate probabilities of binary or categorical outcomes. Probit models effectively address correlated binary responses within longitudinal or clustered datasets. They can accommodate person-specific or cluster-specific effects, rendering them highly suitable for analyzing repeated

measurements or grouped data (Gibbons & Hedeker, 1994). Their model fails to model important bank-specific factors, which this study includes in the analysis. The mathematical form is as follows

$$\mathrm{P(EDI = 1|X) = f(B, E, R, P)} \quad (1)$$

where B is bank-specific factors, E is economic factors, R is regulatory factors, and P is political factors. The econometric model follows the following function form.

$$\begin{aligned}\mathrm{P(EDI = 1|X)} = \Phi\big(&\beta_0 + \beta_1 BankSize_{i,c,t} + \beta_2 NPL_{i,c,t} + \beta_3 DepositRatio_{i,c,t} + \\ &\beta_4 LoanRatio_{i,c,t} + \beta_5 Liquidity_{i,c,t} + \beta_6 KA_{i,c,t} + \beta_7 NonOperEx_{i,c,t} + \\ &\beta_8 ROA_{i,c,t} + \beta_9 PoliticalStability_{c,t} + \beta_{10} RegulQuality_{c,t} + \\ &\beta_{11} OilRenttoGDP_{c,t} + \beta_{12} GDPgrowth_{c,t} + \beta_{13} Crisis + \\ &\beta_{14} IncomeClassification_c\big)\end{aligned} \quad (2)$$

whereas,

β is the coefficient of the independent variables representing the changes in Z score for a unit change in the independent variable, and the standard normal distribution's cumulative distribution function (or CDF) is denoted as Φ. The subscripts *i*, *c*, and *t* represent individual banks, countries, and time. EDI represents a binary (0, 1) variable indicating the presence of explicit deposit insurance. The explicit deposit insurance (EDI) data is taken from the WDI database.

**Table 1:** List of Countries

| | | | |
|---|---|---|---|
| **Lower Income** | Sudan | Russia | Kuwait |
| Benin | Ukraine | South Africa | Liechtenstein |
| Burkina Faso | Vietnam | Thailand | Malta |
| Malawi | Zambia | Tunisia | Namibia |
| Mali | | Turkey | Netherlands |
| Niger | **Upper Middle** | Venezuela | New Zealand |
| Rwanda | Argentina | | Norway |
| Tanzania | Bahrain | **Higher Income** | Oman |
| Togo | Brazil | Australia | Portugal |
| Uganda | Bulgaria | Austria | Puerto Rico |
| Zimbabwe | China (Mainland) | Belgium | Qatar |
| | Colombia | Bermuda | Saudi Arabia |
| **Lower Middle Income** | Croatia | Canada | Singapore |
| Bangladesh | Cyprus | Cayman Islands | Slovakia |
| Botswana | Ecuador | Chile | Slovenia |
| Egypt | Estonia | Czech Republic | South Korea |
| Ghana | Kazakhstan | Denmark | Spain |
| India | Lebanon | Faroe Islands | Sweden |
| Indonesia | Lithuania | Finland | Switzerland |
| Ivory Coast | Malaysia | France | Taiwan |
| Jamaica | Mauritius | Germany | Trinidad and Tobago |
| Jordan | Mexico | Greece | United Arab Emirates |
| Kenya | Panama | Greenland | United Kingdom |
| Morocco | Peru | Guam | United States |
| Nigeria | Poland | Hong Kong | |
| Pakistan | Romania | Hungary | |
| Palestinian Territories | Mexico | Iceland | |
| Papua New Guinea | Panama | Ireland | |
| Philippines | Peru | Israel | |
| Senegal | Poland | Italy | |
| Sri Lanka | Romania | Japan | |

The bank-specific variables include bank size, nonperforming loans ratio, deposit ratio, loan ratio, liquidity, capitalization, non-operational expenditures, and profitability. The source of

bank-specific data is the LSE workspace. Larger banks are expected to improve the probability of EDI adoption. Demirgüç-Kunt et al. (2008) use size and capitalization in their study; they found that higher capitalization and larger size increase the likelihood of EDI adoption. Higher nonperforming loans proxy higher banking sector instability through risk-taking. The possibility of adopting EDI is ambiguous because of the underly moral hazard and market discipline hypothesis. Higher deposits are expected to increase the probability of EDI adoption. Higher lending ratios are also expected to increase the likelihood of EDI adoption. Improved liquidity positions of banks indicate higher stability and increase the probability of EDI adoption.

Various political and economic factors influence the adoption of deposit insurance (Chu, 2021). The macroeconomic variables included in the model are regulatory quality, political stability, GDP growth rates, and oil rent to GDP. We include a dummy variable for the crisis period, which takes a value of 1 during the global financial crisis (2007 to 2009) and the Covid-19 crisis (2020 to 2021) to proxy crisis periods. The data source for macroeconomic variables is the World Development Indicators Database.

Annual data from 1999 to 2023 from all the world's banks (107 countries) were used. Table 1 shows the list of countries included in the analysis, which are classified by World Bank income classification. Due to missing values, the panel was unbalanced. Table 2 summarizes the descriptive statistics of all variables in the model. For example, the EDI value is 0.82, meaning that 82% of the countries in the sample have adopted EDI.

**Table 2.** Descriptive Statistics

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| EDI | 38674 | 0.82 | 0.384 | 0 | 1 |
| Bank Size | 27147 | 22.401 | 2.194 | 5.631 | 30.487 |
| Log (NPL) | 22481 | -0.8 | 1.468 | -6.908 | 10.653 |
| Deposit Ratio | 27117 | 0.898 | 0.34 | 0 | 50.854 |
| Loan Ratio | 26093 | 0.672 | 4.038 | -13.144 | 650.776 |
| Liquidity Ratio | 27089 | -1.706 | 0.547 | -6.446 | 0.203 |
| KA | 26626 | 0.022 | 0.052 | -0.08 | 6.358 |
| Non-Operating Expense Ratio | 26877 | 19.248 | 2.578 | 4.317 | 29.128 |
| ROA | 30340 | 1.009 | 1.674 | -29.19 | 46.13 |
| Political Stability | 33295 | 0.101 | 0.815 | -2.81 | 1.964 |
| Regulatory Quality | 33283 | 0.81 | 0.864 | -2.387 | 2.252 |
| Oil Rent to GDP | 34700 | 2.147 | 6.344 | 0 | 58.369 |
| GDP growth | 37766 | 3.084 | 3.218 | -28.759 | 26.17 |
| Crisis Period | 38674 | 0.16 | 0.367 | 0 | 1 |

## Results and Discussion

Table 3 reports the estimation results of equation (2), while the average marginal effects are reported in column 3. The literature has primarily ignored bank-specific factors that may influence a country's decision to adopt explicit deposit insurance (EDI). We find that bank-specific factors are essential in this decision. Bank size, loan ratio, and liquidity ratio have a significant positive impact on EDI adoption, whereas NPL, non-operating expense ratio, and ROA negatively impact the probability of EDI adoption.

Financial instability decreases the probability of EDI adoption (Cull et al., 2002). The bank-specific marginal effects can be interpreted in line with how they affect the overall stability of the financial sector. The results suggest countries' likelihood of adopting EDI increases with bank size. The marginal effects show a 3.5% increase in probability due to increased bank size. Demirgüç-Kunt et al. (2008) model small banks and find that the probability of adoption of EDI is lower when banks are small, which is consistent with our findings. With increasing size, the banking sector's vulnerability arises in the case of bank runs. It burdens the economy, as suggested by the too-big-to-fail hypothesis. Among bank-specific factors, bank size has the most significant

magnitude. Chu (2021). It also indicates that larger deposit markets will increase adoption probabilities.

**Table 3.** Probit Estimation Results and Marginal Effects

| Deposit Insurance Dummy | Model 1<br>Coef./(Std.Err) | Average Marginal Effects<br>(dy/dx)/(Std.Err) |
|---|---|---|
| Bank Specific | | |
| Bank Size | 0.213*** | 0.035*** |
| | (0.018) | (0.003) |
| Log (Non-Performing Loans) | -0.045*** | -0.007*** |
| | (0.012) | (0.002) |
| Deposit Ratio | 0.363 | 0.059 |
| | (0.270) | (0.044) |
| Loan Ratio | 0.150** | 0.025 ** |
| | (0.075) | (0.012) |
| Liquidity Ratio | 0.095** | 0.016 *** |
| | (0.029) | (0.005) |
| Capital To Equity | 0.019 | 0.003 |
| | (0.180) | (0.029) |
| Non-Operating Expense Ratio | -0.209*** | -0.034 *** |
| | (0.016) | (0.003) |
| ROA | -0.048*** | -0.008 *** |
| | (0.009) | (0.001) |
| Macroeconomic | | |
| Political Stability | 0.023 | 0.004 |
| | (0.023) | (0.004) |
| Regulatory Quality | 0.614*** | 0.100 *** |
| | (0.039) | (0.006) |
| Oil Rent to GDP (Oil import reliance) | -0.065*** | -0.011 *** |
| | (0.003) | (0.000) |
| GDP growth | -0.024*** | -0.004 *** |
| | (0.004) | (0.001) |
| Crisis Period | 0.078** | 0.013 ** |
| | (0.036) | (0.006) |
| Income Classifications | | |
| Low income | 0.376** | 0.061 ** |
| | (0.126) | (0.02) |
| Lower middle income | 0.651*** | 0.106 *** |
| | (0.073) | (0.012) |
| Upper middle income | 0.364*** | 0.059 *** |
| | (0.058) | (0.009) |
| Constant | -0.211 | |
| | (0.271) | |
| Pseudo r-squared | 0.292 | |
| Chi-square | 4169.741 | |
| Akaike crit. (AIC) | 10163.543 | |
| Number of observations | 16851 | |

Note: ***, **, * indicate significant at 0.1, 0.5, and 0.10 level.

The safety nets are suggested to be effective when the country has firm regulatory control. The increase in non-performing loans indicates excessive risk-taking by banks (Prabha & Wihlborg, 2011). We find that the probability of countries adopting explicit insurance falls when excessive risk-taking occurs. A lower chance of deposit insurance adoption is linked to higher percentages of non-performing loans. Similarly, the value of the marginal effect for NPL, which is -0.007, indicates that NPL decreases the probability of adopting deposit insurance. The likelihood of having deposit insurance decreases by 0.7% for every unit increase in NPL. A negative correlation exists between higher non-performing loan levels and deposit insurance probability. Deposit

insurance can induce banks to take on more risky loans, knowing their deposits are protected. This behavior aligns with the moral hazard theory, which predicts that the presence of insurance can lead to increased risk-taking. Introducing deposit insurance safety nets may increase the moral hazard behavior in high-risk-taking.

Higher loan ratios also increase the probability of EDI adoption in countries. Like the loan ratio, improved liquidity management positively impacts the likelihood of adopting explicit deposit insurance. The average marginal effects suggest that their liquidity ratios have a 1.6% marginal impact on the adoption decision. It is important to note that although the results indicate that an improved liquidity position or healthier banks would improve the probability of EDI adoption, EDI adoption will also reduce liquidity risks (Moyo & Mukorera, 2022). So, healthy lending ratios in the banking sector increase the likelihood of adopting explicit deposit insurance. Bank profitability is negatively associated with EDI adoption. However, the size is less than 1%. According to Demirgüç-Kunt et al. (2008), bank capitalization plays a significant role in influencing the decision to implement deposit insurance. Literature suggests a negative moderating role of capital on deposit insurance and the relationship between stability and stability (Ben-Ammar, 2024b). However, interestingly, we do not find that capital ratios significantly impact the decision to adopt the safety net.

Regulatory quality ensures that the explicit deposit insurance schemes do not induce excessive risk-taking due to a lack of market discipline and moral hazard. We find that a unit increase in regulatory quality improves the probability of EDI adoption by 10%, which is a significant positive impact. Qian et al. (2019) find similar results and show that high regulatory ability and competition enhance the probability of EDI adoption.

Oil rent to GDP is a proxy to measure the country's dependence on oil imports and vulnerability to supply-side oil shocks. Excessive reliance on oil imports suggests excessive susceptibility to oil-based shocks. Higher import dependence reduces the probability of adopting the safety net. According to the value of marginal effects for GDP growth, which is -0.004, GDP growth decreases the probability of adoption of deposit insurance by 0.04%. It means that a nation's or financial system's chance of having deposit insurance falls with increasing GDP growth rates. The probability of having deposit insurance tends to be slightly less likely during periods of significant economic growth, according to the inverse link between GDP growth and that likelihood. Cull et al. (2002) find that positive real GDP per capita growth increases the probability of EDI adoption.

Cull et al. (2002) model the recent financial crisis as a factor of EDI adoption and find that the recent crisis also increases the impact of EDI adoption with a 27% marginal effect. In this study, we model the crisis period as a dummy variable that takes a value of 1 during the financial and COVID crises (Hasan et al., 2022). We find a similar impact of the financial crisis on the probability of explicit deposit insurance adoption. However, the average marginal effect is much smaller than in their study. It is important to note that evidence suggests that countries with explicit deposit insurance schemes could resist the negative consequences of financial crises (Hasan et al., 2022).

We find that lower-income countries are more likely to adopt explicit deposit insurance schemes than higher-income countries. In marginal terms, lower-middle-income countries are the most likely to adopt the scheme (Cull et al., 2002). We model the percentage of neighbors who have adopted explicit deposit insurance and find that the probability of adoption increases if neighboring countries have adopted the scheme, which is consistent with our findings.

## Robustness

Finally, we estimate a linear probability and logit model as a robustness test. Table 4 provides robustness estimates using a Logit model (Model 2), a Panel Linear Model (PLM), and their respective marginal effects. Across all models, bank size demonstrates a consistently positive and significant impact, with a higher magnitude in the Logit model than in the Probit model. Non-performing loans exhibit a significant adverse effect in all models, corroborating that higher non-

performing loans reduce the likelihood of deposit insurance adoption. Liquidity and non-operating expense ratios remain statistically significant, with the latter displaying a substantial negative impact across all models. Regarding macroeconomic variables, regulatory quality presents a substantial and statistically significant positive effect in all models, with the highest coefficient in the Logit model. Oil rent to GDP remains negative and highly significant across all models, indicating that countries dependent on oil rents are less likely to implement explicit deposit insurance. GDP growth consistently demonstrates a negative and significant effect, suggesting that robust economic growth diminishes the probability of deposit insurance adoption. Concerning income classifications, lower-income, lower-middle-income, and upper-middle-income categories all exhibit positive and significant effects in predicting deposit insurance, with the most pronounced impact observed in the Logit model.

**Table 4:** Robustness estimates using Logit and PLM

| Deposit Insurance Dummy | Logit Model 2 | Average Marginal Effects | PLM |
|---|---|---|---|
| | Coef./(Std.Err) | (dy/dx)/(Std.Err) | Coef./(Std.Err) |
| Bank Specific | | | |
| Bank Size | 0.433*** | 0.039*** | 0.036*** |
| | (0.036) | (0.003) | (0.003) |
| Log (Non-Performing Loans) | -0.078*** | -0.007*** | -0.007*** |
| | (0.022) | (0.002) | (0.002) |
| Deposit Ratio | 0.706 | 0.063 | 0.087* |
| | (0.52) | (0.046) | (0.045) |
| Loan Ratio | 0.231* | 0.021* | 0.000 |
| | (0.144) | (0.013) | (0.000) |
| Liquidity Ratio | 0.21*** | 0.019*** | 0.016*** |
| | (0.056) | 0.005 | (0.005) |
| Capital To Equity | 0.162 | 0.014 | 0.001 |
| | (0.032) | 0.028 | (0.046) |
| Non-Operating Expense Ratio | -0.424*** | -0.038*** | -0.035*** |
| | (0.032) | (0.003) | (0.002) |
| ROA | -0.096*** | -0.008*** | -0.015*** |
| | (0.019) | (0.002) | (0.002) |
| Macroeconomic | | | |
| Political Stability | 0.09* | 0.008** | 0.011** |
| | (0.045) | (0.004) | (0.005) |
| Regulatory Quality | 1.11*** | 0.099*** | 0.143*** |
| | (0.072) | (0.006) | (0.008) |
| Oil Rent to GDP (Oil import reliance) | -0.115*** | -0.01*** | -0.017*** |
| | (0.005) | (0.000) | (0.000) |
| GDP growth | -0.047*** | -0.004 *** | -0.005*** |
| | (0.008) | 0.001 | (0.001) |
| Crisis Period | 0.149** | 0.012** | 0.012** |
| | (0.066) | (0.006) | (0.006) |
| Income Classification | | | |
| Low income | 0.835*** | 0.074*** | 0.053* |
| | (0.223) | 0.02 | (0.028) |
| Lower middle income | 1.31*** | 0.117*** | 0.182*** |
| | (0.142) | (0.013) | (0.014) |
| Upper middle income | 0.819*** | 0.073*** | 0.121*** |
| | (0.113) | 0.01 | (0.011) |
| Constant | -0.637 | | 0.552*** |
| | 0.515 | | (0.047) |
| Pseudo R-squared/R Squared | 0.288 | | 0.287 |
| Chi-square / F-test | 4118.657 (Prob>chi2=0) | | 424.404 (Prob>F=0) |

| | | |
|---|---|---|
| Akaike crit. (AIC) | 10214.627 | |
| Number of obs | 16851 | 16851 |

Note: ***, **, * indicate significant at 0.1, 0.5, and 0.10 level.

## Conclusion

The study examined the influences of bank-specific, economic, regulatory, and institutional factors on the adoption of explicit deposit insurance schemes. We also examined whether economic instability played a role in the country's decision to adopt the scheme and whether the decision to adopt explicit deposit insurance depends on national income.

The results highlight bank size as the most critical bank-specific factor considered in EDI adoption, consistent with the "too big to fail" hypothesis. However, higher levels of non-performing loans (NPLs) decrease the likelihood of deposit insurance adoption, underscoring the risks of moral hazard in the presence of safety nets. Additionally, robust regulatory quality significantly enhances the probability of adopting explicit deposit insurance, emphasizing the importance of strong regulatory frameworks. The findings also reveal that financial crises and neighboring countries' adoption of similar schemes increase the likelihood of EDI adoption. The robustness of these results was confirmed through linear probability and logit models, reinforcing the consistency of our conclusions.

The current research provides important insights regarding bank-specific income classification and macroeconomic factors influencing the adoption of EDI. A dataset from 107 countries was used to test the model. The bank-specific, economic, and regulatory factors may differ in non-represented countries, thus impacting the robustness and generalization of the results. The analysis of more comprehensive data covering all the countries can increase the generalization of the findings. While this study considers various institutional factors, some unobservable or difficult-to-quantify variables, such as regulatory enforcement motivation, informal financial sector dynamics, and political will, may influence the adoption of explicit deposit insurance.

Additionally, cultural differences among countries, such as risk tolerance levels, may contribute to adopting EDI. The probit regression model is appropriate for binary data. However, this may not cover the complexity of strategic decision-making, such as adopting EDI. Other modeling approaches, such as the hazards model, may provide additional insights. This study uses an event study approach to account for the impact of the financial crisis on EDI. However, defining and measuring financial crises across regions, countries, and periods is challenging. This may lead to classification bias. Similarly, some countries also use alternative financial stability mechanisms. For instance, New Zealand employs an Open Bank Resolution (OBR) system in case of bank failures. Such alternatives may interact with or substitute for the adoption of EDI. The current study does not provide such insights.

While the study examines the determinants of EDI, it does not extensively investigate the long-term implications of such schemes, such as moral hazard, risk-taking behavior, and innovation in the financial systems. Such investigations are vital for policy evaluation. Future research may focus on the implications of the adoption of EDI. Countries with different adoption levels are expected to depict different moral and risk-taking behaviors. Similarly, their attitude towards developing innovative alternative financial stability mechanisms may vary. Country-specific variables such as financial system structures, cultural attitudes toward government interventions, and political will may determine the adoption of explicit deposit insurance. Researchers should extend the findings of this study by incorporating these variables into the model. Future studies should also focus on the other financial stability mechanisms in various regulatory environments. Alternative mechanisms can interact with determinants of EDI adoption to attenuate (amplify) the effects or substitute for the adoption of EDI. Researchers may focus on both areas to bring out more insights.

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# The dynamic effect of cash and non-cash payment instruments on money velocity in Indonesia

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**Abstract**

**Purpose** — This study explores the dynamic effect of electronic money as a non-cash payment instrument on the velocity of money in Indonesia from 2012 to 2020.

**Method** — Using quarterly time series data from 2012 to 2020, the research employs the Error Correction Model (ECM), stationarity, cointegration, and classical assumption tests to ensure the correct estimation procedure.

**Findings** — The findings reveal several essential points: (1) Faster circulation of cash generally increases the velocity of M1; (2) Excessive money supply slows down M1 circulation; (3) An increase in the use of debit cards (ATMs) tends to reduce M1 velocity, while quicker credit card transactions can accelerate it; (4) Rapid circulation of electronic money can expedite M1, but large amounts can hinder it. Overall, both cash and non-cash money equally influence the behavior of M1 velocity in Indonesia.

**Implication** — The government should focus more on money velocity to maintain stability, even though various payment instruments are utilized in the economy.

**Originality** — The current research focuses on the dynamic development of modern finance in Indonesia and electronic money as non-cash payment instruments that impact money velocity.

**Keywords** — Financial development, electronic money, money velocity, ECM, cash payment.

## Introduction

Money velocity is a vital monetary indicator that reflects the speed of money movement (Dong & Gong, 2014). It reflects the frequency of currency units used for transactions and the efficiency of money in facilitating transactions (Oyadeyi, 2024). Money velocity is a tool to assess the impact of monetary policy on economic growth (Genemo, 2021). The money supply indicates high, low, and stable money velocity (hereafter *MV*). Wang (2023) highlighted that a larger number of money supply in the economy will be followed by very active and smooth economic activities, thus stimulating *MV* to be too high. However, a high *MV* tends to result in the possibility of a high inflation rate (Okedigba et al., 2024; Salas, 2020). Conversely, if the money supply is too low, it will result in low money velocity. At the same time, it impacts the economy's sluggishness, and ultimately, the possibility of deflation will be very wide open (Bozkurt, 2014). This cyclical condition underlines that the size of a country's economic activity changes quickly or slowly depending on the amount of money in

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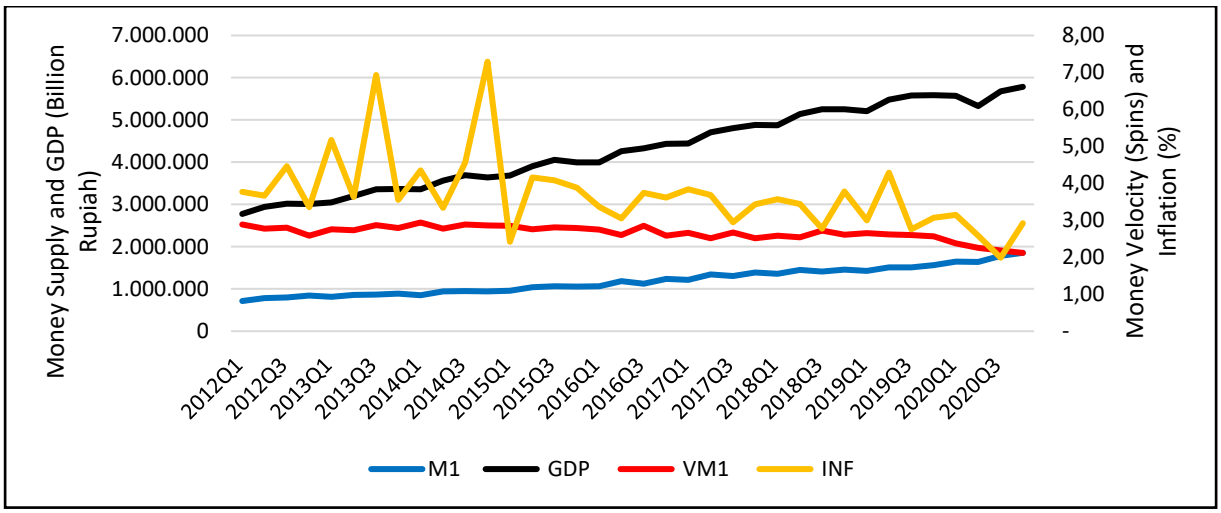
circulation, as indicated by the level of money velocity (Faugere, 2024). It confirms that the stability of the money velocity is a vital indicator in determining the level of economic growth and inflation rate of a country (Avdiu & Unger, 2022; Jung, 2017).



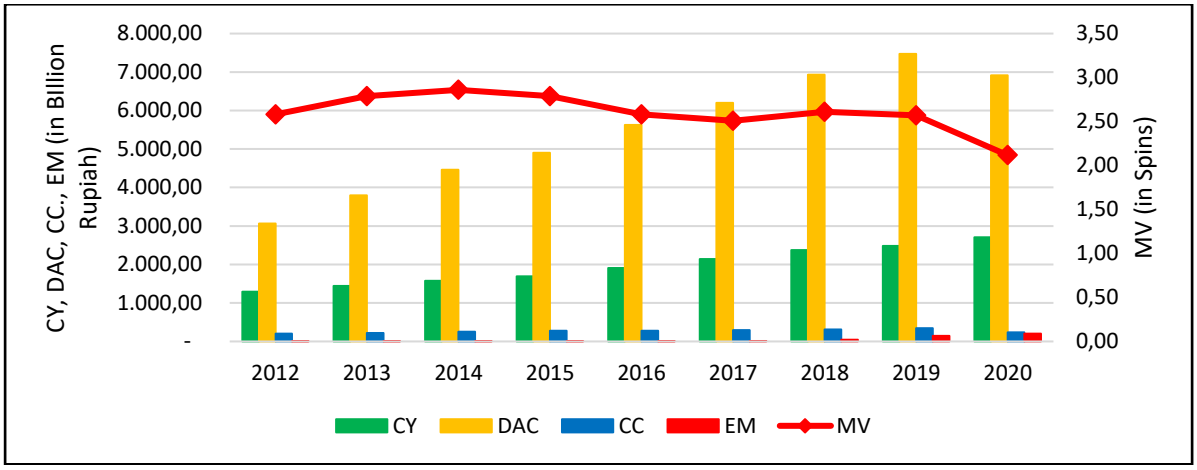

Source: Indonesian Central Bank and Central Bureau of Statistics (CBS) of Indonesia, 2010-2020

**Figure 1.** The Development of Money Supply (M1), Gross Domestic Product, Inflation, and Money Velocity in Indonesia, 2012 (Q1)-2020 (Q4)

Figure 1 reflects the state of money velocity, Gross Domestic Product (*GDP*), money supply, and inflation rate in Indonesia, which shows a different condition than what should happen. It is exposed by the money velocity, which tends to slow down and decrease. However, *GDP* tends to increase. Theoretically, this condition is quite contradictory; where *GDP* or economic productivity is getting higher, it should be supported by money velocity, which is also high, not getting weaker (Arkadani, 2022). In addition, the money supply in Indonesia continues to expand, but is unable to create money velocity to increase, and tends to contract. This contradictory condition makes money velocity an important monetary indicator for predicting the inflation rate. Figure 1 emphasizes that the state of Indonesia's money velocity during the period 2012Q1 to 2020Q4 was not very stable. In general, this condition explains that, during the 2012-2015 period, Indonesia's money velocity showed a stable condition. During the 2016-2020 period, the money velocity experienced conditions that tended to be stable-low. This is based on the instability of money velocity measured through the standard deviation over nine years movement (Benk et al., 2010), which is segregated into three categories: high (>2.85), stable (2.66-2.84), and low (<2.65). It indicates that Indonesia's economic movement has recently experienced growth with a slight slowdown. For this reason, the depressed money velocity in Indonesia during this time must be overcome immediately to reach a more stable condition.

Money velocity uncertainty is mainly caused by money supply and *GDP*. The money supply tends to continue to increase and is difficult to decrease. This condition can be caused, among others, by increasingly diverse means of payment that are increasingly difficult for the central bank to control (Durgun & Timur, 2015; Luo et al., 2021). The primary determinant of money supply is the money multiplier, while non-cash payment instruments can create a sizable money multiplier (Abbas et al., 2014; Mughal et al., 2021; Ongan & Gocer, 2023). Thus, non-cash payment instruments can influence money velocity in Indonesia through the money supply. In addition, non-cash payment instruments can also influence money velocity through *GDP* (Benati, 2020; Mennuni, 2023; Sharma & Syarifuddin, 2019). It is because the level of money velocity can also be affected by various payment instruments that change people's behavior in transactions (Jiang & Shao, 2020). Through observation of data sourced from Bank Indonesia publications, it is shown that there is also a phenomenon where during the 2012-2020 period in Indonesia, the use of cash and non-cash instruments continued to increase. However, money velocity dominantly tends to move slower than the average speed.

The analysis of money is quite critical and interesting in economics. Compared to money, the discussion of money velocity (hereafter *MV*) is no less critical (Dong & Gong, 2014). Through Irving Fisher's Quantity Theory of Money, *MV* can be measured by the ratio of *GDP* to money supply, and it is not considered constant. Thus, *GDP* and money supply changes can directly affect *MV* (Sharma & Syarifuddin, 2019). Through *GDP*, *MV* provides a picture of goods and services transaction activities between economic actors. Several studies explore money velocity and prove that money velocity will be affected by external shocks such as interest rates, per capita income, money growth volatility, and inflation (Ardakani, 2022; Benati et al., 2021; Chen & Siklos, 2022; Nunes et al., 2018; Oyadeyi, 2024). However, the shock that occurs in money velocity is not only caused by these macroeconomic variables, but money velocity also responds to various structural changes, one of which is the escalation of payment system efficiency (Mele & Stefanski, 2019).




Source: Indonesian Central Bank and Central Bureau of Statistics (CBS) of Indonesia, 2010-2020
Note: CY=Currency; DAC= debit cards (ATMs); CC=Credit Card; EM=Electronic Money; MV=Money Velocity

**Figure 2.** Currency, Nominal Transactions of Debit Cards (ATMs), Credit Cards, and Electronic Money in Indonesia (billion rupiahs) and Money Velocity M1 (spins) 2012-2020

A practical payment system facilitates the smooth flow of economic activity by reducing transaction costs and increasing convenience, thereby increasing transaction volumes (Bachas et al., 2021; Brown et al., 2022; Qamruzzaman & Jianguo, 2017). As the intensity of transactions and the amount of money in circulation increase, it is only natural that money will circulate even faster. The prevailing payment system in Indonesia uses cash and non-cash instruments in economic activities. Cash payments use currency. Using less currency in transactions accelerates *MV* (Miskhin, 2010). Based on the data collected, debit cards (ATMs), credit cards, and electronic money are the most popular non-cash payment instruments for non-cash payment systems. Figure 2 illustrates the development of cash and non-cash payments in Indonesia during 2012-2020.

Sharma & Syarifuddin (2019) revealed that Indonesia is currently facing issues in the financial sector, including financial innovation and a cashless society, and these issues are expected to affect the money velocity in Indonesia. Figure 2 shows that currency, debit cards (*ATMs*), credit cards, and electronic money have an increasing trend. Electronic money tends to increase steadily, but since 2017, the nominal increase in electronic money transactions has been rapid. Compared to the other three payment instruments, debit cards (*ATMs*) have an enormous nominal transaction volume. Most of the money velocity during the period moved more slowly and did not have an increasing trend. The decline in transactions with non-cash instruments seen from 2020Q1 to 2020Q2 was due to the COVID-19 pandemic.

Research related to innovation in finance and its relationship with money velocity has been conducted by several researchers, such as Akinlo (2012), Jung (2017), Nampewo & Opolot (2016), and Tule & Oduh (2016). These studies underlined that developments in finance generate a higher *MV*. However, Hermawan et al. (2024) and Li et al. (2024) demonstrated that the existence of

digital money such as Bitcoin and Central Bank Digital Currencies (*CBDCs*) decreases *MV*. Bitcoin tends to be speculative, and *CBDCs* prefer to be stored rather than actively used for consumption. Their research examines financial innovation through proxies such as mobile money, broad money, digital money, and *M*2 multiplier. Meanwhile, this study will use Indonesia's most used payment instruments: cash, electronic money, debit cards (*ATMs*), and credit cards.

From the previous description, it can be analyzed that Indonesia has experienced developments in the payment system, especially non-cash, where its use shows an increasing trend. There will be a possibility of increasing the size of economic activity through *GDP* through efficient payments (Shahbaz et al., 2017; Sreenu, 2020) in the economy. Money velocity is expected to increase with innovations in the payment system (Rehman et al., 2023). For this reason, this empirical research will investigate non-cash and cash payments and how these two payment methods affect money velocity, particularly in Indonesia. These two payment mechanisms, namely cash and non-cash payments, must be considered. Although non-cash payments have proliferated in Indonesia, cash payments using currency have not been abandoned (Acedański et al., 2024). Therefore, it is necessary to investigate the dynamic influence.

Furthermore, this study will analyze the money velocity in three different models. First, how is nominal *MV* affected by the velocity of cash and non-cash payment instruments in nominal terms? Second, how real *MV* (the velocity of money adjusted to the price level where the real money balance element is included in the model) is affected by cash and non-cash payment instruments, which are also in real terms. Third, how nominal *MV* is affected by the number of cash and non-cash payment instruments (in the form of the ratio of both payment system instruments to *GDP*). This research is supposed to contribute to the literature related to the velocity of money.

## Methods

The scope of this study includes the independent variables, namely monetary base (*M*0) or currency, debit cards (*ATMs*), credit cards, electronic money, and trade openness. In contrast, the dependent variable is money velocity. The data used in this research were collected from the Central Bureau of Statistics (*CBS*) of Indonesia and the Indonesian Central Bank in quarterly data form for ten years from 2012 to 2020.

This empirical research uses a quantitative approach, employing an error correction model (*ECM*). *ECM* assumes that the economic variables observed that are cointegrated will experience error correction in the next period if there is an imbalance in a specific period. This means that they can return to the equilibrium position. This study uses *ECM* because variables are not expected to affect the short term directly, but their impact can occur in the long term. Moreover, the behavior of economic actors in holding money is different, so a *time lag* is also needed to observe differences in individual behavior towards money. In addition, examining the behavior of the data, it appears that *ECM* can be employed as one of the dynamic models in investigating the *MV* in Indonesia. The critical reason is that *ECM* can overcome the usual problems in time series data, such as the observed non-stationary variables and spurious regression results.

Before estimating the *ECM* model, several prerequisite tests must be met. This ensures the *ECM* method is suitable and valid for solving the issues. Therefore, this study starts by demonstrating descriptive statistics to provide a concise overview of the data used before the specific tests are conducted. Furthermore, the validity of the research model is continued by showing classical assumption tests such as normality, autocorrelation, heteroscedasticity, and multicollinearity. The sequences of testing stages that must be carried out are (a) Stationarity test using the Augmented Dickey-Fuller test; (b) Cointegration test with residual-based test method; (c) Specification of Error Correction Term (*ECT*) value; and (d) Short and long run estimation with *ECM*.

The determination of variables used in this study follows the quantity theory of money developed by Fisher (1911), which has become an underlying tool often used in monetary analysis, especially in analyzing the money velocity and transactions of goods and services. $MV = PT$ became the equation of Irving Fisher's quantity theory of money. *M* is defined as the money supply. *V* is the money velocity, the money supply in the narrow type, or *M*1. The reason is that *M*1, which consists of currency and demand deposits, has a high level of liquidity compared to *M*2, so its use

in making transactions will be very accessible. The behavior of the money velocity can be verified from the Fisher equation, namely $MV = \frac{PT}{M}$ or $MV = \frac{Y}{M}$. What we need to consider is the condition where the available money is not only paper and coin, but also money in electronic form. For this reason, this study will use cash and non-cash variables along with other variables in the form of trade openness.

This study will develop three different models to explain the velocity of money flows. First, the money velocity will be presented by the following nominal model:

$$\frac{Y}{M_1} = f\left(\frac{Y}{CY}, \frac{Y}{DAC}, \frac{Y}{CC}, \frac{Y}{EM}, TO\right), \text{ or}$$
$$MV_1 = f(cy, dac, cc, em, TO) \quad (1)$$

The equation demonstrates how different types of money, namely cash (*CY*), debit cards in terms of *ATMs* (*DAC*), credit cards (*CC*), electronic money (*EM*), and trade openness (*TO*) explain the velocity of money circulation *M*1. Trade openness is obtained from $\frac{X+M}{GDP}$. *X*, *M*, and *GDP* are the sum of oil and gas, non-oil and gas exports, imports, and gross domestic products. The equation/model is still in nominal form. The second model will consider the element of inflation in the model, resulting in a new equation, namely:

$$\frac{Y}{M_1/_P} = f\left(\frac{Y}{CY/_P}, \frac{Y}{DAC/_P}, \frac{Y}{CC/_P}, \frac{Y}{EM/_P}, \frac{X+M/_P}{GDP}\right), \text{ or}$$
$$VM_{1P} = f(cy_P, dac_P, cc_P, em_P, to_P) \quad (2)$$

Where *P* is the inflation rate, by including the element of inflation, it is expected to provide a picture of the money velocity in real terms where $M1 \,/\, P$ is the real money balance. This study will also create a third model that shows the ratio of cash, non-cash money, and trade to *GDP*. The third model can be written as:

$$MV_1 = f(CY/_{GDP}, DAC/_{GDP}, CC/_{GDP}, EM/_{GDP}, X + M/_{GDP}) \text{ or}$$
$$MV_1 = f(CY_{GDP}, CY_{GDP}, CY_{GDP}, EM_{GDP}, TO) \quad (3)$$

Based on the function equations for the three models, the economic model can be transformed into an econometric model, which provides an overview of the long-term relationship, namely:

Model 1. $MV_{1t} = \beta_0 + \beta_1 cy_t + \beta_2 dac_t + \beta_3 cc_t + \beta_4 em_t + \beta_5 TO_t + \varepsilon_t$ (4)

Model 2. $MV_{1t} = \beta_0 + \beta_1 cy_{Pt} + \beta_2 dac_{Pt} + \beta_3 cc_{Pt} + \beta_4 em_{Pt} + \beta_5 to_{Pt} + \varepsilon_t$ (5)

Model 3. $MV_{1t} = \beta_0 + \beta_1 CY_{GDPt} + \beta_2 DAC_{GDPt} + \beta_3 CC_{GDPt} + \beta_4 EM_{GDPt} + \beta_5 TO_t + \varepsilon_t$ (6)

where $\beta_0$ is the intercept, while $\beta_1$, $\beta_2$, $\beta_3$, $\beta_4$, and $\beta_5$ are regression coefficients (as parameters). Furthermore, to examine the short-term relationship of the variables observed in this study, the equation above can be reformulated in an *ECM* form as follows (Engle & Granger, 1987):

Model 1. $\Delta MV_t = \gamma_0 + \gamma_1 \Delta cy_t + \gamma_2 \Delta dac_t + \gamma_3 \Delta cc_t + \gamma_4 \Delta em_t + \gamma_5 \Delta TO_t + \gamma_6 cy_{t-1} + \gamma_7 dac_{t-1} + \gamma_8 cc_{t-1} + \gamma_9 em_{t-1} + \gamma_{10} TO_{t-1} + \gamma_{11}(cy_{t-1} + dac_{t-1} + cc_{t-1} + em_{t-1} + to_{t-1} - MV_{t-1}) + \varepsilon_t$ (7)

Model 2. $\Delta MV_{Pt} = \gamma_0 + \gamma_1 \Delta cy_{Pt} + \gamma_2 \Delta dac_{Pt} + \gamma_3 \Delta cc_{Pt} + \gamma_4 \Delta em_{Pt} + \gamma_5 \Delta TO_{Pt} + \gamma_6 cy_{Pt-1} + dac_{Pt-1} + \gamma_8 cc_{Pt-1} + \gamma_9 em_{Pt-1} + \gamma_{10} TO_{Pt-1} + \gamma_{11}(cy_{Pt-1} + dac_{Pt-1} + cc_{Pt-1} + em_{Pt-1} + to_{Pt-1} - MV_{Pt-1}) + \varepsilon_t$ (8)

Model 3. $\Delta MV_t = \gamma_0 + \gamma_1 \Delta CY_{GDPt} + \gamma_2 \Delta DAC_{GDPt} + \gamma_3 \Delta CC_{GDPt} + \gamma_4 \Delta EM_{GDPt} + \gamma_5 \Delta TO_t + \gamma_6 CY_{GDPt-1} + DAC_{GDPt-1} + \gamma_8 CC_{GDPt-1} \gamma_9 EM_{GDPt-1} + \gamma_{10} TO_{t-1} + \gamma_{11}(CY_{GDPt-1} + DAC_{GDPt-1} + CC_{GDPt-1} + EM_{GDPt-1} + TO_{t-1} - MV_{Pt-1}) + \varepsilon_t$ (9)

Where, $\Delta MV$ is the change in velocity of money in period *t*. The variable $\Delta X_t$ or independent variable is the change in the independent variable in period *t*. Meanwhile, $X_{t-1}$ is the lags of the independent variable. $\gamma 0$ is the intercept, while $\gamma_1$, $\gamma_2$, $\gamma_3$, $\gamma_4$, $\gamma_5$, $\gamma_6$, $\gamma_7$, $\gamma_8$, and $\gamma_9$ are the regression coefficients of Error Correction Term (ECT).

## Results and Discussion

### Descriptive Statistics

Table 1 displays the descriptive statistics of each variable used in this study. The average values of $MV_1$ and $MV_{1P}$ are not different during the study period, 2012Q1-2020Q4, with 2,661 and 2,862 spins, respectively. When the nominal and real money velocity of all payment instruments is compared, on average, electronic money circulates very quickly, and debit cards (*ATMs*) and *M*1 have a very weak speed. However, debit cards (*ATMs*) have the highest ratio to Indonesia's GDP. Meanwhile, electronic money has the lowest ratio to *GDP*. This suggests that debit cards (*ATMs*) are more widely used in transactions in Indonesia, hence their ratio to *GDP* is also significant, at 43.29 percent. The low speed of rotation of real *DAC* and nominal *DAC*, which amounted to 2.32 and 2.48, respectively, can be caused by the large amount of money in the form of debit cards (*ATMs*) available, causing debit cards (*ATMs*) to circulate more slowly.

**Table 1.** Descriptive Statistics of All Variables Observed (Period 2012Q1-2020Q4)

| Variable | Unit | Mean | Max | Min | Std. Dev | | Frequency (in Time) | Total Frequency (%) |
|---|---|---|---|---|---|---|---|---|
| $MV_1$ | spins | 2.661 | 2.940 | 2.117 | 0.195 | 7 | '12Q1, '13Q3, '14Q1Q3Q4, '15Q1, '16Q3 | 19.4 |
| $MV_{1P}$ | spins | 339.05 | 418.41 | 223.77 | 44.18 | 2 | '13Q3Q4 | 5.6 |
| cy | spins | 6.469 | 7.182 | 5.169 | 0.464 | 7 | '12Q1, '13Q3, '14Q4, '15Q1Q2Q3, 16Q1 | 22.2 |
| $cy_P$ | spins | 822.55 | 1008.28 | 546.32 | 101.12 | 3 | '13Q1Q2Q3 | 8.33 |
| $CY_{GDP}$ | percent | 15.538 | 19.343 | 13.923 | 1.182 | 4 | '17Q4, 20Q2Q3Q4 | 11.1 |
| dac | Spins | 2.329 | 2.959 | 2.059 | 0.225 | 6 | '12Q1Q2Q3Q4, '13Q1Q3 | 16.7 |
| $dac_P$ | spins | 296.07 | 387.84 | 220.36 | 42.677 | 8 | '12Q1Q2Q3Q4, '13Q1Q2Q3Q4 | 22.2 |
| $DAC_{GDP}$ | percent | 43.290 | 48.557 | 33.788 | 3.826 | 4 | '18Q4, '19Q1Q2, '20Q4 | 11.1 |
| cc | spins | 46.515 | 76.585 | 38.845 | 8.338 | 33 | All the time, except for '20Q2Q3Q4 | 91.6 |
| $cc_P$ | spins | 5857.5 | 8046.04 | 4609.06 | 779.58 | 4 | '18Q3, 20Q2Q3Q4 | 11.1 |
| $CC_{GDP}$ | percent | 2.198 | 2.574 | 1.305 | 0.282 | 3 | '14Q4, '15Q2Q4 | 8.33 |
| em | spins | 1888.556 | 6346.680 | 65.194 | 1616.931 | 4 | '12Q1Q2Q3, 13Q1 | 11.1 |
| $em_P$ | spins | 242665.4 | 831732.5 | 6889.80 | 212404.0 | 7 | '12Q1Q2Q3Q4, '13Q1Q2Q4 | 22.2 |
| $EM_{GDP}$ | percent | 0.314 | 1.533 | 0.015 | 0.465 | 7 | '19Q2Q3Q4, '20Q1Q2Q3Q4 | 22.2 |
| TO | percent | 35.380 | 46.922 | 27.519 | 5.248 | 6 | '12Q1Q2Q4, '13Q3Q4, '14Q2 | 16.7 |
| $to_P$ | percent | 0.279 | 0.378 | 0.2104 | 0.0419 | 9 | '12Q1Q2Q4, '13Q4, '14Q1Q2Q3Q4 | 25 |

Source: Real data and calculations based on Indonesian Central Bank and Central Bureau of Statistics (CBS) of Indonesia, 2012-2020

Note: $MV_1$=Velocity of money (*M*1); $MV_{1P}$= velocity of money M1 real; *cy*=velocity of currency; $cy_P$=velocity of currency real; $CY_{GDP}$=ratio currency to *GDP*; dac=velocity of debit cards (*ATMs*) transactions; $dac_P$=velocity of debit cards (ATMs) transactions real; $DAC_{GDP}$=ratio of debit cards (*ATMs*) transaction to *GDP*; cc=velocity of credit card transaction; $cc_P$=velocity of credit card transaction real; $CC_{GDP}$=ratio credit card transaction to *GDP*; *em*=velocity of electronic money transactions; $em_P$=velocity of electronic money transactions real; $EM_{GDP}$=ratio electronic money transaction to *GDP*; *TO*=trade openness; $to_P$=trade openness real.

Based on the nominal model, from 2012Q1 to 2020Q4, descriptive statistics show that 19 percent of the nominal *M*1 money velocity data circulates very fast. Then, 22 percent of banknotes experienced rapid turnover. Sixteen percent of debit cards (*ATMs*) circulate at a high speed. As for credit cards, 91 percent circulate at a higher speed. Only 11 percent of the data has a high velocity for electronic money. In general, it can be concluded that almost all variables had good values at the beginning of the study period, as seen from the frequency table over time.

## Classical Assumption Test

Classical assumption tests are essential in identifying a model's BLUE OLS coefficient estimates. The classical assumption tests consist of no autocorrelation, multicollinearity, and heteroscedasticity. In addition to the classical assumptions, this paper conducts a normality test to checkwhether the data is normally distributed. The results of the normality test using the Jarque-Bera test show that the data used in this study for the three models applied are proven to be normally distributed, which is reflected in the probability value of the Jarque-Bera test, which is above 0.05. Then, the results of the autocorrelation test using the Breusch-Godfrey *LM*-test indicated no autocorrelation in the models used. It can be seen from the $Obs*R^2$ value that the probability of Chi-Square is greater than the 5% alpha level. White's test is used to detect the presence of heteroscedasticity in the model, with the result that all models have no heteroscedasticity. It is shown from the probability Chi-squared, which is above the 5% alpha level or above 0.05. By using Variance Inflation Factors (*VIF*), the correlation between independent variables in the model can be detected. The test results show no multicollinearity in models 1, 2, and 3, indicated by the centered *VIF* value of all the independent variables being less than 10.

**Table 2.** Classical Assumption Test Result

| Models | Variable | Multicollinearity Test | Normality Test | | Autocorrelation Test | | Heteroskedasticity Test | |
|---|---|---|---|---|---|---|---|---|
| | | | Jarque-Bera | Prob. | Obs-Squared | Prob. | Obs-Squared | Prob. |
| Model 1 | cy | 2.381 | 0.710 | 0.701 | 1.964 | 0.374 | 18.470 | 0.956 |
| | dac | 7.326 | | | | | | |
| | cc | 3.315 | | | | | | |
| | em | 7.647 | | | | | | |
| | TO | 2.939 | | | | | | |
| Model 2 | $cy_P$ | 7.342 | 0.092 | 0.954 | 3.171 | 0.204 | 26.863 | 0.545 |
| | $dac_P$ | 5.897 | | | | | | |
| | $cc_P$ | 6.529 | | | | | | |
| | $em_P$ | 2.157 | | | | | | |
| | $to_P$ | 2.631 | | | | | | |
| Model 3 | $CY_{GDP}$ | 2.398 | 1.456 | 0.482 | 0.396 | 0.820 | 19.533 | 0.487 |
| | $DAC_{GDP}$ | 2.750 | | | | | | |
| | $CC_{GDP}$ | 3.713 | | | | | | |
| | $EM_{GDP}$ | 3.081 | | | | | | |
| | TO | 2.940 | | | | | | |

Notes: Model 1: *MV* and payment instruments in nominal; Model 2: *MV* and payment instruments in real; and Model 3: Ratio of all payment instruments to *GDP*

## Stationarity Test

This study employs the Augmented Dickey-Fuller test to examine stationary or non-stationary data. Stationary data will prevent the occurrence of spurious regression. Based on Table 3, it can be concluded that all variables are stationary at the first difference level. This implies that all variables have the same direction towards equilibrium conditions in the long term. The unit root test at the level using the Augmented Dickey-Fuller test shows that of the 17 variables used, only three are stationary in-level, namely $CC_P, TO_P$, and $EM_{GDP}$. The probability of the three variables being below $a$ = 5 %. A unit root test at the level found that not all variables were stationary, and there

were still unit root problems; all variables must be transformed into the first difference form so that all variables can be stationary at the same level. It is known from the calculation results that all variables are stationary at the same level, which is at first difference or *I*(1).

**Table 3.** Augmented Dickey-Fuller Stationarity Test Results Level and 1st Difference

| Model | Variable | Level | First Difference | Conclusion |
|---|---|---|---|---|
| Model 1 | $MV_1$ | -2.140<br>(0.503) | -12.447***<br>(0.000) | I(1) |
| | CY | -1.924<br>(0.618) | -15.146***<br>(0.000) | I(1) |
| | DAC | -3.165<br>(0.107) | -4.375***<br>(-0.007) | I(1) |
| | CC | -2.226<br>(0.460) | -5.363***<br>(0.000) | I(1) |
| | EM | -2.553<br>(0.302) | -6.757***<br>(0.000) | I(1) |
| | TO | -2.972<br>(0.154) | -8.565***<br>(0.000) | I(1) |
| Model 2 | $MV_{1P}$ | -0.673<br>(0.838) | -6.578***<br>(0.000) | I(1) |
| | $cy_P$ | -0.679<br>(0.837) | -6.631***<br>(0.000) | I(1) |
| | $dac_P$ | -0.728<br>(0.825) | -6.763***<br>(0.000) | I(1) |
| | $cc_P$ | -7.062***<br>(0.000) | -6.366***<br>(0.000) | I(1) |
| | $em_P$ | -0.998<br>(0.741) | -6.434***<br>(0.000) | I(1) |
| | $to_P$ | -6.048***<br>(0.001) | -6.222***<br>(0.000) | I(1) |
| Model 3 | $MV_1$ | -2.140<br>(0.503) | -12.447***<br>(0.000) | I(1) |
| | $CY_{GDP}$ | -1.536<br>(0.794) | -14.950***<br>(0.000) | I(1) |
| | $DAC_{GDP}$ | -3.203<br>(0.100) | -4.670***<br>(0.003) | I(1) |
| | $CC_{GDP}$ | -2.440<br>(0.354) | -7.360***<br>(0.000) | I(1) |
| | $EM_{GDP}$ | -3.769**<br>(0.034) | -3.829**<br>(0.027) | I(1) |
| | TO | -2.972<br>(0.154) | -8.565***<br>(0.000) | I(1) |

Notes: Entries in ***, **, * are significant at 1%, 5%, and 10% confidence levels, respectively.

## Cointegration Test

**Table 4.** Cointegration Test Results

| Model | adj. t-Stat | Prob.* |
|---|---|---|
| Model 1 | -4.220 | 0.001 |
| Model 2 | -8.005 | 0.000 |
| Model 3 | -6.183 | 0.000 |

The cointegration test can be recognized by testing the stationarity of the residuals generated from the long-term equation model, also known as the method of residual-based test using the Phillips-Perron test. Cointegration occurs when the residual is stationary at the level. Table 4 shows that the residual test results of the research models used are stationary and significant at the level because

the probability value is below $a$ = 5%. For this reason, it can be interpreted that there is a cointegration or long-term relationship in the *ECM* model, and the method can be continued.

**Error Correction Model (ECM)**

Following the primary purpose of this study, *ECM* is employed to estimate the short-term and long-term effects of the independent variables on the dependent variable of this study. The test results for the short term can be represented in Table 5. Furthermore, Table 5 shows the results of the statistically significant *ECT* regression coefficient with a probability value of 0.000, 0.000, and 0.001, respectively, for model 1, model 2, and model 3. Moreover, the coefficient of *ECT* has a negative value. This indicates that the result of the *ECM* model used in this empirical research is valid. The coefficient of *ECT* will determine the speed at which equilibrium can be re-achieved.

**Table 5.** Short-term Estimation Results

| Model 1 | Coefficient (Prob.) | Model 2 | Coefficient (Prob.) | Model 3 | Coefficient (Prob.) |
|---|---|---|---|---|---|
| C | -0.452 | C | -0.052 | C | -0.470 |
| | (0.536) | | (0.451) | | (0.526) |
| Δcy | 0.188*** | $\Delta cy_P$ | 0.465*** | $\Delta CY_{GDP}$ | -0.067** |
| | (0.009) | | (0.000) | | (0.017) |
| Δdac | -0.003 | $\Delta dac_P$ | -0.495* | $\Delta DAC_{GDP}$ | -0.0028 |
| | (0.995) | | (0.056) | | (0.865) |
| Δcc | -0.007 | $\Delta cc_P$ | 0.013** | $\Delta CC_{GDP}$ | 0.140 |
| | (0.238) | | (0.026) | | (0.450) |
| Δem | 9.931** | $\Delta em_P$ | 0.000*** | $\Delta EM_{GDP}$ | 0.023 |
| | (0.015) | | (0.000) | | (0.915) |
| ΔTO | -0.004 | $\Delta to_P$ | -0.004 | ΔTO | -0.004 |
| | (0.560) | | (0.833) | | (0.560) |
| cy(-1) | 0.026 | $cy_P$(-1) | 0.036 | $CY_{GDP}$(-1) | 0.008 |
| | (0.769) | | (0.609) | | (0.831) |
| dac(-1) | 0.092 | $dac_P$(-1) | -0.049 | $DAC_{GDP}$(-1) | 0.005 |
| | (0.624) | | (0.8314) | | (0.472) |
| cc(-1) | -0.001 | $cc_P$(-1) | -0.002 | $CC_{GDP}$(-1) | -0.032 |
| | (0.861) | | (0.8427) | | (0.814) |
| em(-1) | -1.771 | $em_P$(-1) | 4.071 | $EM_{GDP}$(-1) | -0.032 |
| | (0.510) | | (0.918) | | (0.605) |
| TO(-1) | 0.004 | $to_P$(-1) | 0.040 | TO(-1) | 0.006 |
| | (0.382) | | (0.133) | | (0.232) |
| ECT (-1) | -0.997*** | ECT(-1) | -1.050*** | ECT(-1) | -0.864*** |
| | (0.000) | | (0.000) | | (0.001) |

Notes: ***, **, * indicate significant at 1%, 5%, and 10% confidence level.

The cointegration test results show the existence of cointegration, which indicates a long-term relationship in the model, so the long-term estimate for model 1, model 2, and model 3 is shown in Table 6. In the long and short run, the *MV* of both nominal and real currency (*CY*) positively and significantly influences the *MV* of *M*1. The currency is part of the money in the narrow sense (*M*1). For this reason, the faster the currency circulates, the faster *M*1 rotates in circulation. This result is supported by Khavgpom's (1967) and Aggarwal et al. (2024) findings. They underlined that the currency could spur an increase in *MV* through increased consumption and productive investment.

Meanwhile, the estimation results of the ratio of the currency to *GDP* have a negative and significant relationship with the *MV* in both the long-term and short-term. When the ratio of the currency to *GDP* increases, it means that more currency is in circulation compared to the economic activity that occurs. If the amount of money in the economy rises without a balanced increase in economic activity, the currency tends to settle, and it is not actively used for transactions. This

condition indicates that the greater the ratio of the currency to *GDP*, the slower the rotation of *M*1 will be. This result is consistent with Irving Fisher's quantity of money theory, which states that the money supply and velocity of money have a negative relationship. An increase in the amount of currency can reduce *MV*.

**Table 6.** Long-term Estimation Results

| Model 1 | Coefficient (Prob.) | Model 2 | Coefficient (Prob.) | Model 3 | Coefficient (Prob.) |
|---|---|---|---|---|---|
| C | 1.862*** | C | -0.148 | C | 3.417*** |
| | (0.000) | | (0.528) | | (0.000) |
| cy | 0.229*** | $cy_P$ | 0.541*** | $CY_{GDP}$ | -0.086*** |
| | (0.000) | | (0.000) | | (0.000) |
| dac | -0.325** | $dac_P$ | -0.676*** | $DAC_{GDP}$ | 0.002 |
| | (0.046) | | (0.005) | | (0.714) |
| cc | 0.005* | $cc_P$ | 0.013** | $CC_{GDP}$ | 0.145 |
| | (0.087) | | (0.037) | | (0.120) |
| em | 5.711** | $em_P$ | 0.0001*** | $EM_{GDP}$ | -0.100* |
| | (0.016) | | (0.001) | | (0.056) |
| TO | 0.006 | $to_P$ | 0.004 | TO | 0.006 |
| | (0.194) | | (0.595) | | (0.215) |

Notes: ***, **, * indicate significant at 1%, 5%, and 10% confidence levels.

Using debit cards (*ATMs*) on the velocity of *M*1 shows a negative and significant effect for both nominal and real models. This implies that an increase in the use of debit cards (ATMs) can trigger the velocity of *M*1 to decrease. Debit cards (*ATMs*) are categorized into the broad money supply (*M*2). Debit cards (*ATMs*) allow individuals to reduce their use of cash and demand deposits. Bachas et al. (2021) explained that low-income people use credit cards to accumulate savings and reduce current consumption. Financial hoarding without using it for productive economic purposes also results in a slowdown of the *MV* (Fu et al., 2021). Credit cards in the real model show that they positively affect money velocity. This can be interpreted that the more often credit cards are used, the greater the *MV*. The results of this study support the statement of Genemo (2021) and Liu & Serletis (2021) that payments using credit cards generate much higher *MV*.

In the short term and long term, electronic money significantly and positively affects the *MV* of the currencies. The more transactions made by using electronic money, the greater the speed at which electronic money circulates, ultimately accelerating the *MV* of *M*1. This finding is supported by Anwar et al. (2024). Electronic money has facilitated easy and fast transactions in the economy. It is now often used for micro-transactions such as payment of parking fees, toll roads, public transportation, and others (Brown et al., 2022). Thus, although the value of electronic money transactions is relatively small, the high frequency of transactions accelerates the overall *MV* of the currencies.

## Conclusion

This study explores the effect of cash and non-cash payment systems on money velocity in Indonesia from 2012Q1 to 2020Q4 by applying the Error Correction Model (*ECM*). There are several main conclusions from this research, namely: (1a) in the short run, an increase in the money velocity of nominal and real currency and electronic money causes *MV*1 to increase, meaning that there is a positive and significant relationship, while the speed of circulation of real debit cards (*ATMs*) has a negative and significant effect, increasing the velocity of transactions with debit cards (*ATMs*) in real terms can reduce *MV*1; (1b) in the long run, the velocity of nominal and real currency, credit cards and electronic money has a significant positive effect on *MV*1, while the velocity of nominal and real debit cards (*ATMs*) transactions has a negative and significant impact on *MV*1; (2a) in the short term, the ratio of currency has an adverse effect on *MV*1; (2b) in the long run, the ratio of banknotes and electronic money has a negative and

significant impact on *MV*1; (3) trade openness both in the short and long term for the three research models has no considerable effect.

Based on the results of this study, the government can consider the suggestion that banks should provide innovations and better services in the banking sector to support the public's use of non-cash payments and provide more *EDC* machines, especially for areas that still have minimal availability. In general, non-cash payments are essential in determining *MV* in Indonesia. Therefore, the government should pay more attention to *MV* stabilization, especially *NCPI*.

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Not Applicable

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# How does Green Finance affect the environment in the ASEAN emerging countries?

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**Abstract**

**Purpose —** This study examines how economic growth, green finance, and renewable energy affect environmental quality (CO2 emissions) under the Environment Kuznets Curve (EKC) hypothesis framework.

**Methods** — This study uses data from ASEAN-6 developing countries, including Indonesia, Malaysia, Thailand, Vietnam, the Philippines, and Cambodia, from 2000 to 2020. It employs Panel Autoregressive Distributed Lag (ARDL), which is widely used for time series analysis since it can capture the short-run and long-run effects among variables.

**Findings —** The result shows the presence of the EKC Hypothesis in ASEAN developing countries. Green Finance and Renewable Energy reduce CO2 emissions only in the long run. In contrast, in the short run, Green Finance shows no effect in lowering CO2 Emissions due to initial costs, infrastructure challenges, market dynamics, and delayed policy implementation; the effect seems to increase in the long run as economies evolve, technologies mature, and awareness of environmental issues rises within emerging economies.

**Implication** — This study suggests that ASEAN developing countries should enhance their green finance efforts and expedite the transition to renewable energy by attracting additional investments in green finance and renewable energy transition. Governments in the Southeast Asian region must improve their policies and laws.

**Originality —** Revisiting the EKC hypothesis by including Green Finance within the ASEAN-6 emerging countries, which has been scarcely conducted in recent literature, this study contributes to the region's policymakers regarding green finance allocation and its relationship to environmental quality.

**Keywords —** EKC Hypothesis, environment quality, $CO_2$ emissions, green finance, renewable energy

## Background

During the last decade, Economic growth in the Southeast Asia (ASEAN) region has shown a remarkable average growth rate of 4% to 5%. Strengthened by the economic growth in 2022, which reached 5.7%, the ASEAN region has become the 5th largest economy and the 4th largest exporter globally. In addition, the ASEAN region was also used as a destination for investment, with the second-highest investment in the world (Limanseto, 2023). Progress in various sectors, such as commerce, investment, household consumption, and the industrial sector, undeniably bolsters

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economic growth. Industrialization significantly contributes to the economic prosperity of developing countries in the ASEAN region.

However, the rapid growth of industrialization, especially in the manufacturing sector, can also have adverse environmental consequences. Most manufacturing industries essentially use fossil fuels like natural gas, coal, and oil, especially in emerging countries where technological innovation has not been well-developed. Thus, the use of resources in the form of fossil fuels will also increase, leading to adverse environmental consequences, such as $CO_2$ emissions. The increase in $CO_2$ emissions is due to the increasing population, the greenhouse gas effect, and the use of fossil fuels like natural gas, coal, and oil for industrial activities, motor vehicle use, and electricity generation (Bhutta et al., 2022; Ridwan et al., 2024). Industry is the main contributor to the increase in CO2 emissions in ASEAN developing countries due to aggressive industrialization to improve their national economies.

Based on data, 5 of the 6 ASEAN developing countries are ranked in the top 5 with the highest $CO_2$ emissions in Southeast Asia because of their aggressive efforts to improve their national economy. Indonesia is ranked first with a $CO_2$ emissions figure of 619.28 million tons, arguably high compared to the second position occupied by Vietnam, with a $CO_2$ emissions figure of 326.01 million tons. Responding to high levels of $CO_2$ emissions, ASEAN members are striving to achieve zero carbon emissions through decarbonization. For emerging ASEAN countries, the primary demand is to use energy sources that are more environmentally friendly, and assessing the pace of renewable energy implementation has become a significant concern (Hidranto, 2023). Furthermore, the poorer nations of ASEAN also ratified the Paris Agreement in 2015, which mandates all United Nations (UN) member states to decrease their greenhouse gas emissions and fulfill the agreement's objectives of attaining carbon neutrality by 2050. Net zero emissions refers to a state in which the quantity of carbon dioxide ($CO_2$) released into the atmosphere is lower than the amount of $CO_2$ absorbed by the Earth (Novia & Candy, 2023).

According to Johnson et al. (1997), environmental quality is a pair of characteristics and properties of an environment that will impact humans and organisms. It involves the natural environment, including water and air cleanliness, pollution, and noise disturbance that potentially cause physical and mental health problems (Nguyen et al., 2020). Several proxies, such as $CO_2$ and greenhouse gas emissions, can measure environmental quality. $CO_2$ emissions are generated from fossil fuel combustion and the cement production process, which includes using fuels in liquid, solid, and gas form (World Bank, 2023).

Regarding climate change and environmental issues, Kuznets (1955) investigated the relationship between economic growth and income inequality. Their study revealed a correlation between economic growth and income disparity that follows an inverted U-shaped curve. Specifically, as economic growth rises, income inequality likewise grows. However, as economic growth progresses, there will be specific turning points when income inequality diminishes. The inverted U-shaped Environment Kuznets Curve (EKC) studied by Grossman and Krueger (1995) is utilized to assess the relationship between the deterioration of the environment and economic growth. According to the EKC hypothesis, there is a positive correlation between environmental degradation and income growth in the initial phases of economic development, illustrated by an upward-sloping curve. There is a positive correlation between economic growth and environmental degradation. Once the economy reaches a turning point, the correlation between economic growth and environmental degradation will turn negative, implying increasing income levels associated with simultaneous reductions in $CO_2$ emissions.

Research examining EKC in G7 countries conducted by Raza and Shah (2018) shows that economic growth (GDP) has a significant positive impact, while $GDP^2$ has a negative and significant effect on $CO_2$ emissions, which supports the U-shaped EKC hypothesis. Likewise, subsequent studies proved the existence of the EKC hypothesis as implied by the negative effect of $GDP^2$ on environment quality, specifically in OECD countries (Zafar et al., 2019), Pakistan (Wang et al., 2022), South Asian countries (Tahir et al., 2021), and Africa (2022). Research by Ibrahiem (2020) shows that economic growth has a significant positive effect on $CO_2$ emissions. If economic growth increases by 1%, $CO_2$ emissions increase by about 1.1%, which is consistent

with the case in Egypt, as one of the developing countries struggling to achieve high levels of economic growth. In line with what has been done by Raza and Shah (2018) and Tahir et al. (2021), research conducted by Usman et al. (2022) shows that income level is statistically significantly positively related to $CO_2$ emissions across all quantiles. Khan et al. (2022) revealed that the overall GDP in a region has a significant positive effect on $CO_2$ emissions, where an increasing GDP will worsen environmental quality.

Producers of greenhouse gas emissions include energy use from fossil fuels, agriculture, industrial processes, deforestation, and waste. The highest producer of Greenhouse Gas (GHG) emissions comes from the use of fossil fuel energy (Filonchyk et al., 2024; Putri, 2023; Wang & Azam, 2024). ASEAN countries must face up to achieving a balance point between economic growth and environmental quality (Claire & Widyawati, 2023). This balance requires that transitioning from traditional to renewable energy is essential since it reduces CO2 emissions, mitigates climate change, enhances environmental sustainability, and fosters long-term socioeconomic benefits, including consistent economic growth (Altaf et al., 2025).

Numerous studies have proved that renewable energy significantly negatively affects environmental quality. Khan and Hou (2021) found that renewable energy has a negative effect on environmental quality in the United States, where every 1% increase in renewable energy will help reduce $CO_2$ emissions by 0.062% using the ROBUSTLS measurement tool and 0.057% using the GLM measurement tool. This shows that environmental quality in the United States can improve with renewable energy in the long term. Triki et al. (2023) stated that renewable energy significantly negatively affects the ecological footprint, which measures environmental quality both in the long and short term. These results imply that every level of improvement in environmental quality in Saudi Arabia is concrete, with 18.4% of renewable energy use. Usman et al. (2022) concluded that renewable energy significantly negatively affects $CO_2$ emissions in all quantiles. Wei et al. (2023) noted that renewable energy has a significant negative effect on $CO_2$ emissions, where an increase in the use of renewable energy by 1% will decrease $CO_2$ emissions by 0.09% in the short term and by 0.66% in the long term in the top 10 green future countries.

Despite studies indicating that this energy type can mitigate CO2 emissions and facilitate climate adaptation, the percentage remains minimal in many countries, with a significant portion of energy derived from fossil fuels, resulting in environmental challenges such as increasing CO2 levels and adverse effects on the global climate (Kassi & Li, 2025). Consequently, transitioning from traditional to renewable energy is essential as it reduces CO2 emissions, mitigates climate change, enhances environmental sustainability, and fosters enduring socioeconomic benefits, including consistent economic growth (Ahmed et al., 2025). The shift from fossil fuel-based energy to renewable energy is a top priority for developing countries in the ASEAN region. Renewable energy will likely reduce $CO_2$ emissions within the ASEAN region. Delays in energy transition will exacerbate the detrimental impacts of climate change, rendering future mitigation endeavors more challenging and expensive.

On the other hand, the energy transition requires financial support to finance renewable energy manufacturing. In this case, green finance plays a significant role (Sadiq et al., 2024; Candy et al., 2022). Green finance is financial services and products that support sustainable and environmentally friendly infrastructure. By increasing the amount of financial resources allocated to renewable energy projects, green finance plays a critical role in influencing ecosystems, production methods, and consumption patterns, serving as a significant catalyst for achieving a more sustainable and resilient economy (Yadav et al., 2024). Studies by Wang and Ma (2022), Guo et al. (2022), Hu et al. (2023), and Zhang et al. (2023) found that green finance has a significant negative impact on carbon emissions, implying that green finance can reduce $CO_2$ emissions in China. Likewise, Zhan et al. (2023) illustrate that a 1% increase in green finance will reduce $CO_2$ emissions by 0.492% and greenhouse gas emissions by 0.456% in China. These results show that green finance effectively reduces carbon emissions intensity and carbon emissions per capita in China, both in the short and long term. These findings imply that green finance investment in China is effective in the process of mitigating $CO_2$ emissions in China. In another region, Altaf et al. (2025) and Ahmed et al. (2025) recently proved that green finance implementation had a

substantial marginal impact on the environmental quality in OECD, Azerbaijan, and BRICS countries, respectively. On the contrary, Chan et al. (2024) pointed out that Green Finance and transitions to green technologies are inadequate. Attempts to achieve carbon neutrality need greater collaborative efforts among emerging Asian nations, such as China, to safeguard the sustainable environment. Likewise, Kassi and Li (2025) revealed that Green Finance is only efficient in less polluted regions in China.

Considering the results, it is urgent to perform studies to harness the potential of renewable energy and green finance to separate economic factors from CO2 emissions. Numerous studies indicate a substantial impact of Green Finance and Renewable Energy use on environmental quality (Hu et al., 2023; Zhan et al., 2023; Zhang et al., 2023; Wang & Ma., 2022; Guo et al., 2022; Altaf et al., 2025; Kassi & Li., 2024). However, most studies focus on China and developed countries, while research on emerging countries within the ASEAN region is scarcely available.

The environment and economic growth nexus in emerging countries might be distinctive from developed economies because of the financial and technological gaps (Ahmed et al., 2025). The study (Yang & Tang, 2024) In the ASEAN region, a linear model was used, excluding the EKC hypothesis, which is widely applied to assess the relationship between environmental factors and economic growth. As explained above, the situation might be more pertinent given that ASEAN nations have pursued rapid industrialization in recent decades, resulting in significant regional environmental degradation. This study aims to address the gap by scrutinizing the relationship between green finance and renewable energy on environmental quality in developing ASEAN countries within the framework of the EKC hypothesis. This study offers policymakers, investors, and other ASEAN-6 stakeholders insight into addressing environmental issues.

The rest of the paper is designed with section 2, comprising methodologies, which includes information on data sources, recommended variables, and econometric methodology; section 3 delves into the findings and results. Lastly, the concluding section, comprising a summary and recommendations, is discussed in section 4.

## Methods

### Data

This study examined the effects of GDP, $GDP^2$, green finance, and renewable energy on environmental quality proxied by $CO_2$ emissions. Using data from 2000 to 2020, we focused on ASEAN developing countries, including Indonesia, Malaysia, Thailand, Vietnam, the Philippines, and Cambodia. The data were obtained from Our World in Data World Development Indicators. Table 1 provides detailed information on the data source.

**Table 1.** Measurement of Variables

| Variable | Operational Definition | Units | Source |
|---|---|---|---|
| Environment Quality ($CO_2$ Emissions) | Environment quality (CO2 emissions) refers to the level of environmental quality affected by $CO_2$ emissions. | Tonnes | Our World in Data (https://ourworldindata.org/co2-emissions) |
| GDP per Capita | GDP is the measurement of a country's nominal GDP divided by population. | 2015 US$ | WDI - World Bank (https://data.worldbank.org/indicator/NY.GDP.PCAP.KD) |
| Green Finance | Green finance refers to financing environmentally friendly and sustainable projects to reduce $CO_2$ emissions. It is measured by Adjusted Net Saving, including particulate Emission Damage | 2020 US$ | Our World in Data (https://ourworldindata.org/grapher/international-finance-clean-energy) |
| Renewable energy | Renewable energy refers to the transition from using fossil fuels to renewable sources. | Percent (%) | WDI - World Bank (https://data.worldbank.org/indicator/EG.FEC.RNEW.ZS) |

According to the variables used, the following is the model specification of this study:

$$CO_{2t} = \beta_0 + \beta_1 GDP_t + \beta_2 GDP^2{}_t + \beta_3 RE_t + \beta_4 GF_t + \varepsilon_t \quad (1)$$

Where $CO_2$ refers to $CO_2$ Emissions, β is a constant, GDP refers to Gross Domestic Product, $GDP^2$ refers to the square of Gross Domestic Product, GF refers to Green Finance, RE represents Renewable Energy, and ε represents the error term. The inclusion of the $GDP^2$ in the model is to prove the existence of the EKC hypothesis in the form of an inverse U-shaped curve. The positive influence of GDP, accompanied by the negative influence of GDP squared, indicates that the EKC hypothesis is proven (Kuznets, 1955; Grossman & Krueger, 1995). The variables used in this study refer to the studies of Ahmed et al. (2022), Baskaya et al. (2022), Han and Jun (2023), and Massagony and Budiono (2023).

### Data analysis method

The method of data analysis employed in this study is a Panel Autoregressive Distributed Lag (ARDL) method with Pooled Mean Group Estimators by Pesaran et al. (1999). The reason for using this method is that it can be applied using a mixture of I(0) and I(1) variables (Bahmani-Oskooee et al., 2020; Sohail et al., 2022; Zhan et al., 2023). The ARDL method is more suitable for small sample sizes and offers different estimates at different lag sequences; thus, this approach provides reliable estimates that significantly eliminate the endogeneity problem in the model (Raghutla & Kolati, 2023). In addition, Pooled Mean Group estimation allows for heterogeneity in short-run coefficients across different panels while assuming that the long-run coefficients are the same across all panels.

## Results and Discussion

### Descriptive Statistics

**Table 2.** Descriptive Statistics

| | $CO_2$ | GDP | $GDP^2$ | GF | RE |
|---|---|---|---|---|---|
| Mean | 1.97E+08 | 3689.842 | 2,053,6415 | 1.06E+08 | 32.597 |
| Median | 1.82E+08 | 2873.436 | 8257510. | 10750000 | 30.095 |
| Maximum | 6.59E+08 | 11114.54 | 1.24E+08 | 1.09E+09 | 81.580 |
| Minimum | 1974896. | 488.003 | 238,146.6 | 10,000.00 | 1.960 |
| Std. Dev. | 1.55E+08 | 2640.893 | 28275906 | 1.91E+08 | 20.552 |
| Skewness | 0.897 | 1.118 | 1.991 | 2.848 | 0.598 |
| Kurtosis | 3.509 | 3.423 | 6.302 | 12.401 | 2.933 |
| | | | | | |
| Jarque-Bera | 19.131 | 28.477 | 147.164 | 664.485 | 7.898 |
| Probability | 0.000 | 0.000 | 0.000 | 0.000 | 0.019 |
| | | | | | |
| Sum | 2.60E+10 | 487059.2 | 2.71E+09 | 1.40E+10 | 4302.750 |
| Sum Sq. Dev. | 3.14E+18 | 9.14E+08 | 1.05E+17 | 4.80E+18 | 55331.35 |
| Observations | 132 | 132 | 132 | 132 | 132 |

Table 2 summarizes the statistics of the key variables analyzed in this research. The findings show that CO2 Emissions, GDP, its squared term, Green Finance, and Renewable Energy exhibit positive skewness, implying that most data points are clustered towards the lower end of the distribution. The standard deviations for most variables were much lower than the mean, indicating that the model variables were stable. The Jarque-Bera test indicates significant deviations from normality for renewable energy utilization and population, as evidenced by their low P-values.

### Panel Unit Root Test

The results of the unit root test, as presented in Table 3, show that only the Green Finance variable is stationary at a 1% significance level, indicating that it is of I(0). The same tests for all other

variables using the first differenced data indicate that they are stationary at 1%, 5%, and 10% significance levels or are of I(1). The mixed results of the tests confirm the appropriateness of using ARDL to estimate the model.

**Table 3.** Results from the Panel Unit Root Test

| Test | Variables | Level | First Difference |
|---|---|---|---|
| Levin, Lin, and Chu | $CO_2$ Emissions | -0.285 | -4.403*** |
| | GDP | -0.404 | -1.499* |
| | $GDP^2$ | 1.297 | -1.669** |
| | Green Finance | -110.015*** | -53.217*** |
| | Renewable Energy | -0.013 | -4.436*** |
| Im, Pesaran and Shin W-Stat | $CO_2$ Emissions | 2.205 | -3.899*** |
| | GDP | 2.286 | -2.162** |
| | $GDP^2$ | 3.545 | -1.857** |
| | Green Finance | -44.014*** | -31.526*** |
| | Renewable Energy | 1.5822 | -4.142*** |
| ADF – Fisher Chi-square | $CO_2$ Emissions | 7.578 | 38.530*** |
| | GDP | 3.310 | 22.121** |
| | $GDP^2$ | 1.534 | 19.928* |
| | Green Finance | 296.393*** | 347.678*** |
| | Renewable Energy | 4.443 | 39.473*** |
| PP - Fisher Chi-square | $CO_2$ Emissions | 14.590 | 67.539*** |
| | GDP | 2.656 | 59.680*** |
| | $GDP^2$ | 1.095 | 60.261*** |
| | Green Finance | 138.822*** | 621.914*** |
| | Renewable Energy | 3.883 | 65.718*** |

Notes: ***, **, and * indicated statistically significant at 1%, 5%, and 10%, respectively.

## Cointegration Test

**Table 4.** Pedroni Residual Cointegration Test

| Test Statistic | t-Statistic | Prob. |
|---|---|---|
| Panel PP-Statistic | -2.577*** | (0.005) |

Notes: Symbol ***, **, and * indicated statistically significant at 1%, 5%, and 10%, respectively.

Table 4 shows the results of the Pedroni residual cointegration test. Using the Panel PP-Statistic, the outcome indicates that the error correction parameter is negative and significant at the 1% level. This explains that the cointegration test rejects the null hypothesis, indicating long-term cointegration.

## Long Run and Short Run Outcomes in ASEAN Developing Countries

Table 5 shows the findings of the panel ARDL model, where in the long run, GDP has a positive significant effect on $CO_2$ emissions, while $GDP^2$ has a negative significant effect on $CO_2$ emissions. The high economic growth most likely arises from a higher level of industrialization, which will, in turn, increase the level of $CO_2$ emissions, which will deteriorate the environmental quality in the region (Claire & Widyawati, 2023; Dong et al., 2019; Dong et al., 2021; Rehman et al., 2021). The quadratic effect of GDP on CO2 emissions confirms an inverted U-shaped curve, indicating the presence of the Environmental Kuznets Curve (EKC) Hypothesis, which has been substantiated in developing ASEAN countries. This finding aligns with Kuznets's (1955) proposal, subsequently expanded by Grossman and Krueger (1995). The existence of the EKC hypothesis in developing ASEAN countries supports that of previous studies (Adeel-Farooq et al., 2020; Anwar et al., 2021; Claire & Widyawati, 2023; and Guzel & Okumus, 2020).

**Table 5.** Result of ARDL Model

| Variable | Coefficient | Std. Error | t-Statistic | Prob.* |
|---|---|---|---|---|
| | Long Run Equation | | | |
| LNGDP | 1.405 | 0.031 | 40.643 | 0.000*** |
| LNGDP2 | -0.702 | 0.017 | -40.643 | 0.000*** |
| LNGF | -0.014 | 0.006 | -2.523 | 0.014** |
| LNRE | -0.171 | 0.035 | -4.811 | 0.000*** |
| | Short Run Equation | | | |
| COINTEQ01 | -0.298 | 0.174 | -1.711 | 0.091* |
| D(LNGDP) | 0.705 | 0.280 | 2.522 | 0.014** |
| D(LNGDP(-1)) | 0.243 | 0.301 | 0.807 | 0.422 |
| D(LNGDP$^2$) | -0.714 | 0.347 | -2.056 | 0.042** |
| D(LNGDP$^2$ (-1)) | -0.236 | 0.256 | -0.920 | 0.360 |
| D(LNGF) | -0.001 | 0.001 | -0.827 | 0.411 |
| D(LNGF (-1)) | -0.000 | 0.001 | -0.302 | 0.764 |
| D(LNRE) | -0.599 | 0.266 | -2.254 | 0.027** |
| D(LNRE(-1)) | -0.222 | 0.117 | -1.899 | 0.061* |
| C | 2.200 | 1.270 | 1.733 | 0.087* |
| Root MSE | 0.032 | Mean dependent var | | 0.053 |
| S.D. dependent var | 0.068 | S.E. of regression | | 0.041 |
| Akaike info criterion | -3.012 | Sum squared resid | | 0.137 |
| Schwarz criterion | -1.898 | Log likelihood | | 249.784 |
| Hannan-Quinn criterion. | -2.559 | | | |

Table 5 reports the long-term negative and significant effects of green finance variables on $CO_2$ emissions. The relationship is significant at a 5% level. In terms of its strength, an increase in the use of Green Finance by 1% tends to reduce the CO2 emission by 1.36%, indicating a positive role of Green Finance in improving environmental quality. This further entails that when an economy undertakes strategies in green finance aimed at enhancing environmental quality, it will achieve its intended purposes (Guo et al., 2022; Hu et al., 2023; Wang & Ma, 2022; Sadiq et al., 2024; Yadav et al., 2024; Zhan et al., 2023; Zhang et al., 2023; Yang & Tang, 2024)However, in the short run, Green Finance has an insignificant effect on CO2 emissions, implying that immediate changes in financing may not lead to quick emissions reductions. This could be due to various factors, such as the uncertain time required to implement the projects or behavioral shifts among businesses and consumers. It emphasizes the importance of patience and sustained investment in green finance initiatives (Chan et al., 2024; Kasi and Li., 2025).

Additionally, Table 6 presents diagnostic tests for each specific group's empirical model. The results indicate the absence of heteroskedasticity, serial correlation, non-normally distributed residuals, and omitted variable bias. Therefore, the estimated results are valid for interpretation.

**Table 6.** Post Estimation Diagnostics Tests

| Country | Heteroskedasticity (Breusch-Pagan-Godfrey) | Normality (Jarque Bera) | Serial Correlation (Breusch-Godfrey) | Specification (Ramsey Reset) |
|---|---|---|---|---|
| Indonesia | 0.185 | 0.546 | 2.209 | 0.682 |
| | (0.950) | | (0.142) | (0.188) |
| Malaysia | 1.247 | 0.535 | 0.195 | 1.240 |
| | (0.322) | | (0.825) | (0.082) |
| Thailand | 1.922 | 0.448 | 1.006 | 1.188 |
| | (0.162) | | (0.084) | (0.554) |
| Vietnam | 0.008 | 1.699 | 3.511 | 0.503 |
| | 0.999 | | 0.054 | (0.622) |
| Philippines | 0.525 | 0.359 | 2.074 | 1.781 |
| | (0.671) | | (0.158) | (0.093) |
| Cambodia | 0.561 | 0.844 | 1.247 | 1.734 |
| | (0.647) | | (0.501) | (0.083) |

Further discussion, renewable energy hurts $CO_2$ emissions both in the long and short run. In the long run, this relationship is significant at a 1% significance level. In terms of its strength, it reflects that through renewable energy, there will be an eradication of the level of carbon emission by 17.04%, which reflects an appreciable role of Renewable Energy use towards environmental quality. In the short run, the effect of renewable energy is more marginally significant, at 5% and 10% levels. This suggests that while renewable energy can contribute to emissions reductions quickly, the extent of this impact may be limited initially. Several factors might be responsible, including existing reliance on fossil fuels, infrastructure constraints, or the time needed for the renewable sector to scale up. These results corroborate the studies by Khan and Hou (2021), Raghutla and Kolati (2023), Triki et al. (2023), Usman et al. (2022), Wei et al. (2023), and Altaf et al. (2025).

In summary, the results of this study underscore the critical relationship between green finance, renewable energy, and carbon emissions. The findings reveal that green finance and renewable energy are pivotal in reducing carbon emissions, highlighting the importance of integrating these elements into national and regional policies. The results indicate that renewable energy has a significantly higher impact on carbon emissions reduction than green finance, with a reduction of 17.04% versus 1.36% for green finance. This disparity suggests that while both factors are crucial for improving environmental quality, renewable energy is currently a more potent tool in the fight against carbon emissions. The significant long-run effect of green finance on carbon emissions indicates that sustained investment in environmentally friendly initiatives can lead to lasting changes in energy consumption and production patterns. In the rapidly industrializing context of ASEAN countries, where economic growth often comes at the expense of environmental degradation, green finance can provide the necessary capital to transition to cleaner technologies (Yang & Tang, 2024). For instance, Indonesia and Vietnam, which have been heavily reliant on fossil fuels, can benefit from green financial instruments that encourage investments in sustainable projects. By fostering a supportive regulatory environment and ensuring access to green finance, these countries can mitigate the carbon footprint associated with their industrial activities over time.

The dual impact of both short and long-run renewable energy highlights its role as a versatile solution for carbon emission reductions. As countries like Thailand and the Philippines ramp up their solar and wind energy investments, immediate benefits appear in reduced dependency on coal and other fossil fuels. This transition is particularly vital in the face of rapid industrialization, which often leads to increased emissions. Malaysia's commitment to enhancing its renewable energy capacity can significantly reduce carbon emissions, foster a cleaner environment, and support sustainable economic growth. Most investments in renewable energy are going to Vietnam due to its advanced industrialization and rapid growth, making it an attractive destination for many investors. Significant financial resources and expenditures are required to enhance renewable energy sources, facilitate the transition to sustainable energy, and implement waste reduction programs (Sadiq et al., 2024).

## Conclusion

The present analysis quantifies the influence of GDP, green finance, and renewable energy on CO2 emissions for the ASEAN-6 emerging. Several statistical tests, including the unit root test, Pedroni Residual Cointegration Test, descriptive statistics, Panel ARDL analysis, and post-estimation diagnostic testing, have been used to analyze the relationship among the variables in the network. The study's findings indicate that ASEAN enhances the UN's efforts to mitigate CO2 emissions and address climate change. The study aims to offer relevant policy implications for the ASEAN countries' ambitions to reduce CO2, together with a crucial lesson for the future of the global community. The study's conclusions will assist policymakers in strategically allocating investments to achieve environmental sustainability. Our findings have significant policy implications. Firstly, prioritizing renewable energy utilization is essential for ASEAN nations to address the environmental challenges climate change poses. Establishing strong objectives for renewable energy and feasible laws is crucial to this process. Secondly, policymakers should leverage the

study's insights to develop green finance structures that optimize CO2 reduction efficacy. Thirdly, comprehending the inverted U-shaped relationship enables policymakers to prioritize measures that speed up the attainment of the turning point, expediting the transition to the beneficial phase of renewable energy. The government's main objective is to ensure companies switch to renewable energy. Green Finance can facilitate the transition to green energy. Attractive financing interest rates, lower than the market rate, and simplified terms might incentivize corporations to engage in renewable energy or other sustainability sectors. All this would also be crucial in supporting economic growth while achieving environmental sustainability.

This study has determined that the EKC Hypothesis is valid in ASEAN developing countries when considering green finance and renewable energy variables. However, it only establishes a non-linear relationship between economic growth and environmental quality without identifying the possibility of a non-linear relationship between green finance and renewable energy on CO2 emissions. This is imperative since the energy transitions in ASEAN countries are still in progress in recent and upcoming decades. Secondly, future studies might consider the turning point at which a country will achieve improved environmental quality, as the economic and industrial disparities among countries might lead to gaps between countries.

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# The role of productivity, wages, demand, and exchange rates on export performance: Evidence from the Turkish manufacturing industry

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**Abstract**

**Purpose** — This study explores the determinants of export performance in the Turkish manufacturing industry by examining the effects of productivity, wages, demand, and sector-specific real effective exchange rates from 2006 to 2019.

**Methods** — Using firm-level export data across 21 manufacturing sectors, the study applies a Fixed-Effects model with Driscoll-Kraay standard errors to address heteroscedasticity, autocorrelation, and cross-sectional dependence. Endogeneity concerns are mitigated using Two-Step System GMM estimation, complemented by Moment Quantile Regression (MQR) for robustness checks across the export distribution.

**Findings** — The results reveal that higher productivity, increased wages, and stronger external demand significantly enhance exports, while currency appreciation adversely affects export performance. Productivity emerges as the most influential factor.

**Implication** — Productivity enhancement, stable exchange rate management, and workforce development support export-driven growth. Targeted policies that strengthen sectoral competitiveness and expand foreign market access are essential for sustaining manufacturing exports.

**Originality** — This study departs from traditional macro-level analyses by constructing sector-specific indices for real exchange rates and external demand. It offers a more granular and precise understanding of export dynamics. The methodological rigor combines static and dynamic panel estimators to ensure robustness and advance empirical insights into firm-level export behavior.

**Keywords** — Export performance, Productivity, Real effective exchange rate, External demand, Turkish manufacturing, Sectoral analysis, System GMM.

## Introduction

Many countries, including the USA, UK, and Turkey, began implementing supply-side economic policies after the 1980s. In this period, the development of communication and transportation technologies and the decrease in production costs accelerated the globalization of trade. The increase in foreign trade volume has led to a rise in the importance given to exports by countries and firms. These changes significantly accelerated trade globalization and deepened national economies' integration into global value chains. Consequently, export performance emerged as a critical driver of economic growth, employment creation, innovation capacity, and competitive

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advantage for firms and nations (Abbas et al., 2015). The export-led growth paradigm, particularly in manufacturing sectors, has become a central strategic focus in many national economic agendas.

In this regard, in the early 2000s, theoretical research in international trade began to examine the behavior of exporting and non-exporting firms with heterogeneous firm models (Melitz, 2003; Bernard et al., 2007a; Bernard et al., 2007b; Melitz and Ottaviano, 2008; Eaton et al., 2011; Alvarez et al., 2013; Chaney, 2014; Chaney, 2016; Spearot, 2016; Kim and Osgood, 2019; Boitier, 2022; Aghion et al., 2024; Khasanov and Hiwatari, 2025). Melitz (2003), the basis of these current studies, emphasized the importance of productivity and sunk costs to initiate exporting. According to this model, exporting firms have relatively higher productivity than non-exporting firms. Among the heterogeneous firm models developed later, Eaton et al. (2011) focused on market and firm-specific heterogeneity in entry costs and demand shocks. Chaney (2016) emphasized the liquidity constraints for heterogeneous firms to initiate exporting. Aghion et al. (2024) investigated how the demand conditions faced by heterogeneous firms in markets affect their innovation decisions. Khasanov and Hiwatari (2025) considered heterogeneity between parent institutions and trading partners and emphasized the role of productivity on exports.

New dimensions have been added to heterogeneous firm models, with the empirical literature developing at the same time (for example Bernard and Jansen, 2004; Dekle and Ryoo, 2007; Greenaway et al., 2007; Alvarez and Lopez, 2009; Fung and Liu, 2009; Dekle et al., 2010; Zhang and Liu, 2012; Abbas et al., 2015; Rashid and Wager, 2017; Van den Berg et al., 2019; Karamollaoglu and Yalcin, 2020; Dincer et al., 2021; Jafari et al., 2023; Fambeu, 2024; Liu et al., 2024; Matthias et al.,2025). Research on firm exporting in theoretical and empirical literature has resulted in several significant findings. First, exporting firms incur sunk costs, such as research, equipment, machinery purchases, advertising, etc. If a firm can bear these sunk costs, it begins exporting (Campa, 2004). On the other hand, wages have been found to have a dual effect on exports. On one hand, an increase in wages raises firms' production costs, which negatively impacts their exports (Fung and Liu, 2009; Nguyen and Sun, 2012; Cheung and Sengupta, 2013; Rashid and Wager, 2017; Rashid et al., 2021; Dangizer and Dangizer, 2024). On the other hand, higher wages may indicate a more skilled workforce, which can positively affect exports due to the increased productivity and expertise of the labor force (Gourley and Seaton, 2004; Sun, 2009; Abraham and Van Hove, 2010; Greenaway et al., 2012; Zhang and Liu, 2012; Nguyen, 2021).

In the case of Turkey, which has undergone significant structural reforms and trade liberalization since the 1990s, the manufacturing industry represents a vital engine of export growth. Yet, comprehensive assessments that account for industry-specific dynamics are relatively scarce. Studies on firm exports typically analyze total exports using macroeconomic variables, often assuming that all observations are homogeneous when analyzing total exports with some variables. In this study, however, we aim to consider sectoral differences, calculate external income based on industry-specific weights, and use average export data of exporting firms on an industry-specific basis. This approach acknowledges that assuming homogeneity is not just a preference but a necessity, given the constraints in the data, and thus, such assumptions are made. Considering the existing studies in the literature, this study was intriguing in examining the factors affecting exports on an industry-specific basis by considering the average number of firms in the sector.

This study addresses this critical gap by examining the export performance of Turkish manufacturing industries from a sector-specific perspective for the period 2006-2019. This study's contributions to the literature are the following: First, the industry-specific real exchange rates and GDP are calculated to see how these factors impact Turkish manufacturing exports. It is observed that many published papers use the real exchange rate index calculated by central banks as a proxy for relative prices. The real exchange rate index is the weighted geometric average of the host country's price level ratio to the countries with which it does foreign trade. In other words, while it is considered total exports, in this study, it is calculated separately for each sector by considering sectoral export data. On the other hand, as an indicator of foreign demand, the sum of the Gross Domestic Product (GDP) of countries with a significant share in the world economy or international trade (USA, EU, etc.) is used. In our study, the GDP value of the countries to which Turkey exports and the sum of GDP weighted according to the export ratio are used as foreign

demand indicators. Secondly, the method used in the analysis of the study. The Fixed Effect model with Driscoll-Kraay standard error, which is resistant to the problems of variance, autocorrelation, and cross-sectional dependence, is used. In addition to this method, the Moments Quantile Regression (MQR) estimation technique is used to assess the robustness of the estimator.

## Methods

### Data and Model

The study used firms' exports in 21 sectors according to the ISIC Rev4 Level 2 classification covering 2006–2019. It is important to note that the data collection ended in 2019 since 2020 and onwards were significantly impacted by the Covid–19 pandemic. Therefore, the study's focus is primarily on pre–pandemic conditions, as the effects of the pandemic on exports are not accounted for in the analysis. Firm export data is calculated by dividing foreign sales by the number of entrepreneurs from the income statement in the Turkish Entrepreneur Information System (TEIS) database. In the calculation of the industry specific real effective exchange rate index, export data were gathered from the Turkish Statistical Institute (TURKSTAT), the annual average buying rate of exchange was obtained from the Central Bank of Turkey Republic (CBRT) database, and Consumer Price Index (CPI) data were got from the IMF's database. GDP data of partner countries according to export weight were taken from the World Bank's database. The seasonal and calendar-adjusted industrial gross wage-salary index is obtained from TURKSTAT, and the seasonal and calendar-adjusted production per hour worked index is collected from the TEIS database.

**Table 1.** The definitions of the variables and the data source

| Variables | The Definitions of Variables | Data Source |
|---|---|---|
| Lexp | Firm–based export calculated from the income statement in the Turkish manufacturing industry (foreign sales/number of enterprises) ($) | TEIS |
| Lreer | Industry-specific real exchange rate (index) | Authors' Calculation |
| Lgdp | Industry-specific GDP ($) | Authors' Calculation |
| Lppw | Production per working hour (index) | TEIS |
| Lwage | Gross wages (index) | TURKSTAT |

To calculate the industry-specific real effective exchange rate index, 20 countries with the highest share in Turkiye's industry-specific foreign trade were determined. In the foreign trade weighting calculation, the method used in Saygili et al. (2012) study was applied, while the geometric mean method was used to calculate the industry-specific real effective exchange rate index. Model 1 shows the real effective exchange rate index calculation.

$$rer_c^t = \frac{P^{TR}}{P^C x\, e_{CTR}} \tag{1}$$

In Model 1, $\mathrm{rer_c^t}$ refers to the exchange rate of the national currency of country c and the national currency of Turkiye at time t (the real exchange rate index), $\mathrm{P^{TR}}$ denotes Turkiye's CPI rate, $\mathrm{P^C}$ shows the partner country's CPI rate, and $\mathrm{e_{CTR}}$ represents the nominal exchange rate. Calculation of export weight, import weight, and foreign trade weight were implemented according to the models included in the study of Saygili et al. (2012).

$$wx_{ci}^t = \frac{X_{ci}^t}{\sum_{c=1}^N X_{ci}^t} \quad , \quad mt_{ci}^t = \frac{M_{ci}^t}{\sum_{c=1}^N M_{ci}^t} \tag{2}$$

$$wt_{ci}^t = \left(\frac{\sum_{c=1}^N X_{ci}^t}{\sum_{c=1}^N X_{ci}^t + \sum_{c=1}^N M_{ci}^t}\right) wx_{ci}^t + \left(\frac{\sum_{j=1}^N M_{ci}^t}{\sum_{j=1}^N X_{ci}^t + \sum_{j=1}^N M_{ci}^t}\right) mt_c^i \tag{3}$$

$$Reer_i^t = \prod_{c=1}^N (rer_c^t)^{wt_{ci}^t} \tag{4}$$

In Model 2, where $\mathrm{wx_{ci}^t}$ represents the export weight of country c in sector i, $\mathrm{mt_{ci}^t}$ is the import weight of *c* country in sector *i*, and in Model 4, $\mathrm{wt_{ci}^t}$ refers to the foreign trade weight of

the country c in sector i. Models 2 and 3 $X_{ci}^{t}$ ile $M_{ci}^{t}$ denotes Turkiye's exports to 20 countries (c) and imports from 20 countries in sector i at time t, respectively. Model 4 was used to calculate the sectoral real effective exchange rate index. The weighing of selected countries for each sector results in variations in this index across sectors. Model 5, where $Reer_{i}^{t}$ is the sectoral real effective exchange rate index, $wt_{ci}^{t}$ is the weight of foreign trade in the i sector of country c, and $rer_{c}^{t}$ is the real effective exchange rate index. To measure the effect of the increase in partner countries' incomes on exports, industry-specific GDP was calculated using a method like the industry-specific real exchange rate index (Fung and Liu, 2009).

$$GDP_{ci}^{t} = \sum_{c=1}^{N}(wx_{ci}^{t} \text{ x } GDP_{c}^{t}) \quad (5)$$

Model 5, where $GDP_{ci}^{t}$ is industry-specific GDP, $wx_{c}^{i}$ is the export weight of partner countries in sector i, and $GDP_{c}^{t}$ is the GDP of partner countries at time *t*. In other words, this model was calculated using the first 20 countries to which Turkiye exports in sector *i*. Then, the GDP value of these 20 countries is multiplied by their export weight.

## Econometric Methodology

In this study, the relationship between variables is analyzed with both static and dynamic panel data models. The heteroscedasticity, autocorrelation, and cross-section dependence in static panel data models should be checked first. The estimation results may be biased if one or more of these assumptions are violated. In panel data models, it is a basic assumption that the variances of error terms have constant variance between units. The modified Wald test can be used to detect the presence of heteroscedasticity in the fixed effects model (Greene, 2003). For the autocorrelation test, Bhargava, Franzini, and Narendranathan's Durbin–Watson d test and Baltagi Wu's Local Best Invariant (LBI) test are recommended (Hill et al., 2011). In the Baltagi–Wu and Durbin Watson autocorrelation test, if the test value is less than 2, the model has first–order autocorrelation (Gujarati and Porter, 2008). When some assumptions of the panel data regression model are violated, estimators producing robust standard errors should be used to obtain valid results (Hoechle, 2007). Driscoll and Kraay (1998) proposed a standard nonparametric covariance matrix estimator based on large T asymptotics that is robust to all general dimensional and temporal correlation types. This method produces robust standard errors instead of biased ones in the presence of heteroscedasticity, autocorrelation, and cross–section dependence in panel data models. It is stated that the method is reliable when N is larger than T or when N and T are finite samples of comparable size (Driscoll and Kraay, 1998). Models 6 and 7 were created for the fixed effects model.

$$Lexp_{it} = C + \beta_1 Lgdp_{it} + \beta_2 Lppw_{it} + \beta_3 Lwage_{it} + \gamma_i + \varepsilon_{it} \quad (6)$$

$$Lexp_{it} = \vartheta + \delta_1 Lreer_{it} + \delta_2 Lppw_{it} + \delta_3 Lwage_{it} + \gamma_i + u_{it} \quad (7)$$

In the models, *i* denotes sectors, *t* represents time, $\gamma_i$ indicates unit effect and $\varepsilon_{it}$ refers to the error term. Industry-specific exports are utilized as the dependent variable, and industry-specific real effective exchange rate, industry-specific GDP, production per working hour, and gross wage are employed as independent variables. Natural logarithms of all variables are taken.

In addition to the Fixed Effect model, the Driscoll-Kraay standard error estimator and a Two-Step system generalized method of moments (GMM) were used to address the endogeneity problem in the variables of the estimated model. The system GMM estimators proposed by Arellano and Bover (1995) and Blundell and Bond (1998) are widely preferred in the literature. Compared to the static panel model, system GMM can consider the variables' dynamic effects and prevent the endogeneity problem caused by adding lagged terms (Qiu, 2023). On the other hand, this estimator is appropriate for panel data sets with N>T. The GMM estimator produces efficient results in dynamic models with past values of the dependent variable and when the independent variables are not exogenous. Moreover, the estimator also copes with the presence of unobservable country-specific fixed effects and the presence of heteroscedasticity and autocorrelation (Roodman, 2009).

The instrument set was carefully controlled to avoid the problem of instrument proliferation in the two-step system GMM estimation. We limited the lag range of GMM-style instruments to second and third lags and applied the instrument collapse procedure (Roodman, 2009). As a result, the total number of instruments remained below the number of panel units (N = 21), satisfying the recommended rule of thumb. The Hansen test p-value remained at 1.000, but caution is warranted, and a reduced instrument set was tested to ensure robustness.

$$Lexp_{it} = C + \beta_1 Lexp_{it-1} + \beta_2 Lexp_{it-2} + \beta_3 Lexp_{it-3} + \beta_4 Lgdp_{it} + \beta_5 Lppw_{it} + \beta_6 Lwage_{it} + \varepsilon_{it} \quad (7)$$

$$Lexp_{it} = \vartheta + \delta_1 Lexp_{it-1} + \delta_2 Lexp_{it-2} + \delta_3 Lexp_{it-3} + \delta_4 Lreer_{it} + \delta_5 Lppw_{it} + \delta_6 Lwage_{it} + \delta_7 Lwage_{it-1} + u_{it} \quad (8)$$

Variable $\text{Lexp}_{\text{it}-1}$, $\text{Lexp}_{\text{it}-2}$, and $\text{Lexp}_{\text{it}-3}$ represent the first-order, second-order, and third-order lags of industry-specific exports, respectively. $\text{Lwage}_{\text{it}-1}$ denotes one lag of gross wages.

## Results and Discussion

In the first stage of the econometric analysis, descriptive statistics of the annual observation values of the variables are reported to examine the determinants of Turkish manufacturing industry exports. Table 2 shows the descriptive statistics test results.

**Table 2.** Descriptive statistics

| | Lexp | Lgdp | Lreer | Lwage | Lppw |
|---|---|---|---|---|---|
| Mean | 6.0843 | 12.3043 | 1.9242 | 2.1752 | 2.0194 |
| Std. Devition | 0.5659 | 0.2520 | 0.1721 | 0.2456 | 0.0748 |
| Minimum | 4.5310 | 11.4086 | 1.4747 | 1.7145 | 1.8062 |
| Maximum | 7.5542 | 12.9401 | 2.6078 | 2.7653 | 2.3538 |

When examining Table 2, the lexp variable of 21 sectors has a mean of 6.08 and a standard deviation of 0.57, respectively. It is observed that the minimum and maximum values for the lexp variable are calculated as 4.53 and 7.55, and these values are recorded in Printing and Reproduction of Recorded Media and Motor Vehicle, Trailer, Trailer and Semi-Trailer manufacturing, respectively. The other transport vehicles manufacturing sector has the highest lgdp value, and Tobacco has the lowest lgdp value. Manufacture of Other Non–Metallic Mineral Products and Other Manufacturing are the sectors with the highest and lowest industry-specific exchange rate. When the other variables in Table 2 are analyzed, it is noteworthy that there is a significant difference among the sectors. This shows that there is heterogeneity among industries.

Following the descriptive statistics, the relationship between manufacturing exports and productivity, wages demand, and real exchange rates is analyzed. This study used the Fixed-Effect model with Driscoll-Kraay standard error and the Two-Step system GMM to obtain reliable and flexible estimates. The Fixed-Effect model with Driscoll-Kraay standard error handles heteroscedasticity, autocorrelation, and cross–section dependence. Methodologically, using Two-Step System GMM as developed by Arellano & Bover (1995) and Blundell & Bond (1998) allows efficient estimation for dynamic panels with potential endogeneity. Controlling the number of instruments through the collapse procedure, as Roodman (2009) suggested, keeps the estimation results valid and not over-identified, which is essential considering that the p-value of the Hansen test in this model reaches 1,000. Therefore, caution in the selection and number of instruments is critical to ensure the inferential validity of the model. Table 3 shows baseline model results.

Two-Step System GMM estimation results are presented in Table 3. The coefficients of the Hansen test testing the null hypothesis of the validity of the instrumental variables, and the non–rejection of the $H_0$ hypothesis supports the selection of instruments. The Sargan test assumes that the residuals or error terms are not correlated with the instrumental variables. The validity of the test arises when the $H_0$ hypothesis, indicating that the over–identifying instruments are valid, is

accepted. According to the Hansen statistical result, the instrumental variables are valid, and according to the Sargan test result, there is no relationship between the error terms and the instrumental variables.

**Table 3.** Results for the baseline model

| | (Two-Step System GMM) | (Two-Step System GMM) | (Driscoll-Kraay Std. Err) | (Driscoll-Kraay Std. Err) | (Driscoll-Kraay Std. Err) | (Driscoll-Kraay Std. Err) |
|---|---|---|---|---|---|---|
| L.lexp | 0.974*** | 0.924*** | | | 0.626*** | 0.633*** |
| | (0.09) | (0.06) | | | (0.07) | (0.07) |
| L2.lexp | -0.266** | -0.199** | | | | |
| | (0.10) | (0.09) | | | | |
| L3.lexp | 0.286*** | 0.266*** | | | | |
| | (0.06) | (0.08) | | | | |
| Lgdp | 0.202* | | 0.077* | | | 0.124** |
| | (0.11) | | (0.04) | | | (0.05) |
| L.lgdp | -0.222* | | | | | |
| | (0.11) | | | | | |
| Lwage | 0.091** | 0.633** | 0.715*** | 0.725*** | 0.299*** | 0.276*** |
| | (0.04) | (0.24) | (0.04) | (0.04) | (0.05) | (0.04) |
| L.lwage | | -0.586** | | | | |
| | | (0.25) | | | | |
| Lppw | 0.212** | 0.219** | 0.668*** | 0.666*** | 0.349*** | 0.372*** |
| | (0.08) | (0.10) | (0.10) | (0.10) | (0.06) | (0.06) |
| Lreer | | -0.043* | | -0.059 | -0.067** | |
| | | (0.02) | | (0.03) | (0.02) | |
| Constant | -0.287 | -0.383* | 2.231*** | 3.275*** | 1.082*** | -0.608 |
| | (0.25) | (0.18) | (0.62) | (0.19) | (0.31) | (0.68) |
| Observations | 231 | 231 | 294 | 294 | 273 | 273 |
| Sargan (p-val.) | 0.243 | 0.201 | | | | |
| Hansen (p-val.) | 1.000 | 1.000 | | | | |
| AR (1) (p-val.) | 0.008 | 0.004 | | | | |
| AR (2) (p-val.) | 0.998 | 0.925 | | | | |

Note: ***, **, and * indicate significant at 1%, 5%, and 10% level.

The estimation results using the Two-Step System GMM approach confirm significant export dynamics in the Turkish manufacturing industry. The results indicate that a one-period lag in Turkish manufacturing exports positively impacts exports. This aligns with Melitz's (2003) theory of heterogeneous firms, where companies that have incurred sunk costs to enter the export market tend to maintain their position. Meanwhile, the second lag's negative effect indicates a non-linear medium-term impact, possibly reflecting the dynamics of production or capacity adjustments. This finding is consistent with the results obtained from the Fixed Effect model with Driscoll-Kraay standard error. Furthermore, industry-specific GDP, employment, and wages positively affect exports. On the other hand, the Turkish lira's appreciation results in a 4-6% decrease in exports. The effect of industry-specific GDP on manufacturing exports is positive. This finding indicates that the higher GDP of partner countries increases the demand for Turkiye's manufacturing products. This result may be related to a country's domestic consumption increasing as its income grows. As a result, demand for imports from other countries will likely rise, particularly as commodity demand increases. The results obtained in the literature support this finding by Bernard & Jansen (2004), Rashid & Wager (2017), Cil and Dülger (2018), Karamollaoglu & Yalcin (2020), Rashid et al. (2021), and Aslan & Akpiliç (2024). However, the negative effect of GDP lag in the short run highlights the potential for a lag in the transmission of global demand to the domestic manufacturing sector, a phenomenon also discussed in the context of trade adjustment by Chaney (2016).

In addition, the depreciation of the national currency has a positive impact on exports. Theoretically, when national currency depreciates, domestic products are more competitive in international markets, which positively affects exports. This result is similar with the previous study by Bernard & Jansen (2004); Dekle & Ryoo (2007); Greenaway et al. (2007); Alvarez & Lopez (2009); Fung & Liu (2009); Dekle et al. (2010); Greenaway et al. (2012); Zhang & Liu (2012), Karamollaoğlu & Yalçın (2020); Ekanayake & Dissanayake (2022); Blecker (2023); Joshi et al. (2023); Palazzo (2024); and Urgessa (2024). This emphasizes the need for an exchange rate policy conducive to export stability.

The effect of the wage increase on exports can be explained in two ways. Firstly, the increase in wages may increase the firm's production costs and cause the firm to lose competitiveness and decrease exports. Secondly, an increase in wages may indicate that firms employ a more qualified labour force, and exports may be expected to increase thanks to this qualified labour force. As a result of the analysis, a positive relationship was found between gross wages and exports. It is believed that the increase in wages indicates that firms employ a more qualified labour force and thus have a positive effect on exports. This result supports the studies of Gourley& Seaton (2004), Greenaway et al. (2012), Zhang & Liu (2012), and Nguyen (2021).

On the other hand, productivity positively affects exports. Increased firm productivity may lead to a decrease in the cost per product by reducing production costs. This reduction in production costs leads to an increase in exports. This relationship is supported by the previous study by Bernard & Jansen (2004), Monreal–Perez et al. (2012), Karamollaoglu & Yalcin (2020), Rashid et al. (2021), Ciarli et al. (2023), Nguyen & Le Pham (2025). This finding also strengthens the quality upgrading model in exports, where improvements in internal firm competencies are translated into international competitiveness.

In the second stage, the baseline model was analyzed using the Moments Quantile Regression (MQR) estimation technique to assess the robustness of the estimator. In the literature, Rufael and Weldemeskel (2022), Emenekwe and Emodi (2022), and Pham et al. (2024) prefer the MQR estimator for the robustness of Driscoll–Kraay results. The MQR estimator is assumed to produce more consistent results in controlling heterogeneity and endogeneity and dealing with asymmetric relationships among the determinants of panel data regression models (Ma et al., 2023). Table 4 shows robust analysis results.

**Table 4.** The robust analysis results for the baseline model

| | Model I | | | Model II | | |
|---|---|---|---|---|---|---|
| | 0.25 | 0.50 | 0.75 | 0.25 | 0.50 | 0.75 |
| Lgdp | 0.939*** | 0.899*** | 0.845*** | | | |
| | (0.000) | (0.000) | (0.000) | | | |
| Lreer | | | | 0.204 | 0.092 | -0.041 |
| | | | | (0.301) | (0.602) | (0.842) |
| Lwage | 0.566*** | 0.547*** | 0.522*** | 0.758*** | 0.691*** | 0.612*** |
| | (0.000) | (0.000) | (0.002) | (0.000) | (0.000) | (0.000) |
| Lppw | 0.968** | 1.151** | 1.394** | 0.813 | 1.181** | 1.616** |
| | (0.031) | (0.010) | (0.017) | (0.183) | (0.029) | (0.011) |
| Constant | -8.947*** | -8.530*** | -7.978*** | 2.078** | 2.014** | 1.938* |
| | (0.000) | (0.000) | (0.000) | (0.049) | (0.033) | (0.080) |

Note: ***, **, and * mean rejection of null hypotheses of cross-sectional independence at 1%, 5%, and 10% level.

According to the MQR estimation results in Table 4, industry-specific GDP, productivity, and wages increase exports at all quantile levels. According to the estimation results, productivity is the factor that affects exports the most. In contrast to these findings, the results reveal that the industry-specific exchange rate does not impact exports. This indicates that these factors impact sectors with high exports and have structural significance in smaller sectors, supporting the findings of Pham et al. (2024) and Ma et al. (2023) regarding the importance of robust estimators in capturing distributional heterogeneity in panel data.

## Conclusion

The findings of this study provide insights into the factors influencing firm–based exports in the Turkish manufacturing industry. By employing the Fixed Effect model with Driscoll-Kraay standard error, and two-step system GMM estimators, it is revealed that there are significant relationships between various variables and firm exports. A two-stage strategy was implemented to assess the validity of the baseline model. In the first stage, the robustness of the model's economic theory was thoroughly examined. This involved scrutinizing the model to ensure it aligns with established economic principles and theoretical expectations. During the model's robustness analysis, diagnostic tests were conducted for both the alternative model and the alternative estimator to evaluate autocorrelation, heteroscedasticity, and cross–section dependence. These tests aimed to assess the reliability of the results and determine if any issues could impact the validity of the findings. Upon reviewing the robustness of the results, it was observed that the coefficients demonstrated both economic and statistical similarities to the study's main findings. This further strengthens the credibility of the baseline model, as it suggests that the relationships between the variables remain consistent and reliable across different estimation approaches.

Firstly, the industry-specific real exchange rate impacts firm exports positively. This suggests that changes in the relative value of the Turkish currency play a crucial role in determining the competitiveness of firms in international markets. Therefore, a stable exchange rate policy is vital for promoting export growth in the manufacturing industry. Secondly, the industry-specific GDP exhibits a significant positive relationship with firm exports. This implies that an increase in foreign income and demand for Turkish goods in importing countries positively affects firm–based exports. Policymakers should focus on enhancing trade relations and expanding market access to leverage the potential of foreign demand for Turkish goods. Moreover, the production per working hour demonstrates positive effects on firm exports. This suggests that productivity improvements enhance a firm's export capabilities. Efforts to boost manufacturing productivity and efficiency through technological advancements, innovation, and workforce training can foster export–oriented growth. Lastly, the gross wage reflects a positive association with firm exports. This suggests that higher wages might be an incentive for workers and lead to an improvement in export performance. These findings highlight the importance of exchange rates, external demand, productivity, and export wages. Policymakers should consider implementing strategies to promote a stable exchange rate environment, stimulate foreign demand, increase productivity, and reward workers to improve the competitiveness of Turkish manufacturing firms in global markets.

In the context of developing countries like Turkiye, promoting the export–oriented manufacturing industry remains a critical policy priority. Evaluating the results holistically, policymakers hold responsibilities such as implementing a stable exchange rate policy, producing goods that cater to the demands of importing countries with the growth of foreign income, enhancing productivity in the production process, and fostering the training and employment of a qualified workforce to improve production efficiency.

Future research could extend this analysis by incorporating post-pandemic trade dynamics, exploring firm heterogeneity more deeply, and integrating digitalization factors that increasingly shape global trade competitiveness.

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## Appendix A

**Table A1.** Estimator's decision

| | Unit Effect | | Time Effect | | Unit and/or Time Effect | |
|---|---|---|---|---|---|---|
| | Coefficients | P value | Coefficients | P value | Coefficients | P value |
| F Test | 391.84*** | 0.000 | 0.730 | 0.730 | --- | --- |
| ALM | 1198.42*** | 0.000 | 0.000 | 1.000 | --- | --- |
| LR | 683.12*** | 0.000 | 0.000 | 1.000 | 901.59*** | 0.000 |
| Score Test | 1.5e+05*** | 0.000 | 0.000 | 1.000 | --- | --- |
| Hausman | 13.56*** | 0.008 | --- | --- | --- | --- |

Note: ***, **, and * mean rejection of null hypotheses of cross-sectional independence at 1%, 5%, and 10% level.

**Table A2.** Basic assumptions in the fixed effects model

| Modified Wald Test | | |
|---|---|---|
| | Coefficient | P value |
| Heteroscedasticity | 1039.70*** | 0.000 |
| DW Test | | |
| Autocorrelation | Coefficient = 0.556<br>LBI Test<br>Coefficient = 0.891 | |

Note: ***, **, and * mean rejection of null hypotheses of cross-sectional independence at 1%, 5%, and 10% level.

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# Informal economy, institutional quality, and socioeconomic conditions in African countries

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**Abstract**

**Purpose —** This paper examines the impact of the informal economy and institutional quality on socioeconomic conditions in 35 African countries from 2000 to 2022.

**Methods** — The study employs Driscoll-Kraay, Fully Modified Ordinary Least Squares, Method of Moments Quantile Regression, Dynamic Panel Threshold, and Dumitrescu-Hurlin (D-H) Granger non-causality techniques.

**Findings —** The findings indicate that the informal economy significantly worsens socioeconomic conditions, whereas stronger institutional quality, evident in factors such as government stability and corruption control, enhances these outcomes. A critical institutional quality threshold of 5.282 is established, suggesting that countries with institutional quality above this level experience substantial improvements in socioeconomic conditions. Unidirectional causality from the informal economy to socioeconomic conditions and a bidirectional relationship between institutional quality and socioeconomic outcomes are also noted.

**Implication —** Enhancing institutional quality is essential for promoting economic development and improving overall well-being in African and similar countries. Addressing institutional weaknesses could enable these countries to exceed the quality threshold and achieve better socioeconomic outcomes.

**Originality —** This research differs from previous ones by investigating the effects of both informality and institutional quality within a threshold framework on socioeconomic situations in African countries. Furthermore, it includes a socioeconomic conditions index that combines three subcomponents: poverty, unemployment, and consumer confidence. Additionally, the study employs various measures of institutional quality to explore their differing impacts on socioeconomic conditions.

**Keywords** — informality; institutions; socioeconomic conditions; panel analysis, Africa

## Introduction

The informal economy in Africa presents a multifaceted challenge intricately tied to the socioeconomic conditions across the continent (Dada et al., 2022; Hart, 2009). Informality, defined as economic activities not regulated by the state, constitutes a significant share of the African economy (Medina & Schneider, 2018). It includes a wide range of activities, from street vending to informal financial services, and has become a vital component of survival for many African families (UNDP, 2022). Despite its prevalence, the informal economy is often characterised by low

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productivity, inadequate social protection, and limited access to finance (UNDP, 2022; World Bank, 2021). As a result, informality is a complex issue that is both a consequence of and a contributor to African socioeconomic challenges.

The prevalence of informality in Africa can be examined through multiple theoretical lenses. The dualistic labor market theory, originating with Lewis (1954) and extended by Fields (1975), proposes that the informal sector acts as a residual labor market, absorbing individuals who cannot secure formal employment. Similarly, the structural articulation theory, advanced by Castells and Portes (1989), attributes informality to economic structures that cannot provide adequate formal employment opportunities (Ajide & Dada, 2024b).

In the African context, where economic diversification is limited and formal sectors struggle to absorb a growing labor force, the structural articulation theory offers a compelling explanation for the persistence of informality. Empirical studies from countries like Kenya and Ghana (Chen, 2012; Becker, 2004) establish how limited opportunities in the formal sector and economic stagnation contribute to informal activities, supporting the structural articulation argument. This phenomenon is exacerbated by high levels of underemployment and unemployment, which drive individuals into informal work as a last resort (Gómez & Irewole, 2023; Ogbonna et al., 2023). Furthermore, empirical research in South Africa (Cichello & Rogan, 2017) reveals that the informal sector functions as a buffer for unemployed individuals, reinforcing the dualistic labor market perspective.

A third perspective emanates from the neoliberal approach, which perceives informality as a voluntary choice made by individuals seeking to avoid the constraints of formal regulation (De Soto, 1989). This perspective is also applicable in Africa, where excessive regulation, corruption, and bureaucratic inefficiencies often make formalisation costly and unattractive for small businesses (Canelas, 2019; Xu et al., 2021). Consequently, many entrepreneurs opt to operate informally, where they can avoid taxes and regulatory burdens, even if it means sacrificing certain protections and benefits associated with formal employment (Dada et al., 2022).

These theories all accentuate the vital role of institutions in shaping informality (Ofori et al., 2023; Ujunwa et al., 2021). Institutions, defined as the formal and informal rules governing economic, political, and social interactions (North, 1990), impact the incentives and constraints faced by economic agents. Poor institutional quality—characterized by corruption, lack of government accountability, and weak rule of law—often leads to higher levels of informality as individuals seek ways to navigate an unpredictable environment (Olaniyi & Odhiambo, 2024).

Institutional quality is a key factor in understanding the prevalence of informality (Kırşanlı, 2023) and its impact on socioeconomic outcomes (Fagbemi et al., 2021). According to institutional theory (North, 1990), strong institutions promote trust, reduce transaction costs, and facilitate economic exchanges, encouraging formalization. On the contrary, weak institutions increase uncertainty and costs associated with formal economic activity, leading to an expansion of the informal economy. In Africa, where institutional weaknesses are widespread, informality becomes a rational response to the challenges the formal regulatory environment presents. For instance, in countries with insecure property rights, individuals may prefer to operate informally rather than risk losing assets to corrupt officials or bureaucratic inefficiencies.

Strong institutions create an environment conducive to economic growth, improve access to services, and reduce inequality (North 1990; Olaniyi & Odhiambo 2024). On the other hand, weak institutions exacerbate inequality and poverty by restraining opportunities and access to resources (Fagbemi & Asongu, 2020). In Africa, weak institutional quality is closely linked to poor socioeconomic conditions, as evidenced by low scores on socioeconomic indicators, widespread poverty, and high unemployment rates (Sarsani, 2011; Darin-Mattsson, 2017; Galal, 2024a, 2024b).

Studies establish that countries with stronger institutional frameworks tend to have lower levels of informality, higher economic growth rates, and improved socioeconomic outcomes (Olaniyi & Odhiambo, 2024; Fagbemi et al., 2021). For example, Osinubi et al. (2023) discovered that good governance can help reduce poverty and unemployment, improving overall socioeconomic conditions. Relatively, countries like Botswana and Rwanda, which have relatively stronger institutions, experience lower levels of informality than countries with weaker institutions, such as South Sudan and Zimbabwe (Bolarinwa & Simatele, 2023).

The nexus between informality and socioeconomic outcomes and between institutions and socioeconomic outcomes has been nonlinear (Bolarinwa & Simatele, 2023; Ochi et al., 2023; La Porta & Shleifer, 2014). This implies that the effect of these factors on socioeconomic outcomes does not follow a simple linear relationship. Instead, there appears to be a threshold level of institutional quality that countries must reach before they begin to see substantial reductions in informality and improvements in socioeconomic outcomes.

While the general outlook on informality is often pejorative, it is essential to recognise the role of the informal economy as a safety net for people with low incomes. In many African countries, the informal sector provides livelihoods for millions of people who would otherwise be unemployed. It provides economic security in environments where formal employment opportunities are scarce and social safety nets are weak or non-existent. According to Bolarinwa and Simatele (2023), the informal economy plays a vital role in poverty reduction in low- and middle-income African nations despite its productivity and income stability limitations. This dual role of informality, both a consequence of institutional weakness and a source of resilience for vulnerable populations, highlights the issue's complexity and underscores the need for nuanced policy approaches. Studies by Diallo et al. (2017) and Sahnoun and Abdennadher (2019) also support the argument that the informal economy contributes to reducing unemployment for many urban poor and rural populations despite the challenges faced by the sector.

Understanding the link between socioeconomic outcomes, institutional quality, and informality in Africa is crucial in this context. Although significant research has examined the role of institutions, these studies often rely on narrow measures of institutional quality. For example, Jamil et al. (2022) and Fagbemi et al. (2021) use limited indicators like governance. Likewise, Ochi et al. (2023), Widiastuti et al. (2022), Abé Ndjié (2019), and Shabbir et al. (2019) focus on individual socioeconomic indicators such as employment or poverty. This paper argues that while these studies provide valuable insights, policy interventions could benefit from understanding a broader range of institutional quality measures and their impact on comprehensive socioeconomic conditions.

This paper aims to investigate the relationship between informality and socioeconomic outcomes on the one hand and between institutional quality and socioeconomic outcomes on the other hand in a threshold framework. To this end, the paper makes various contributions to the literature. First, it extends the work of Fagbemi et al. (2021) by using a comprehensive measure of institutional quality, encompassing five indicators: government stability, control of corruption, law and order, democratic accountability, and bureaucratic quality. This broader approach provides a detailed analysis of how these components impact African socioeconomic conditions, addressing the region's high level of informality (Ajide & Dada, 2024b; Dada et al., 2021). Second, the study examines the distributional effects of informality and institutional quality on socioeconomic conditions using Machado and Silva's (2019) quantile regression approach, which allows for heterogeneous impacts across different population segments (Olaniyi & Odhiambo, 2024). Third, it identifies the institutional quality threshold necessary to alleviate the adverse effects of informality. Finally, by considering the reverse causality between informality, institutional quality, and socioeconomic conditions (Bolarinwa & Simatele, 2023; Pham, 2022), this study offers a nuanced understanding of the complex interactions that shape the informal economy and its impact on socioeconomic outcomes.

## Methods

### Data

This study uses a panel dataset comprising 35 African countries[1] from 2000 to 2020, relying on quantitative methods to comprehensively analyze the effects of informality and institutional quality on socioeconomic outcomes. Data sources include the World Bank, the International Country Risk Guide (ICRG) Database, and national statistical agencies (Elgin et al., 2021). Informal output is

[1] The 35 African countries include Algeria, Angola, Botswana, Burkina Faso, Cameroon, Democratic Republic of Congo, Republic of Congo, Cote d'Ivoire, Egypt, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Libya, Madagascar, Malawi, Mali, Morocco, Mozambique, Namibia, Niger, Nigeria, Senegal, Sierra Leone, South Africa, Tanzania, Togo, Tunisia, Uganda, Zambia, and Zimbabwe.

measured as a percentage of official GDP using the Multiple Indicators Multiple Causes (MIMIC) model, following Elgin et al. (2021). Socioeconomic conditions are assessed using an index that measures the risk of socioeconomic dissatisfaction, ranging from 0 (highest risk) to 12 (lowest risk). An institutional quality index is constructed using five indicators: government stability, control of corruption, law and order, democratic accountability, and bureaucratic quality (Fagbemi et al., 2021). These indicators assess the overall institutional environment in each country and its impact on informality. The institutional variables are rescaled from 0 to 10, with higher values indicating stronger institutional quality (Aluko & Ibrahim, 2021; Tang et al., 2020). The institutional variables provide a comprehensive assessment of governance. Government stability reflects the government's capacity to implement policies effectively, while law and order capture the strength of legal institutions and public adherence to rules. Democratic accountability measures government responsiveness to citizens, fostering trust and compliance. Bureaucratic quality minimizes the adverse effects of political instability on public service delivery. These indicators offer a robust measure of institutional quality, facilitating a detailed analysis of how governance impacts informality and socioeconomic outcomes. The control variables include GDP (constant 2015 US$), inflation, and access to electricity to capture other macroeconomic factors that may influence informality and socioeconomic conditions. The descriptions of the variables are presented in Table 1.

**Table 1:** Variables Description

| Variable | Symbol | Measurement | Source |
|---|---|---|---|
| Informal Economy | IFE | Multiple indicators multiple causes model-based (MIMIC) estimates of informal output (% of official GDP) | Elgin *et al.* (2021) |
| Socioeconomic Conditions | SOC | "A measure of the socioeconomic pressures at work in society that could constrain government action or fuel social dissatisfaction". "The risk rating assigned is the sum of three subcomponents: Unemployment, Consumer Confidence, and Poverty and each of them has a maximum score of four points and a minimum score of zero point". A score of four points equates to very low risk and a score of zero points to very high risk". It is on a scale of 0 -12. | ICRG |
| Control of Corruption | COR | "A measure of corruption within the political system that is a threat to foreign investment by distorting the economic and financial environment, reducing the efficiency of government and business by enabling people to assume positions of power through patronage rather than ability, and introducing inherent instability into the political process". It is on a scale of 0-6. | ICRG |
| Democratic Accountability | DAC | "A measure of, not just whether there are free and fair elections, but how responsive government is to its people". It is on a scale of 0-6. | |
| Law and Order | LAO | "Two measures comprising one risk component. Each sub-component equals half of the total. The "law" sub-component assesses the strength and impartiality of the legal system, and the "order" sub-component assesses popular observance of the law". It is on a scale of 0-6. | |
| Government Stability | GOS | "A measure of both of the government's ability to carry out its declared program(s) and its ability to stay in office. The risk rating assigned is the sum of three subcomponents: Government Unity, Legislative Strength, and Popular Support". It is on a scale of 0-12. | |
| Bureaucratic Quality | BUQ | "Institutional strength and quality of the bureaucracy is a shock absorber that tends to minimize revisions of policy when governments change". It is on a scale of 0-4. | |
| Institutional Quality Index | IQI | Average of COR, DAC, LAO, GOS, and BUQ | Authors' Computations from ICRG |
| Economic Growth | GDP | Natural logarithm of GDP (constant 2015 US$) | WDI |
| Inflation | INF | Inflation, consumer prices (annual %) | |
| Electricity | ELE | Access to electricity (% of population) | |

### Model Specification

The study's analytical framework is grounded in institutional theory, which emphasizes the role of institutional quality in determining economic outcomes (North, 1990). The present study is consistent with the studies of Osinubi and Simatele (2024), Bolarinwa and Simatele (2023), Pham (2022), and Fagbemi et al. (2021) on the effects of informal economy and institutional quality on socioeconomic conditions in African countries. However, the model is modified to include a few variables that can influence socioeconomic conditions, as shown in Equation 1.

$$SOC_{it} = \gamma_0 + \gamma_1 IFE_{it} + \gamma_2 INS_{it} + \gamma_3 GDP_{it} + \gamma_4 INF_{it} + \gamma_5 ELE_{it} + \varepsilon_{it} \quad (1)$$

where SOC, IFE, INS, GDP, INF, and ELE indicate socioeconomic conditions, informal economy, different indicators of institutional quality (IQI {institutional quality index}, COR {control of corruption}, DAC {democratic accountability}, LAO {law and order}, GOS {government stability}, and BUQ {bureaucratic quality}), real GDP, inflation, and electricity, respectively. *i and t* represent the countries and the study period, $\gamma_0$ is the intercept, $\gamma_1$-$\gamma_5$ are the parameters to be estimated, and $\varepsilon$ is the error term. Real GDP, inflation, and access to electricity are included in the model because they have been established in the literature to have significant effects on socioeconomic conditions and the informal economy (Ajide & Dada, 2024b; Bolarinwa & Simatele, 2023; Pham, 2022; Fagbemi et al., 2021; Sahnoun & Abdennadher, 2019). Most crucially, the indicators of institutional quality variables would be introduced into the equation step-by-step, estimating six alternative models, each of which would handle one of the indicators.

### Method of Analysis

Equation 1 will be evaluated using Driscoll-Kraay, Fully Modified Ordinary Least Squares, and Methods of Moments Quantile Regression approaches. The study employs Machado and Silva's (2019) quantile regression approach to assess the distributional effects of informality and institutional quality on socioeconomic conditions. This approach captures heterogeneous impacts across population segments, allowing for a deeper understanding beyond average effects (Olaniyi & Odhiambo, 2024). The different methods are important because they solve the issues of endogeneity, cross-sectional dependence, serial correlation, heterogeneity, nonlinearity, and distributional effects (Olaniyi & Odhiambo, 2024).

Additionally, the study investigates the level of institutional quality needed to mitigate the adverse effects of informality on socioeconomic conditions using a dynamic panel threshold model by Seo et al. (2019) and Seo and Shin (2016). This method is better than the static method since it considers nonlinear relationships and a real-world dynamic perspective, as well as the behaviour of variables before and after the threshold (Olaniyi & Odhiambo, 2024).

The study employs a panel Granger non-causality approach developed by Dumitescu and Hurlin (2012) to determine the causal relationships among the informal economy, institutional quality, and socioeconomic conditions. This method is significant since it accounts for cross-sectional dependence and heterogeneity among African countries. The D-H is a bivariate causality test based on the panel vector autoregressive (VAR) modeling approach.

## Results and Discussion

### Cross-Sectional Dependence and Panel Unit Root Tests

Most African countries are related economically, socially, or politically. This suggests that a shock in one of the countries can spread to other related countries. As a result, the series must be adjusted for cross-sectional dependence. This is done by employing Breusch and Pagan (1980), Pesaran et al. (2008), Baltagi et al. (2012), and Pesaran (2004) CD tests. The results of the four CD tests in Table 2 show that African countries are highly interconnected. Notably, the Breusch-Pagan LM, Bias-corrected scaled LM, and Pesaran scaled LM statistics do not apply to LAO and BUQ because the values are nearly the same for each country across the study period. Thus, the study uses unit root tests and estimation procedures that account for cross-sectional dependence. Tables 3 (intercept alone) and 4 (intercept and trend) show the panel unit root tests devised by Pesaran

(2007): Im-Pesaran-Shim, cross-sectionally augmented IPS (CIPS), and cross-sectionally augmented Dickey-Fuller (CADF). The IPS test does not account for the presence of CD, but CIPS and CADF do. However, CIPS outperforms CADF when the variables are cross-sectionally dependent. Some variables are stationary at the level, while others are stationary at the first difference, according to the many tests used. As a result of the differing results from the different techniques, all the variables would be stationary at first difference. According to Olaniyi and Odhiambo (2024), the mixed orders of integration demonstrate that the variables act divergently in the short term. As a result, there is a need to investigate the presence of long-term relationships.

**Table 2:** Cross-Sectional Dependence Tests

| Variable | Breusch-Pagan LM | Pesaran scaled LM | Bias-corrected scaled LM | Pesaran CD |
|---|---|---|---|---|
| SOC | 2370.143*** | 51.459*** | 50.584*** | 7.865*** |
| IFE | 4316.867*** | 107.892*** | 107.017*** | 40.841*** |
| IQI | 2485.777*** | 54.819*** | 53.936*** | 18.385*** |
| COR | 2628.694*** | 58.954*** | 58.079*** | 93.410*** |
| DAC | 2718.050*** | 61.544*** | 60.669*** | 9.904*** |
| LAO | NA | NA | NA | 4.770*** |
| GOS | 4742.074*** | 120.218*** | 119.343*** | 63.182*** |
| BUQ | NA | NA | NA | 11.412*** |
| GDP | 10079.13*** | 274.931*** | 274.056*** | 94.410*** |
| INF | 1409.293*** | 23.605*** | 22.730*** | 11.084*** |
| ELE | 9303.907*** | 252.459*** | 251.584*** | 84.110*** |

Note: *** indicates significance at 0.01

**Table 3.** Panel Unit Root Tests (Intercept Only)

| | IPS Test | | CIPS Test | | CADF Test | |
|---|---|---|---|---|---|---|
| Variable | Level | 1st Difference | Level | 1st Difference | Level | 1st Difference |
| SOC | -2.444*** | -12.408*** | -2.795*** | -3.806*** | -2.173*** | -3.701*** |
| IFE | 0.096 | -9.091*** | -1.970 | -3.690*** | -2.067*** | -2.861*** |
| IQI | -4.027*** | -11.837*** | -2.077 | -3.811*** | -2.236*** | -3.164*** |
| COR | -2.733*** | -10.284*** | -1.464 | -3.430*** | -1.689 | -2.891*** |
| DAC | -6.019*** | -10.674*** | -1.493 | -3.303*** | -2.019 | -3.144*** |
| LAO | -9.465*** | -18.724*** | -1.020 | -1.611 | -1.079 | -1.215 |
| GOS | -3.848*** | -14.328*** | -2.583*** | -4.363*** | -2.804*** | -3.834*** |
| BUQ | 6.256 | -3.271*** | 1.207 | -0.050 | -0.935 | 0.312 |
| GDP | 2.165 | -11.955*** | -2.670*** | -4.921*** | -2.011 | -3.290*** |
| INF | -10.965*** | -16.878*** | -2.957*** | -4.736*** | -2.565*** | -3.943*** |
| ELE | 4.723 | -15.858*** | -2.972*** | -5.594*** | -2.216*** | -4.311*** |

Note: *** indicates significance at 0.01

**Table 4.** Panel Unit Root Tests (Intercept and Trend)

| | IPS Test | | CIPS Test | | CADF Test | |
|---|---|---|---|---|---|---|
| Variable | Level | 1st Difference | Level | 1st Difference | Level | 1st Difference |
| SOC | -0.744 | -10.135*** | -2.880*** | -3.950*** | -2.909*** | -3.890*** |
| IFE | 0.830 | -6.589*** | -1.967 | -3.961*** | -1.961 | -3.178*** |
| IQI | -3.364*** | -9.346*** | -2.449 | -4.227*** | -2.598** | -3.476*** |
| COR | -2.771*** | -7.148*** | -2.106 | -3.714*** | -2.383 | -3.050*** |
| DAC | -3.907*** | -9.025*** | -1.936 | -3.963*** | -2.439 | -3.650*** |
| LAO | -8.1595*** | -15.470*** | -0.958 | -2.762*** | -1.067 | -2.134 |
| GOS | -3.359*** | -10.809*** | -2.857*** | -4.509*** | -2.968*** | -3.907*** |
| BUQ | -0.599 | -3.088*** | 0.694 | -0.685 | 0.376 | -0.330 |
| GDP | -2.077 | -11.283*** | -2.625** | -5.278*** | -2.095 | -3.685*** |
| INF | -9.0558*** | -18.548*** | -3.345*** | -4.970*** | -2.863*** | -4.196*** |
| ELE | -0.136 | -13.450*** | -4.067*** | -5.648*** | -3.233*** | -4.214*** |

Note: *** and ** indicate significance at 0.01 and 0.05 levels.

### Slope Homogeneity and Cointegration Tests

The next step is to check for slope homogeneity and cointegration among variables. Table 5 shows Pesaran and Yamagata's (2008) slope homogeneity test findings. From the table, the null hypothesis of slope homogeneity is rejected, implying the existence of slope heterogeneity across African countries. Table 6 illustrates the cointegration test results using the method described by Persyn and Westerlund (2008). This test controls heterogeneity and cross-sectional dependence. Three of the statistics corroborate the existence of cointegration, meaning that the variables will converge with time.

**Table 5.** Slope Homogeneity Test

| Model | $\hat{\Delta}$ | $\hat{\Delta}_{adj}$ |
|---|---|---|
| SOC = f(IFE, IQI, GDP, INF, ELE) | 11.863*** | 14.529*** |
| SOC = f(IFE, COR, GDP, INF, ELE) | 12.251*** | 15.004*** |
| SOC = f(IFE, DAC, GDP, INF, ELE) | 12.561*** | 15.384*** |
| SOC = f(IFE, LAO, GDP, INF, ELE) | 11.819*** | 14.475*** |
| SOC = f(IFE, GOS, GDP, INF, ELE) | 10.429*** | 12.772*** |
| SOC = f(IFE, BUQ, GDP, INF, ELE) | 10.686*** | 13.088*** |

Note: *** indicates significance at 0.01

**Table 6.** Panel Cointegration Test

| Statistic | Value | Z-value | p-value | Robust p-value |
|---|---|---|---|---|
| Gt | -2.885*** | -3.779 | 0.000 | 0.000 |
| Ga | -10.781*** | 1.071 | 0.858 | 0.000 |
| Pt | -14.938*** | -2.791 | 0.003 | 0.000 |
| Pa | -9.044 | -0.107 | 0.457 | 0.200 |

Note: *** indicates significance at 0.01

### Empirical Findings and Policy Recommendations

The study employs Driscoll-Kraay regression to account for cross-sectional dependence and heterogeneity (see Table 7), Fully Modified Least Squares regression in Table 8 to take care of serial correlation and endogeneity, and Method of Moments Quantile Regression (see Table 9) to account for heterogeneous distribution effects across quantiles. Also, the study uses a Dynamic Panel Threshold Regression as shown in Table 10 to investigate the threshold value of institutional quality in the association between informal economy and socioeconomic conditions in African countries.

The estimates from the three methodologies reveal that the informal economy has a considerable and negative impact on African socioeconomic conditions, whether using bundle or unbundle measures of institutions. Specifically, the quantile regression estimates show that greater informal economic activity damages socioeconomic conditions across the quantiles (Q10-Q90). Studies by Osinubi and Simatele (2024), Gasparini and Torbarolli (2009), Loayza et al. (2009), and Krstić and Sanfey (2007) support this finding by indicating that increased informal economic activities result in lower socioeconomic conditions. The negative impacts of the informal economy on socioeconomic results have significant consequences for policy development. The results demonstrate that elevated levels of informality correlate with inadequate earnings, inconsistent incomes, and restricted access to basic services. Consequently, mitigating informality should be a primary policy aim for African countries. Attention must be on formalizing informal businesses by implementing targeted incentives, including streamlined registration procedures, tax advantages, and access to financing. Also, enhancing social protection systems for informal workers may lessen the adverse effects of informality by bolstering job security and income stability. Development organizations and NGOs could be instrumental in formulating and executing initiatives that enable the transition from informality to formality, ensuring that marginalized groups are not overlooked.

A strong institution is expected to create a conducive environment and provide the resources needed to improve socioeconomic conditions. From the three estimations, institutional

quality, irrespective of its measurement, significantly affects African socioeconomic conditions. The finding aligns with Fagbemi et al. (2021), who argue that strong governance can help improve socioeconomic conditions by lowering unemployment, inequality, and poverty levels. The significant relationship between institutional quality and socioeconomic outcomes indicates that prioritizing investment in institutional development is essential for African countries. The results suggest that enhancements in factors such as governmental stability, corruption control, law enforcement, democratic accountability, and bureaucracy effectiveness substantially improve socioeconomic conditions.

Table 10 shows the findings for the threshold effect of institutional quality in the relationship between the informal economy and socioeconomic conditions. The linearity tests indicate the presence of nonlinearity and thresholds of institutional quality in the relationship between the informal economy and socioeconomic conditions, as the null hypothesis of linearity is rejected for all measures of institutional quality. The overall institutional quality, often known as the institutional quality index, has a threshold value of 5.282. Other indices of institutional quality have threshold values of 4.035, 3.330, 3.499, 7.610, and 2.929, for corruption control, democratic accountability, law and order, government stability, and bureaucratic quality, respectively. According to the findings, the thresholds for overall institutional quality, corruption, and government stability are higher than their average values, 4.843, 3.406, and 6.878, respectively. In contrast, those for democratic accountability, law and order, and bureaucratic quality are lower, 5.505, 5.140, and 3.239, respectively.

The threshold of institutional quality yields results like those of Olaniyi and Odhiambo (2024), who discovered a threshold of 5.281 before institutional quality can enhance natural resource rents in spurring renewable energy transitions in resource-rich African nations. Considering that the average IQI in the data is 4.483, achieving and maintaining institutional quality levels beyond established criteria, such as the IQI threshold of 5.282, is essential for significantly enhancing socioeconomic outcomes. Development organizations can facilitate these initiatives by offering technical and financial help to improve governance frameworks and public sector capabilities. The nonlinear correlation between institutional quality and socioeconomic outcomes, characterized by thresholds, indicates that a one-size-fits-all approach may be ineffective. Policymakers must customize their tactics according to their country's existing level of institutional quality. Countries operating below the established thresholds should prioritize foundational enhancements, including the development of law and order and the mitigation of corruption, to foster a stable and predictable environment. Countries that have exceeded these criteria should implement strategies to maintain and enhance institutional quality to promote equitable growth. These distinct tactics will assist nations in optimizing the advantages of institutional development and strengthening the overall socioeconomic environment.

Finally, the study confirms a one-way causality from the informal economy to socioeconomic conditions and a two-way causality between institutional quality and socioeconomic conditions, as displayed in Table 11. The one-way causal relationship supports evidence from Makame and Christine (2024), Sahnoun and Abdennadher (2019), Diallo et al. (2017), Loayza et al. (2009), and Krstić and Sanfey (2007). For the case of institutional quality, the findings are in tandem with the study of Fagbemi et al. (2021), who observed that socioeconomic factors influence governance and vice versa.

### Alternative Control Variables

To further strengthen our estimates, we employ other control variables in investigating the effects of the informal economy and institutional quality on socioeconomic conditions. The variables are foreign direct investment, urban population, and sanitation, which have been documented in the literature as factors that can influence socioeconomic conditions, especially poverty, unemployment, and income inequality (Bolarinwa & Simatele, 2023; Gómez & Irewole, 2023; Ochi et al., 2023; Pham, 2022; Fagbemi et al., 2021). The estimates from the three techniques, as shown in Tables A and B in the appendix, are consistent with the earlier findings that the informal economy and institutional quality worsen and improve socioeconomic conditions, respectively, in African countries.

**Table 7.** Driscoll and Kraay Estimates

| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| IFE | -0.076*** | -0.104*** | -0.106*** | -0.104*** | -0.062** | -0.108*** |
| IQI | 0.384*** | | | | | |
| COR | | 0.039** | | | | |
| DAC | | | 0.061*** | | | |
| LAO | | | | 0.126*** | | |
| GOS | | | | | 0.168*** | |
| BUQ | | | | | | 0.061 |
| GDP | -0.109 | -0.283 | -0.334 | -0.223 | 0.173 | -0.339 |
| INF | -0.0002 | -0.0001 | 0.0001 | -0.0001 | 0.0002 | 0.0001 |
| ELE | 0.006 | 0.005 | 0.005 | 0.004 | 0.008 | 0.005 |
| Constant | 7.068 | 14.134* | 15.191** | 12.200* | 0.486 | 15.534** |
| F-statistic | 65.160*** | 44.880*** | 28.750*** | 28.400*** | 30.76*** | 42.99*** |
| Number of observations | 735 | 735 | 735 | 735 | 735 | 735 |
| Number of groups | 35 | 35 | 35 | 35 | 35 | 35 |

Note: ***, **, and * indicate significance at 0.1, 0.5, and 0.10 levels.

**Table 8.** Fully Modified Least Squares Estimates

| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| IFE | -0.033** | -0.050*** | -0.062*** | -0.059*** | -0.070*** | -0.061*** |
| IQI | 0.805*** | | | | | |
| COR | | 0.471** | | | | |
| DAC | | | 0.135* | | | |
| LAO | | | | 0.302*** | | |
| GOS | | | | | 0.386*** | |
| BUQ | | | | | | 0.171** |
| GDP | -0.242*** | -0.196* | -0.297** | -0.207** | -0.233 | -0.263** |
| INF | -0.002 | -0.002 | 0.002 | -0.0001 | 0.001 | 0.002 |
| ELE | 0.027*** | 0.028*** | 0.034*** | 0.024*** | 0.028*** | 0.029*** |
| Constant | 5.679*** | 7.283*** | 10.770*** | 8.405*** | 7.840*** | 10.297*** |

Note: ***, **, and * indicate significance at 0.1, 0.5, and 0.10 levels.

**Table 9.** Method of Moments Quantile Regression Estimates

| Variable | Location | Scale | Quantiles | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Q10 | Q20 | Q30 | Q40 | Q50 | Q60 | Q70 | Q80 | Q90 |
| **MODEL 1** | | | | | | | | | | | |
| IFE | -0.044*** | -0.016*** | -0.019*** | -0.028*** | -0.035*** | -0.040*** | -0.046*** | -0.050*** | -0.056*** | -0.061*** | -0.068*** |
| IQI | 0.692*** | -0.003 | 0.698*** | 0.696*** | 0.695*** | 0.693*** | 0.692*** | 0.691*** | 0.690*** | 0.689*** | 0.687*** |
| GDP | -0.197*** | 0.045*** | -0.271*** | -0.245*** | -0.225*** | -0.210*** | -0.193*** | -0.181*** | -0.166*** | -0.152*** | -0.131*** |
| INF | -0.0004 | -0.001** | 0.001 | 0.0003 | 0.00001 | -0.00002 | -0.00004 | -0.001 | -0.001* | -0.001** | -0.001** |
| ELE | 0.023*** | -0.004*** | 0.031*** | 0.028*** | 0.026*** | 0.025*** | 0.023*** | 0.022*** | 0.020*** | 0.019*** | 0.017*** |
| Constant | 5.660*** | 0.424 | 4.956*** | 5.200*** | 5.393*** | 5.534*** | 5.696*** | 5.807*** | 5.949*** | 6.086*** | 6.278*** |
| **MODEL 2** | | | | | | | | | | | |
| IFE | -0.056*** | -0.011*** | -0.038*** | -0.044*** | -0.049*** | -0.053*** | -0.057*** | -0.061*** | -0.064*** | -0.068*** | -0.073*** |
| COR | 0.313*** | -0.007 | 0.325*** | 0.321*** | 0.318*** | 0.315*** | 0.313*** | 0.311*** | 0.309*** | 0.307*** | 0.304*** |
| GDP | -0.154*** | 0.009 | -0.169*** | -0.164*** | -0.160*** | -0.156*** | -0.153*** | -0.150*** | -0.147*** | -0.144*** | -0.140*** |
| INF | -0.001** | -0.001** | 0.0001 | 0.0004 | 0.001 | -0.001** | -0.001** | -0.002*** | -0.002*** | -0.002*** | -0.002*** |
| ELE | 0.024*** | -0.002* | 0.027*** | 0.026*** | 0.025*** | 0.024*** | 0.024*** | 0.023*** | 0.023*** | 0.022*** | 0.021*** |
| Constant | 7.383*** | 1.094** | 5.524*** | 6.138*** | 6.669*** | 7.089*** | 7.478*** | 7.834*** | 8.153*** | 8.519*** | 9.027*** |
| **MODEL 3** | | | | | | | | | | | |
| IFE | -0.069*** | -0.011*** | -0.049*** | -0.056*** | -0.061*** | -0.065*** | -0.069*** | -0.073*** | -0.076*** | -0.081*** | -0.087*** |
| DAC | 0.090*** | -0.007 | 0.102*** | 0.098*** | 0.095*** | 0.092*** | 0.089*** | 0.087*** | 0.085*** | 0.082*** | 0.078*** |
| GDP | -0.206*** | 0.017 | -0.235*** | -0.225*** | -0.218*** | -0.212*** | -0.205*** | -0.200*** | -0.195*** | -0.188*** | -0.179*** |
| INF | -0.001 | -0.001*** | 0.003*** | 0.002*** | 0.002*** | 0.001** | 0.001 | 0.0001 | 0.003 | 0.001* | 0.002*** |
| ELE | 0.026*** | -0.003*** | 0.032*** | 0.030*** | 0.028*** | 0.027*** | 0.026*** | 0.025*** | 0.024*** | 0.022*** | 0.020*** |
| Constant | 9.596*** | 1.073*** | 7.760*** | 8.377*** | 8.865*** | 9.249*** | 9.675*** | 9.992*** | 10.324*** | 10.780*** | 11.346*** |
| **MODEL 4** | | | | | | | | | | | |
| IFE | -0.068*** | -0.009*** | -0.051*** | -0.057*** | -0.062*** | -0.066*** | -0.069*** | -0.071*** | -0.074*** | -0.078*** | -0.084*** |
| LAO | 0.270*** | -0.011 | 0.290*** | 0.283*** | 0.277*** | 0.272*** | 0.269*** | 0.266*** | 0.263*** | 0.258*** | 0.252*** |
| GDP | -0.150*** | 0.009 | -0.166*** | -0.160*** | -0.55*** | -0.152*** | -0.149*** | -0.147*** | -0.144*** | -0.141*** | -0.136*** |
| INF | -0.0004 | -0.001** | 0.002* | 0.001 | 0.001 | 0.001 | 0.0003 | 0.0001 | 0.0001 | 0.0003 | 0.001 |
| ELE | 0.021*** | -0.003*** | 0.026*** | 0.024*** | 0.022*** | 0.021*** | 0.020*** | 0.019*** | 0.019*** | 0.017*** | 0.016*** |
| Constant | 7.589*** | 1.069** | 5.674*** | 6.300*** | 6.920*** | 7.368*** | 7.675*** | 7.957*** | 8.287*** | 8.698*** | 9.305*** |

| Variable | Location | Scale | Quantiles | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Q10 | Q20 | Q30 | Q40 | Q50 | Q60 | Q70 | Q80 | Q90 |
| **MODEL 5** | | | | | | | | | | | |
| IFE | -0.070*** | -0.011*** | -0.050*** | -0.057*** | -0.063*** | -0.067*** | -0.071*** | -0.074*** | -0.078*** | -0.082*** | -0.087*** |
| GOS | 0.266*** | 0.023 | 0.225*** | 0.240*** | 0.251*** | 0.260*** | 0.267*** | 0.273*** | 0.283*** | 0.290*** | 0.300*** |
| GDP | -0.173*** | -0.009 | -0.157*** | -0.163*** | -0.167*** | -0.171*** | -0.174*** | -0.176*** | -0.180*** | -0.183*** | -0.187*** |
| INF | -0.0002 | -0.001*** | 0.002** | 0.001 | 0.0003 | 0.0001 | 0.0002 | 0.001 | 0.001** | 0.001*** | 0.002*** |
| ELE | 0.025*** | -0.001 | 0.026*** | 0.025*** | 0.025*** | 0.025*** | 0.025*** | 0.025*** | 0.024*** | 0.024*** | 0.024*** |
| Constant | 7.586*** | 1.308*** | 5.256*** | 6.113*** | 6.772*** | 7.283*** | 7.659*** | 8.027*** | 8.572*** | 9.020*** | 9.561*** |
| **MODEL 6** | | | | | | | | | | | |
| IFE | -0.061*** | -0.008*** | -0.048*** | -0.052*** | -0.056*** | -0.058*** | -0.061*** | -0.064*** | -0.067*** | -0.070*** | -0.074*** |
| BUQ | 0.192*** | -0.004 | 0.200*** | 0.197*** | 0.195*** | 0.194*** | 0.192*** | 0.191*** | 0.189*** | 0.187*** | 0.185*** |
| GDP | -0.219*** | 0.043** | -0.289*** | -0.264*** | -0.245*** | -0.233*** | -0.220*** | -0.205*** | -0.188*** | -0.171*** | -0.149*** |
| INF | -0.001 | -0.002*** | 0.002*** | 0.001** | 0.0004 | 0.0001 | 0.001 | 0.001*** | 0.002*** | 0.003*** | 0.004*** |
| ELE | 0.022*** | -0.004 | 0.028*** | 0.026*** | 0.024*** | 0.023*** | 0.022*** | 0.020*** | 0.019*** | 0.017*** | 0.015*** |
| Constant | 9.639*** | 0.272*** | 9.191*** | 9.351*** | 9.471*** | 9.547*** | 9.632*** | 9.728*** | 9.830*** | 9.938*** | 10.079*** |

Note: ***, **, and * indicate significance at 0.1, 0.5, and 0.10 levels.

**Table 10.** Dynamic Panel Threshold Estimates

| | IQI | COR | DAC | LAO | GOS | BUQ |
|---|---|---|---|---|---|---|
| Lower Regime ($INS_{it} \leq \rho$) | | | | | | |
| Lagged SOC | 0.883*** | 0.396*** | 0.310*** | 0.655*** | 0.893*** | 1.250*** |
| IFE | -0.161*** | -0.041 | -0.050*** | -0.156*** | -0.004 | 1.163*** |
| IQI | -0.383 | | | | | |
| COR | | -0.205*** | | | | |
| DAC | | | -0.185* | | | |
| LAO | | | | -0.256*** | | |
| GOS | | | | | 0.219*** | |
| BUQ | | | | | | 1.122* |
| Upper Regime ($INS_{it} > \rho$) | | | | | | |
| Lagged SOC | -0.751*** | 0.724*** | 0.317*** | 0.196 | -0.328*** | -0.205** |
| IFE | -0.041** | 0.009 | 0.016 | 0.101*** | -0.128*** | -0.228*** |
| IQI | 0.968** | | | | | |
| COR | | 0.692*** | | | | |
| DAC | | | 0.147 | | | |
| LAO | | | | 2.543*** | | |
| GOS | | | | | -0.341*** | |
| BUQ | | | | | | -1.781** |
| Constant | -0.056 | -6.567*** | -0.1772*** | -11.535*** | 8.415*** | 15.844*** |
| Threshold Value | 5.282*** | 4.035*** | 3.330* | 3.499*** | 7.610*** | 2.929 |
| Linearity Test (Bootstrapped p-value) | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** | 0.000*** |

Note: ***, **, and * indicate significance at 0.1, 0.5, and 0.10 levels. 1000 bootstrap iterations are used to compute its p-values.

**Table 11.** Causality test

| | Wald statistics | P-value | Decision |
|---|---|---|---|
| IFE does not Granger cause SOC | 2.459*** | 0.000 | Reject |
| SOC does not Granger cause IFE | 1.164 | 0.493 | Accept |
| IQI does not Granger cause SOC | 2.863*** | 0.000 | Reject |
| SOC does not Granger cause IQI | 2.150*** | 0.000 | Reject |

Note: *** indicates significance at 0.01

## Conclusion

The study investigates the effects of informal economy and institutional quality on socioeconomic conditions in 35 African countries between 2000 and 2022, with the view to determining the threshold of institutional quality in the relationship between informal economy and socioeconomic conditions and the direction of causality between the variables. The study employs Driscoll-Kraay, Fully Modified Ordinary Least Squares, Method of Moments Quantile Regression, Dynamic Panel Threshold, and Dumitrescu-Hurlin non-causality Granger techniques. The findings from the first

three estimation techniques show that the informal economy has a negative and significant effect on African socioeconomic conditions. In contrast, institutional quality, regardless of how it is measured, has a substantial and positive impact on African socioeconomic conditions. As a result, the study concludes that the informal economy and institutional quality retards and improves socioeconomic conditions, respectively.

Thus, this study provides strong evidence for the importance of institutional quality in influencing the informal economy and its impact on African socioeconomic situations. Identifying a precise threshold for institutional quality is a helpful guide for policymakers looking to eliminate informality and improve socioeconomic results. Institutional strengthening, improved governance, economic stability promotion, and infrastructure service enhancement are critical measures for attaining inclusive growth and lowering informality across the continent. However, one drawback of the study is that it did not test for the interactive effect of institutions and informality, which could provide more insight into how these variables influence socioeconomic outcomes. Furthermore, the study is based on aggregated data, which may mask key micro-level differences and limit the analysis's granularity. Future studies might examine the interaction effects of institutional quality and informality and the function of other potential moderators like education and technological advancement in defining the informal sector. Addressing these shortcomings could contribute to a complete understanding of the interactions between institutions, informality, and socioeconomic development in Africa.

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## Appendix

**Table A.** Driscoll, Kraay, and Fully Modified OLS Estimates

| Variable | Driscoll and Kraay | | | | | | Fully Modified OLS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Model 1** | **Model 2** | **Model 3** | **Model 4** | **Model 5** | **Model 6** | **Model 1** | **Model 2** | **Model 3** | **Model 4** | **Model 5** | **Model 6** |
| IFE | -0.079** | -0.076** | -0.069** | -0.082*** | -0.104*** | -0.073** | -0.032* | -0.049** | -0.084*** | -0.062*** | -0.078*** | -0.080*** |
| IQI | 0.368*** | | | | | | 0.997*** | | | | | |
| COR | | 0.039* | | | | | | 0.682*** | | | | |
| DAC | | | 0.058*** | | | | | | 0.039 | | | |
| LAO | | | | 0.132*** | | | | | | 0.439*** | | |
| GOS | | | | | 0.127*** | | | | | | 0.543*** | |
| BUQ | | | | | | 0.031 | | | | | | 0.212** |
| Control variables | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |
| Constant | 4.870*** | 6.366*** | 5.835*** | 6.057*** | 6.882*** | 6.269*** | 1.755 | 4.747** | 8.002*** | 5.352*** | 4.193*** | 6.886*** |

Note: *** p<0.01; ** p<0.05; * p<0.1

**Table B.** Method of Moments Quantile Regression Estimates

| Variable | Location | Scale | Quantiles | | | | Variable | Location | Scale | Quantiles | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Q10** | **Q30** | **Q50** | **Q90** | | | | **Q10** | **Q30** | **Q50** | **Q90** |
| IFE | -0.062*** | -0.011** | -0.042** | -0.055*** | -0.063*** | -0.079*** | IFE | -0.084*** | -0.006*** | -0.073*** | -0.080*** | -0.084*** | -0.094*** |
| IQI | 0.727*** | 0.058** | 0.623*** | 0.691*** | 0.733*** | 0.815*** | LAO | 0.313*** | 0.011 | 0.294*** | 0.306*** | 0.314*** | 0.330*** |
| Control Variables | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | Control Variables | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |
| Constant | 3.169*** | 0.939*** | 1.481*** | 2.589*** | 3.278*** | 4.615*** | Constant | 5.845*** | 1.011*** | 4.134*** | 5.163*** | 5.914*** | 7.405*** |
| **Variable** | **Location** | **Scale** | **Quantiles** | | | | **Variable** | **Location** | **Scale** | **Quantiles** | | | |
| | | | **Q10** | **Q30** | **Q50** | **Q90** | | | | **Q10** | **Q30** | **Q50** | **Q90** |
| IFE | -0.076*** | -0.012*** | -0.056*** | -0.067*** | -0.076*** | -0.095*** | IFE | -0.091*** | -0.010*** | -0.074*** | -0.083*** | -0.091*** | -0.106*** |
| COR | 0.329*** | 0.003 | 0.323*** | 0.326*** | 0.329*** | 0.334*** | GOS | 0.256*** | 0.014 | 0.234*** | 0.247*** | 0.257*** | 0.277*** |
| Control Variables | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | Control Variables | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |
| Constant | 6.212*** | 1.395*** | 3.953*** | 5.156*** | 6.224*** | 8.324*** | Constant | 6.119*** | 1.262*** | 4.065*** | 5.207*** | 6.143*** | 8.028*** |
| **Variable** | **Location** | **Scale** | **Quantiles** | | | | **Variable** | **Location** | **Scale** | **Quantiles** | | | |
| | | | **Q10** | **Q30** | **Q50** | **Q90** | | | | **Q10** | **Q30** | **Q50** | **Q90** |
| IFE | -0.092*** | -0.011*** | -0.075*** | -0.083*** | -0.091*** | -0.108*** | IFE | -0.076*** | -0.009*** | -0.060*** | -0.070*** | -0.076*** | -0.090*** |
| DAC | 0.038* | 0.017 | 0.011 | 0.025 | 0.038* | 0.064** | BUQ | 0.233*** | 0.040*** | 0.165** | 0.204*** | 0.233*** | 0.292*** |
| Control Variables | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | Control Variables | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |
| Constant | 7.636*** | 1.392*** | 5.464*** | 6.561*** | 7.613*** | 9.743*** | Constant | 6.150*** | 1.066*** | 4.318**** | 5.381*** | 6.137*** | 7.739*** |

Note: *** p<0.01; ** p<0.05; * p<0.1

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